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ABSTRACTS 1602-1918

VOLUME 48 **JULY 1945** NUMBER 571

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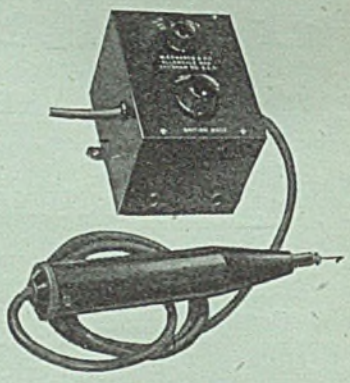

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061.055.5 1602

Carnegie Institution of Washington. Year Book No. 43. July 1, 1943–June 30, 1944. *Carnegie Instn Yearb.*, 43, 206 *pp.*, 1943–1944.

061.055.5 : 522.1 *see Abstr.* 1652

061.055.5 : 523.892.1 *see Abstr.* 1672

378 : 62 1603

Concurrent graduate study—its place in postwar engineering education. STANSEL, F. R. *Proc. Inst. Radio Engrs, N.Y.*, 33, *pp.* 3–4, *Jan.*, 1945.

511.223 1604

Fermat's quotient and related arithmetic functions. VANDIVER, H. S. *Proc. Nat. Acad. Sci., Wash.*, 31, *pp.* 55–60, *Jan.*, 1945.—Two arithmetic functions, related to Fermat's quotient or the Bernoulli numbers are introduced and their properties are studied. One of these is $G(n, p) = (B'_{n+\mu} - B'_n)/p$ where $B'_n = (-)^{n-1} b_{2n}/n$, b_{2n} being a Bernoulli number and $\mu = \frac{1}{2}(p-1)$ (p prime). L. S. G.

511.26 1605

New types of relations in finite field theory. VANDIVER, H. S. *Proc. Nat. Acad. Sci., Wash.*, 31, *pp.* 50–54, *Jan.*, 1945.—A continuation of earlier work [Abstr. 1179 (1945)]. Let $p^n - 1 = mc$ where p is prime, $k > 0$, a is any non-zero element of a finite field $F(p^n)$ and let $0 < r < c$. The sum

$$\sum_{s=0}^{\infty} c \binom{k(p^n-1)}{r+cs} a^{cs}$$

is evaluated and also two similar sums. L. S. G.

511.46 1606

On the representation of a number as a sum of squares and certain related identities. RANKIN, R. A. *Proc. Camb. Phil. Soc.*, 41, *pp.* 1–11, *April*, 1945.—The Diophantine equation considered is

$$x_1^2 + x_2^2 + \ldots + x_c^2 = n$$

where n and c are given positive integers and $x_1, \ldots, x_c$ are integral. Let $f(x_1, \ldots, x_c)$ be any function of the roots $x_1, \ldots, x_c$ of this equation. A general elementary method is given for deducing identities of the form $\sum f(x_1, \ldots, x_c) = 0$ where c is a multiple of 4 and the function f is, in the simplest cases, a polynomial. The summation here extends over all possible solutions of the original equation. The particular cases $c = 4$ and n even, and $c = 8$ are studied in detail and it is shown that identities of the type obtained may also be derived by equating coefficients in elliptic function expansions. L. S. G.

511.7 : 517.522.2 1607

Note on the expansion of a power series into a continued fraction. WALL, H. S. *Bull. Amer. Math. Soc.*, 51, *pp.* 97–105, *Feb.*, 1945.—A simple method is given for expanding a given power series

$$P(1/z) \equiv C_0/z + c_1/z^2 + c_2/z^3 + \ldots$$

into either a J-fraction,

$$\frac{a_0}{b_1 + z} - \frac{a_1}{b_2 + z} - \frac{a_2}{b_3 + z} - \ldots,$$

or an S-fraction,

$$\frac{a_0}{z} - \frac{a_1}{1} - \frac{a_2}{z} - \frac{a_3}{1} - \frac{a_4}{z} - \ldots,$$

and these fractions frequently furnish a method for summing a slowly convergent or divergent series. As an example, it is shown that the 3rd approximant of the J-fraction for the function $P(1/z) = \log(1 + 1/z)$ is

$$\frac{1}{0{\cdot}5 + z} - \frac{1/12}{0{\cdot}5 + z} - \frac{1/15}{0{\cdot}5 + z}$$

and for $z = 1$, this gives $\log 2$ correct to 4 decimal places. Only 6 coefficients of $P(1/z)$ are used in this computation. L. S. G.

512.33 1608

Quadratic and higher reciprocity of modular polynomials. POCKLINGTON, H. C. *Proc. Camb. Phil. Soc.*, 40, *pp.* 212–214, *Oct.*, 1944.—All the polynomials considered have rational integer coefficients. The λ-ic characters of 2 polynomials with respect to each other and a prime p are compared by relating each to the resultant of the polynomials, which are irreducible with respect to p. It is shown that the ordinary quadratic character of one prime with respect to another is also the resultant of 2 polynomials. L. S. G.

512.897 : 519.272 1609

An extension of a theorem of Mehler's on Hermite polynomials. KIBBLE, W. F. *Proc. Camb. Phil. Soc.*, 41, *pp.* 12–15, *April*, 1945.—Mehler's identity

$$\exp\left[-\frac{1}{2(1-\rho^2)}(x^2 - 2\rho xy + y^2)\right] = (1-\rho^2)^{\frac{1}{2}} \exp\{-\tfrac{1}{2}(x^2+y^2)\} \sum_{k=0}^{\infty} \rho^k H_k(x) H_k(y)$$

where $H_k(x)$ is Hermite's polynomial, is of special interest in statistical theory since it represents the normal correlation function as the product of the normal distribution functions for the two variables and a series which is bilinear in Hermite polynomials, the orthogonal polynomials for the normal distribution function. The identity is here generalized to any number of variables. L. S. G.

513.83 1610

Torus homotopy groups. FOX, R. H. *Proc. Nat. Acad. Sci., Wash.*, 31, *pp.* 71–74, *Feb.*, 1945.—The groups are defined and their properties are discussed briefly. They are used in a study of certain products introduced by Whitehead in an attack on the problem of calculating the homotopy groups of a topological space. L. S. G.

513.83 : 621.3.012.8 1611

On the foundations of electrical network theory. INGRAM, W. H., AND CRAMLET, C. M. *J. Math. Phys.*, 23, *pp.* 134–155, *Aug.*, 1944.—Every electrical network has a topological representation and in the present paper a study is made of the application of topology to the study of networks. The matrix technique of circuit transformation, whereby the peculiarities of a network may be described in an appropriate choice of basis, is studied and a method for obtaining equivalent circuit bases is derived. L. S. G.

516.2 1612

Expansions of coordinates of points of a plane curve in terms of s or ψ. PIAGGIO, H. T. H. *Proc. Camb. Phil. Soc.*, 41, *pp.* 68–70, *April*, 1945.—The expansions,

only the first few terms of which were given previously, are now given in general terms. Some errors in previous expansions are noted. L. S. G.

517.43 1613

Some theorems in operational calculus. SHASTRI, N. A. *Proc. Indian Acad. Sci. A*, 20, *pp.* 211–223, *Nov.*, 1944.—When $f(p)$ and $h(x)$ are operationally related, i.e.

$$f(p) = p\int_0^\infty e^{-px}h(x)dx \quad R(p) > 0$$

we write $f(p) \simeq h(x)$. Some theorems are established which are useful for deducing new properties of known functions occurring in mathematical physics and for obtaining new operational representations. 3 of these are:

I. If $f(p) \simeq h(x)$ and $\frac{1}{p^m}h(p) \simeq g(x)$, then

$$f(p) = \Gamma(m+2)p\int_0^\infty \frac{g(t)}{(p+t)^{m+2}}dt \quad R(m) > -2$$

II. If $f(p) \simeq h(x)$ and $p^{\frac{1}{2}}h(1/p) \simeq g(x)$ then

$$\pi^{-\frac{1}{2}}f(p^2/4) \simeq xg(x^2).$$

III. If $f(p) \simeq h(x)$ and $p^{-s}h(1/p) \simeq g(x)$ then

$$f(p) = 2p^{\frac{1}{2}s+1}\int_0^\infty t^{-\frac{1}{2}s}g(t)K_s(2\sqrt{\{pt\}})dt \quad R(p) > 0,$$

K_s being the Bessel Function of the 2nd kind. Numerous examples are given. These involve Bessel Functions, Sonine polynomials and parabolic cylinder functions. L. S. G.

517.51 1614

Construction of groups of commutative functions. SILBERSTEIN, L. *Phil. Mag.*, 36, *pp.* 43–54, *Jan.*, 1945.—If $f(x)$ and $g(x)$ are such that $f\{g(x)\} = g\{f(x)\}$ for all x, then $f(x)$ and $g(x)$ are said to be commutative. When $g(x)$ is given and λ is a root of the equation $g(x) = x$ it is shown that $f(x)$ may be developed, in the neighbourhood of the point $x = \lambda$, into a series

$$f(x) = \lambda + f'(\lambda)(x-\lambda) + \frac{1}{2!}f''(\lambda)(x-\lambda)^2 + \ldots.$$

and a process is given for finding the derivatives $f^{(r)}(\lambda)$. Two special cases are considered, (i) $g(x) = e^x - 1$, giving rise to the logarithmic group of functions, and (ii) $g(x) = \sin x$, giving the trigonometric group of functions. Included amongst the latter is the function

$$f(x,n) = x - n\frac{x^3}{3!} + (5n^2 - 4n)\frac{x^5}{5!} - \frac{1}{3}(175n^3 - 336n^2 + 164n)\frac{x^7}{7!} + \ldots$$

which, when n is a positive integer, is an iteration of the operator sin. Thus

$$\sin\sin x = x - \frac{1}{3}x^3 + \frac{1}{10}x^5 - \frac{23}{630}x^7 + \ldots$$

L. S. G.

517.512.2 : 535.435 : 537.531 *see Abstr.* 1854

517.512.2 : 539.31 1615

Double Fourier series and boundary value problems. GREEN, A. E. *Proc. Camb. Phil. Soc.*, 40, *pp.* 222–228, *Oct.*, 1944.—It is shown that a simple solution of many problems in elasticity in which the boundary is rectangular can be obtained by the aid of double Fourier series. The method is direct and requires little algebraic manipulation. It is an extension of that used by Goldstein for ordinary Fourier series [Abstr. 1019 (1936), 1036 (1937)]. Examples are discussed relating to problems of stability and vibration and the problem of the clamped rectangular plate bent by a uniform pressure is studied. L. S. G.

517.52 1616

Note on the multiplication of series by Cauchy's rule. HARDY, G. H. *Proc. Camb. Phil. Soc.*, 40, *pp.* 251–252, *Oct.*, 1944.—Let $A = \Sigma a_m$ and $B = \Sigma b_n$ be 2 convergent series and write

$$C = \Sigma c_p = \Sigma(a_0b_p + a_1b_{p-1} + \ldots + a_pb_0).$$

It is shown that a sufficient pair of (unsymmetrical) conditions for the convergence of C are $a_m = O(m^{-\delta})$, $b_n = O\{(n\log n)^{-1}\}$ for large m and n and any $\delta > o$. L. S. G.

517.521.8 = 4 1617

A relation between different methods of summation. RUDBERG, H. *Ark. Mat. Astr. Fys.*, 30 *A*, *No.* 10, 15 *pp.*, 1944.—A generalization of the Cesaro method of summation is made and this is shown to be equivalent to the Abel method. The same equivalence exists between the Euler method and the exponential method of Borel. L. S. G.

517.522.2 : 511.7 *see Abstr.* 1607

517.534.4 : 530.145.61 1618

Some applications and properties of the hyperspherical harmonics with three polar angles. ERIKSSON, H. A. A. *Ark. Mat. Astr. Fys.*, 30 *B*, *No.* 4, 8 *pp.*, 1944.—On the basis of the Fourier expansion

$$\tfrac{1}{2}\pi\cos\tfrac{1}{2}\theta = \sum_{n=1}^{\infty}\frac{n}{n^2-\frac{1}{4}}\sin n\theta \qquad (0 < \theta < 2\pi),$$

an expansion of the reciprocal of the distance between 2 points in three-dimensional space is obtained in terms of hyperspherical harmonics. It is then shown that the latter are the eigenfunctions of a certain integral equation. An application is made to the wave equation of the Kepler problem in momentum space. For this purpose a differential equation is obtained from the Schrödinger equation by means of an iteration followed by a Fourier transformation. The differential equation is then written as an integral equation whose solution follows from the theory developed in the earlier part of the paper. The result agrees with that of Fock [Abstr. 471 (1936)] but the method is better in that no convergence factor need be introduced to obtain the integral equation in the momentum space. L. S. G.

517.544.2 1619

An extension of Lie's theorem on isothermal families. KASNER, E., AND DE CICCO, J. *Proc. Nat. Acad. Sci., Wash.*, 31, *pp.* 44–50, *Jan.*, 1945.—The necessary and sufficient condition is given in order that $g(x, y) = \text{const.}$ represent an isothermal family upon a surface Σ when (x, y) are general curvilinear coordinates on Σ, i.e. when the line element of Σ is of the form

$$ds^2 = E(x,y)dx^2 + 2F(x,y)dxdy + G(x,y)dy^2$$

where $H^2 = EG - F^2 > 0$. An application is made to the Monge surface Σ given by $z = f(x, y)$. In this

case the condition is found that the level curves $z = \text{const.}$ form an isothermal family. This is applied to the mapping upon a plane π of the loxodromes of Σ, showing that they may be represented by straight lines for a sphere (Mercator) and a spheroid (Lambert), but not for an ellipsoid of 3 unequal axes. L. S. G.

517.56 1620

Proposed symbols for the modified cosine and exponential integrals. SCHELKUNOFF, S. A. *Quart. Appl. Math.*, 2, *p.* 90, *April*, 1944.—The standard sine and cosine integrals are

$$\text{Si } x = \int_0^x \frac{\sin t}{t} dt, \quad \text{Ci } x = \int_\infty^x \frac{\cos t}{t} dt,$$

but the latter has a logarithmic singularity at $x = 0$. In problems of electromagnetic radiation these integrals frequently arise but the impedance functions, involving Ci x, are free from the singularity. It is suggested that a more suitable function is

$$\text{Cin } x = \int_0^x \frac{1 - \cos t}{t} dt, \text{ and Ein } z = \int_0^z \frac{1 - e^{-w}}{w} dw$$

is suggested as a modified exponential integral.

517.564 : 517.947.4 : 539.388.24 1621

The elastic stresses produced by the indentation of the plane surface of a semi-infinite elastic solid by a rigid punch. HARDING, J. W., AND SNEDDON, I. N. *Proc. Camb. Phil. Soc.*, 41, *pp.* 16–26, *April*, 1945.—A new mathematical technique is presented. By a systematic application of the method of integral transforms the problem of the indentation is reduced to essentially one of solving a pair of integral equations whose solution is readily found. In a cylindrical co-ordinate system, if Φ is a solution of the biharmonic equation $\nabla^4\Phi = 0$ $(\nabla^2 = \partial^2/\partial r^2 + \frac{1}{r}\partial/\partial r + \partial^2/\partial z^2$, in the case of axial symmetry), then its Hankel transform

$$G = \int_0^\infty r\Phi J_0(\xi r) dr$$

must satisfy the ordinary differential equation $(d^2/dz^2 - \xi^2)^2 G = 0$, the general solution of which is $G = (A + Bz)e^{\xi z} + (C + Dz)e^{-\xi z}$ where A, B, C, D (in general functions of ξ) are determined by the boundary conditions. The determination of A, B, C and D involves the solution of the integral equations

$$\int_0^\infty f(p) J_0(p\rho) dp = g(\rho), \quad 0 \leqslant \rho \leqslant 1$$

and

$$\int_0^\infty p f(p) J_0(p\rho) dp = 0, \quad \rho > 1.$$

These are solved and expressions are obtained for the displacements and stress components. In illustration, 3 special cases are studied. These are indentation by (i) a rigid conical punch, (ii) a rigid sphere and (iii) a flat-ended cylindrical punch. L. S. G.

517.564.3 1622

Note on the equation $f(z)K_n'(z) - g(z)K_n(z) = 0$. ERDÉLYI, A., AND KERMACK, W. O. *Proc. Camb. Phil. Soc.*, 41, *pp.* 74–75, *April*, 1945.—An equation of this type often arises in boundary value problems and it is then necessary to show that the real parts of the roots are negative. The functions $f(z)$ and $g(z)$ are given analytic functions (usually polynomials) in z without common zeros and a proof is given of the result that the equation certainly has no root $z = x + iy$ with $x \geqslant 0$ provided that $\mathcal{R}\{g(z)/f(z)\} \geqslant 0$ for $x \geqslant 0$. If $f(z) = az + b$, $g(z) = Az + B$ where a, b, A and B are real constants the condition is satisfied if the constants all have the same sign. If $f(z) = az^2 + bz + c$ and $g(z) = Az^2 + Bz + C$, where a, b, . . . c are real constants the condition is satisfied if

$$aA \geqslant 0,\ cC \geqslant 0 \text{ and } bB - aC - Ac + z(acAC)^{\frac{1}{2}} \geqslant 0.$$

L. S. G.

517.65 : 621.396.67 1623

On the solution of definite integrals occurring in antenna theory. WEINBAUM, S. *J. Appl. Phys.*, 15, *pp.* 840–841, *Dec.*, 1944.—The integrals are

$$I = \int_0^h \frac{\exp\{-j\beta(r^2 + z^2)^{\frac{1}{2}}\}}{(r^2 + z^2)^{\frac{1}{2}}} dz,$$

$$J = \int_0^h \frac{\cos \beta(z^2 + l^2)^{\frac{1}{2}} \sin \beta z}{z(z^2 + l^2)^{\frac{1}{2}}} dz,$$

and they occur in the evaluation of the mutual impedance of aerials. Expressions for I and J are found in the form of infinite series involving Bessel functions. L. S. G.

517.913 1624

On the asymptotic solution of boundary-value problems for ordinary differential equations containing a parameter. WASOW, W. *J. Math. Phys.*, 23, *pp.* 173–183, *Nov.*, 1944.—In boundary-value problems, the differential equations are often simplified by neglecting the terms containing differential coefficients of a high order. The relationship of the complete and simplified problem is examined in the case of homogeneous linear differential equations depending linearly on a parameter, ρ. The first question is: does the solution of a boundary-value problem for the original equation converge to a limit as $\rho \to \infty$, and if so, does this limit satisfy the limiting equation? When the answer is affirmative the second question is: which of the boundary conditions cease to be satisfied by the limiting function? These questions are answered by a simple and easily applicable rule. The case of a non-homogeneous differential equation is examined briefly. L. S. G.

517.93 : 533.3 : 621.3 1625

Some present nonlinear problems of the electrical and aeronautical industries. KELLER, E. G. *Quart. Appl. Math.*, 2, *pp.* 72–86, *April*, 1944.—Such problems are of two types, continuous and discrete, the former reducing, mathematically, to systems of nonlinear partial differential equations and the latter (possessing a finite number of degrees of freedom) being frequently reducible to systems of non-linear ordinary differential equations. Only discrete problems are discussed, and these illustrate the practical methods available for solving the equations. Non-linear control circuits and non-linear springs are discussed

and also some non-linear transmission line phenomena. Electric locomotive oscillations are analysed and a problem relating to the dynamic breaking of a synchronous machine is solved. A double-valued non-linear aerodynamical problem governed by the equation

$$I\ddot{\theta} + \beta\dot{\theta} + \mu\{k_1\theta + k_2 \tan^{-1} k_3(\theta \pm \alpha)\} = 0$$

is solved, the period and amplitude of a periodic solution of this equation being obtained. The problem of two oleo-pneumatically coupled masses one of which is subject to impact is solved in detail.

L. S. G.

517.93 : 621.316.7 = 3 1626

On the degree of damping in the third-order differential equation of regulation. OPPELT, W. *Arch. Elektrotech.*, 37, *pp.* 357–360, *July* 31, *and p.* 508, *Oct.* 31, 1943.—[Abstr. 1541 B (1945)].

517.944 : 517.946 1627

The transformation of partial differential equations. BATEMAN, H. *Quart. Appl. Math.*, 1, *pp.* 281–296, *Jan.*, 1944.—The transformations are classified by placing a given transformation in Group A or Group B according as it arises from the conditions that a linear or quadratic differential form shall be of a specified type. Group C includes all other transformations and those which arise in the reduction of an equation to a canonical form. The transformation of a linear differential equation to a form in which the variables are separated belongs to Group B. The present paper is devoted almost entirely to transformations of Group A, which includes those associated with the Calculus of Variations. Associated equations of the types of Monge and Legendre are studied as well as the transformation of the Monge–Ampère equation which, in a special case, reduces to the linear equation. Various transforms of Legendre's equation are considered. The paper is written from the point of view of applications to fluid dynamics and a comprehensive bibliography is given. L. S. G.

517.946 : 517.944 *see Abstr.* 1627

517.946.6 : 621.316.7 = 3 1628

Stability and aperiodicity of motion of the 4th order. SCHMIDT, K. *Arch. Elektrotech.*, 37, *pp.* 217–220, *April* 30, 1943.—[Abstr. 1542 B (1945)].

517.946.9 : 534.113 1629

Studies on geodesics in vibrations of elastic beams. MICHAL, A. D. *Proc. Nat. Acad. Sci., Wash.*, 31, *pp.* 38–43, *Jan.*, 1945.—A one-parameter family of positions of a vibrating beam is called a dynamical path and it is shown that such paths satisfy a certain integro-differential equation. Some properties of the solutions of this equation are examined and particular attention is paid to the geometric aspects of the subject. It is shown that the vibration states (dynamical paths), with a constant total energy level, of an elastic beam hinged at both ends, may be represented by the geodesics of a certain Riemannian space of infinite dimension. The curvature of this space is not constant so that the vibrations mentioned serve as a physical model for the geodesics of this space. As an example the harmonic vibrations of a simply supported beam are considered. L. S. G.

517.947.4 : 530.12 1630

Relativistic wave equations for zero rest-mass. GÅRDING, L. *Proc. Camb. Phil. Soc.*, 41, *pp.* 49–56, *April*, 1945.—A brief survey is made of the Lorentz group, L, and the representations of L and its various subgroups. Then all the relativistically invariant sets of partial homogeneous differential equations are established in which every unknown function u satisfies $\Box u = 0$, $\Box$ being the relativistic Laplace Operator. Dirac's equations for the electron when its mass is zero appear as a special case. The theory of spinors is necessary in deducing the equations.

L. S. G.

517.947.4 : 539.388.24 : 517.564 *see Abstr.* 1621

517.948.33 1631

Non-linear integral equations of the Hammerstein type. DOLPH, C. L. *Proc. Nat. Acad. Sci., Wash.*, 31, *pp.* 60–65, *Jan.*, 1945.—The equations are of the form

$$\psi(x) = \int_a^b K(x, y) f\{y, \psi(y)\} dy$$

where $f(y, \psi)$ is non-linear. Conditions on $f(y, \psi)$, in order that there exist a solution $\psi(x)$, are given and these are more general than those previously considered. L. S. G.

517.948.34 1632

On a class of integro-differential equations. PITT, H. R. *Proc. Camb. Phil. Soc.*, 40, *pp.* 199–211, *Oct.*, 1944.—A study is made of equations of the form

$$\sum_{r=0}^{R} \int_{-\infty}^{\infty} f^{(r)}(x - y) dk_r(y) = 0$$

where $k_r(y)$ are given functions and $f(x)$ is to be determined. The properties of the class of functions satisfying this equation are investigated and it is shown that the general solution may be expressed in the form (called a generalized Fourier series) $f(x) \sim \sum e^{\omega_n x} A_n(x)$, where the $A_n(x)$ are polynomials depending on $f(x)$ and the ω_n are certain constants. The convergence of this solution is examined and the generalized Fourier series leads to a proof, under fairly wide conditions, that the bounded and uniformly continuous solutions of the equation are almost periodic functions. L. S. G.

518.2 : 526.6 1633

Table of direction-cosines to four figures at intervals of one degree in latitude and longitude over a zone of 60° of longitude and latitude from 0° to 40°. JONES, W. M. *N.Z.J.Sci.Tech. B*, 26, *pp.* 155–159, *Nov.*, 1944.—These tables are intended for use in seismological (also perhaps navigation and radio transmission) problems where the distance from a given point to any point inside a certain region may be required. C. J. G.

518.3 : 621.396.621 1634

Radio data charts. 18. SOWERBY, J. McG. *Wireless World*, 51, *pp.* 84–85, *March*, 1945.—[Abstr. 1683 B (1945)].

518.4 1635

A geometrical interpretation of the relaxation method. SYNGE, J. L. *Quart. Appl. Math.*, 2, *pp.* 87–89, *April*, 1944.—The convergence of the relaxation method is illustrated geometrically by means of a family of ellipsoids. Gaskell's method [Abstr. 150 (1945)] for liquidating the greatest error is also interpreted geometrically. L. S. G.

518.5 1636

Improved slide rule. *J. Sci. Instrum.*, 22, *p.* 38, *Feb.*, 1945.—The 5 in. Dualistic rule includes the *C* and *D* scales in their usual positions. In place of the *A* and *B* scales, there is substituted a second pair of *C* and *D* scales, but these are displaced laterally in relation to the ordinary *C* and *D* scales by $\frac{1}{2}$ the length of the rule. The effect is to give alternative readings in the ordinary operations of multiplication and division, and if the result runs off the scale, it will be found on the alternative *C* and *D* scale.

518.5 : 615.84 1637

A slide rule for the calculation of data concerning the use of radon in gamma-ray therapy. PELC, S. R. *Brit. J. Radiol.*, 18, *pp.* 57–60, *Feb.*, 1945.

518.5 : 625.28 1638

Special slide rules for rapid calculation of locomotive performance. PERKINSON, T. F. *Gen. Elect. Rev.*, 47, *pp.* 47–49, *Dec.*, 1944.—[Abstr. 1745 B (1945)].

519.211 1639

Negative probability. BARTLETT, M. S. *Proc. Camb. Phil. Soc.*, 41, *pp.* 71–73, *April*, 1945.—It is shown that orthodox probability theory may be extended to include probability numbers outside the conventional range and, in particular, negative probabilities. Random variables are generalized to new variables defined through their characteristic functions. Physical applications (e.g. in quantum mechanics) are noted and it is pointed out that negative probabilities must always be combined with positive ones to give an ordinary probability before a physical interpretation is admissible. L. S. G.

519.24 1640

Significant figures of numbers in statistical tables. GOUDSMIT, S. A., AND FURRY, W. H. *Nature, Lond.*, 154, *pp.* 800–801, *Dec.* 23, 1944.—A quantitative explanation is given of the fact that most numbers in statistical tables start with a small digit. The result obtained is that, of all entries in a given table, the fraction which begins with the digit p is $\log_{10}\frac{1}{p}(p+1)$ which is 0·301 when $p = 1$ and 0·176 when $p = 2$.

L. S. G.

519.24 1641

Distribution of numbers and distribution of significant figures. FURRY, W. H., AND HURWITZ, H. *Nature, Lond.*, 155, *pp.* 52–53, *Jan.* 13, 1945.—Some approximations used in an earlier note [Abstr. 1640 (1945)] are discussed in more detail. It is pointed out that

$$(\log x)^{-1} \sim \tfrac{1}{2} + 2\sum_{i=1}^{\infty} x^i(1+x^i)^{-2}$$

when $x > 1$ but x is not large. When $x = 10$, the error is $\frac{8}{3}\%$, and when $x = 4$, it is 0·004%. L. S. G.

519.241.5 1642

An inequality relating means. BRONOWSKI, J. *Proc. Camb. Phil. Soc.*, 40, *pp.* 253–255, *Oct.*, 1944.—Let a and b be positive constants such that either $a > b > 1$ or $1 > b > a$ and let $x_1, x_2, \ldots, x_n$ be real exponents, not all zero, such that $\sum x_i = 0$. It is proved that $\sum a^{x_i} > \sum b^{x_i}$, and this result is used to show that $\sum a^{y_i}/a^y > \sum b^{y_i}/b^y$ where $y_1, y_2, \ldots, y_n$ are real exponents, not all equal, having an arithmetic mean y. L. S. G.

519.25 1643

On a new symmetrical balanced incomplete block design. BHATTACHARYA, K. N. *Bull. Calcutta Math. Soc.*, 36, *pp.* 91–96, *Sept.*, 1944.—The block designs considered are important in agricultural field experiments and biological researches where statistical methods find an application. If v objects are arranged in b sets of k objects each, such that every object occurs in just r sets and every pair of objects in just λ sets, we obtain the type of block design considered. A detailed study is made of the design for which $v = b = 25$, $r = k = 9$, $\lambda = 3$. L. S. G.

519.271.3 1644

A labour-saving method of sampling. HALDANE, J. B. S. *Nature, Lond.*, 155, *pp.* 49–50, *Jan.* 13, 1945.

519.271.3 1645

Inverse statistical variates. TWEEDIE, M. C. K., HALDANE, J. B. S. *Nature, Lond.*, 155, *p.* 453, *April* 14, 1945.—[See Abstr. 1644 (1945)].

519.272 : 512.897 *see Abstr.* 1609

519.283 : 620.113 1646

Statistical methods in quality control. I. Variability of quality—frequency distributions. *Elect. Engng, N.Y.*, 64, *pp.* 181–182, *May*, 1945.

519.34 : 531.225 : 534.01 1647

Variational methods for the solution of problems of equilibrium and vibrations. COURANT, R. *Bull. Amer. Math. Soc.*, 49, *pp.* 1–23, *Jan.*, 1943.—Variational problems are formulated mathematically and the various possible boundary conditions are discussed. One example considered is the problem of the torsion of long columns with multiply connected cross-sections. The Rayleigh-Ritz method of attacking a variational problem numerically is critically examined. Other methods studied are those of finite differences and general random statistical methods. The method of gradients (method of steepest descent), due to Hadamard, is explained. A numerical treatment is given of 2 plane torsion problems for multiply connected domains. In one of these the cross-section is a square from which a smaller square is removed; in the other the cross-section is square with 4 smaller squares removed. The Rayleigh-Ritz method and the finite-difference method (using a triangular network) are each used and the results are compared.

L. S. G.

519.41 1648

The "odd" number six. TODD, J. A. *Proc. Camb. Phil. Soc.*, 41, *pp.* 66–68, *April*, 1945.—The number 6 is odd in the sense of the theorem: the symmetric group of degree $n (n \neq 6)$ contains n and only n subgroups of order $(n-1)!$ which form a single conjugate set; the symmetric group of degree 6 contains 12 subgroups of order 5!, which are simply isomorphic with one another and form 2 conjugate sets of 6 each. This theorem is applied to the problem of constructing an algebraic equation whose roots will be given functions of the roots of a given equation, and it appears that the construction is not always possible when $n = 6$. A geometric application is also made to explain a curious phenomenon associated with the figure of 6 points in a projective space of 4 dimensions.

L. S. G.

519.52 1649

Concerning tangents to continua in the plane. MOORE, R. L. *Proc. Nat. Acad. Sci., Wash.*, 31, *pp.* 67–70, *Feb.*, 1945.—The tangents are defined and used in proving 5 theorems concerning the properties of continua (mostly compact). L. S. G.

519.53 1650

The Wiener measure of Hilbert neighbourhoods in the space of real continuous functions. CAMERON, R. H., AND MARTIN, W. T. *J. Math. Phys.*, 23, *pp.* 195–209, *Nov.*, 1944.—Let C be the space of all real-valued functions $x(t)$ defined and continuous on $0 \leqslant t \leqslant 1$ and vanishing on $t = 0$. In a recent paper [Abstr. 789 (1945)] it was shown that for every positive number R, the subset of C for which

$$\int_0^1 [x(t)]^2 dt < R^2,$$

has a positive Wiener measure. This measure is now evaluated. L. S. G.

522.1 1651

A brief report on the activity of the Abastumani Astrophysical Observatory on Mt. Kanobili in the years 1940–42. KHARADSE, E. K. *Bull. Abastumani Astrophys. Obs.*, *No.* 7, *pp.* 209–214, 1943. A. HU.

522.1 : 061.055.5 1652

Mount Wilson Observatory. ADAMS, W. S. *Carnegie Instn Yearb.*, 43, *pp.* 3–18, 1943–1944.

522.38 1653

The division errors of the reversible transit circle of the Royal Observatory, Greenwich. JONES, H. SPENCER, AND CULLEN, R. T. *Mon. Not. Roy. Astr. Soc.*, 104, 4, *pp.* 218–235, 1944.—The fixed circle of this instrument and the method of determining its division errors are described. There are in effect 2 independent sets of graduations displaced with respect to each other by 10′. Six microscopes are set so that adjacent ones read on the 2 series. Division errors must therefore be determined over 120°. The auxiliary microscopes are mounted in positions variable by 2° to avoid the use of divided object glasses and to reduce the accumulation of accidental errors. The error of each 5′ graduation is given with a probable error $<0''{\cdot}03$. The errors are analysed and found to consist of accidental errors superposed on a combination of a recurrent $2\frac{1}{2}°$ variation and of periodic variations in periods of 15°, 30° and 60°. A. HU.

522.61 : 535.317 *see Abstr.* 1759

523.11 : 530.12 *see Abstr.* 1676

523.112 1654

The recession-constant of the galaxies. EDDINGTON, A. S. *Mon. Not. Roy. Astr. Soc.*, 104, 4, *pp.* 200–204, 1944.—Four independent methods of calculating the nebular recession-constant from laboratory data agree on the value 572 km./sec. per megaparsec. This is considered in conjunction with modern astronomical data on the metagalactic system and leads to an estimate of the state of expansion of the universe (ratio of the present radius to the Einstein radius) of betw. 3 and 8. Adopting 5 for this figure, the present radius is 1 500 megaparsecs. A table is given showing the dates when other values held; this leads to the supersession of logarithmically infinite past time by an upper limit of 90×10^9 yr., corresponding to the time elapsing since the universe was in an initial statistically-uniform equilibrium state. A. HU.

523.12 : 530.145 1655

A quantum theory of the origin of the solar system. HALDANE, J. B. S., MILNE, E. A. *Nature, Lond.*, 155, *pp.* 133–136, *Feb.* 3, 1945.—It is well known that kinematical relativity predicts a zero radius for space at the origin of kinematical time, t, so that the volume of the universe is then zero and the density of matter infinite. Haldane points out that the energy of photons existing at times slightly greater than $t = 0$ would have energies comparable with the total mechanical energy of the solar system, $\gamma mM/R$, where m is the mass of the planets, M the mass of the sun, R its present radius and γ the present-day value of the constant of gravitation. It is therefore suggested that the planets may have been formed by the absorption of one or more of these photons by the sun at a very early stage in the history of the universe, with an ejection of the planet, much in the same way as an electron is raised to an orbit of higher energy by the absorption of a photon at the present time. Calculations of the time at which such photons existed leads to a time-scale of the order of 10^{11}–10^{12} years. Milne adds some explanations of the details of kinematical relativity, in particular of the calculated value of $\gamma mM/R$. This holds good because, in kinematical relativity, both γ and R are proportional to t. G. C. McV.

523.154 1656

On the mechanism of accretion by stars. BONDI, H., AND HOYLE, F. *Mon. Not. Roy. Astr. Soc.*, 104, 5, *pp.* 273–282, 1944.—A rigorous investigation of the mechanism of accretion is made for the case where the interstellar matter contains enough molecules to keep the temperature low by radiation [Abstr. 2931 (1940)]. The steady-state equations are formulated. Together with the boundary conditions they do not determine a unique solution, and the situation at any given time depends on the perturbations suffered by the system. The accretion rate is found for the extreme case of a star initially in empty space crossing the plane boundary of a cloud of uniform density. The drag of interstellar clouds decreases stellar peculiar velocities and increases the rate of accretion. The importance of this effect to stellar dynamics and stellar evolution is briefly discussed. A. HU.

523.2 1657

On the origin of the solar system. HOYLE, F. *Proc. Camb. Phil. Soc.*, 40, *pp.* 256–258, *Oct.*, 1944.—It is pointed out that all the theories of the origin, at present available, except one, are untenable for dynamical or physical reasons. The problem of the origin is discussed directly from an observational point of view, the conditions observed in novae being a basis for the theory [see Abstr. 2130 (1943)]. The case of special interest occurs when the nova is a binary companion of the sun and this case is examined in some detail. The essential requirement that the nova must satisfy is that the total mass in the form of diffuse gaseous material must be about 1/10 the solar mass. L. S. G.

523.54 1658

An analysis of British meteor data. II. Analysis. PORTER, J. G. *Mon. Not. Roy. Astr. Soc.*, 104, 5, *pp.* 257–272, 1944.—The material previously collected [Abstr. 2491 (1943)] is analysed. Errors of all types tend to increase with length of path and brightness of the meteor. Correlations betw. the various physical quantities are tabulated. No essential difference is found betw. shower and sporadic meteors, discrepancies previously found in their heights and the so-called seasonal effect being due to faulty sampling. The low observed speeds are believed to be real, and to be due to retardation by the atmosphere before the meteors become visible. This effect also explains the anomalous appearance of telescopic meteors. There is no evidence for hyperbolic velocities: practically all meteors behave as members of the solar system.

A. HU.

523.6 1659

Note on two new comets. TEVSADSE, G. A. *Bull. Abastumani Astrophys. Obs., No.* 7, *pp.* 201–206, 1943.—Details of the independent discovery by the author of the comets 1942*f* and 1942*g* are given. Changes in magnitude and spectrum of the latter are described, and elements of both orbits are deduced.

A. HU.

523.755 1660

An investigation of the polarization of the solar corona at the total eclipse of September 21, 1941. VASHAKIDSE, M. A. *Bull. Abastumani Astrophys. Obs., No.* 7, *pp.* 1–24, 1943.—The amount and direction of the polarization of the outer corona (4′ to 50′) is studied in light of wavelength 4 200 Å and 5 500 Å on 7 plates taken near Alma Ata with an 8 in. camera fitted with an analyser rotated betw. exposures. Intensity measures with a probable error of 3% were made on each plate with a photo-electric microphotometer at 30 points on each of 120 radii. Corrections for unequal exposure times, for chemical fog and for sky background intensity are discussed and applied. The amount of polarization depends markedly on position angle, but probably not on wavelength. The max. of polarization tends to occur at a greater distance from the limb where the corona is extended, and is also farther out in photographic than in visual light. The polarization is mainly radial: slight deviations in the outer corona in photographic light are attributed either to unsatisfactory background corrections or to a real rotation in the Sun's magnetic field. A. HU.

523.755 1661

Radiometric observation of the solar corona during the eclipse of 1941, September 21. NIKONOV, V. B. *Bull. Abastumani Astrophys. Obs., No.* 7, *pp.* 33–69, 1943.—The water-cell absorption method is used to compare the spectral composition of the total radiation of the corona with that of the Sun. The radiometer used consists of a thin-layer Bi–Sb vacuum thermocouple on which is projected, by means of a small fluorite lens, an image of a spherical mirror uniformly illuminated by the test object. The deflections of a sensitive galvanometer connected to the thermocouple are recorded, with and without a water cell 1 cm. thick, with the radiometer directed first to the corona and then, on the day after the eclipse, to a distant sunlit diffusing screen. Full details of the calibration of the apparatus and the testing of the diffusing screen are given, and possible sources of error discussed. In the region $0{\cdot}3 < \lambda < 5{\cdot}5\,\mu$ there is found in the corona out to 4 solar radii, an infra-red excess of about 0·2 mag. as compared with the Sun, suggesting the presence of thermal radiation due to dust particles. The total light of the corona in the region $0{\cdot}3 < \lambda < 1{\cdot}3\,\mu$ is $1{\cdot}04 \times 10^{-6}$ that of the Sun. It is suggested that the coronal light may vary in intensity with sunspot number. A. HU.

523.775.5 1662

On the effect of line absorption on the temperature determination of the inner corona. HASE, V. T. *Bull. Abastumani Astrophys. Obs., No.* 7, *pp.* 73–80, 1943.—The hypothesis that the light of the inner corona is due to scattering of sunlight by high-velocity electrons is shown to be in partial contradiction to just that fact which is usually cited in its support, viz. that the colour temperatures of the corona and of the Sun are equal. The spectrophotometric gradient of the corona should in fact depend on the spectral region considered and on the instrumental equipment used in observing it. Confirmation of the hypothesis depends on 2nd order differences betw. the observed energy distributions. A. HU.

523.823 : 523.841.37 *see Abstr.* 1666

523.841 1663

Comparison stars for RS and Nova Puppis. STOY, R. H. *Mon. Not. Roy. Astr. Soc.*, 104, 4, *pp.* 236–238, 1944.—Cape Zone Catalogue plates are examined to give international photographic and photovisual magnitudes for 49 stars in the region around these 2 stars. Magnitudes of RS Puppis over a complete cycle are given. A. HU.

523.841.3 1664

Changes in γ Cassiopeiae during the past 100 years. EDWARDS, D. L. *Mon. Not. Roy. Astr. Soc.*, 104, 5, *pp.* 283–291, 1944.—Photometric and spectroscopic observations of γ Cass since 1840 are reviewed with the object of detecting variations previous to the outbursts since 1933. Visual observations of magnitude and spectrum and photographic observations of line intensity, radial velocity and intensity ratio of the components of double emission lines agree in suggesting a cycle consisting of 2 max. separated by 4·30 yr. in a main period of 10·67 yr. The only exception is the outburst of 1934.6 which seems to have been an unusual event. A. HU.

523.841.37 1665

Amplitude effect in Cepheid variables. ROY, S. K. *Nature, Lond.*, 155, *p.* 24, *Jan.* 6, 1945.

523.841.37 : 523.823 1666

Range of light variation in Cepheid variables. BHATNAGAR, P. L. *Phys. Rev.*, 67, *pp.* 194–195, *March* 1 *and* 15, 1945.

523.841.37 : 523.877 1667

A note on the pulsation theory of Cepheid variables. BHATNAGAR, P. L., AND KOTHARI, D. S. *Mon. Not. Roy. Astr. Soc.*, 104, 5, *pp.* 292–296, 1944.—Rosseland's treatment [Abstr. 47 (1944)] of a homogeneous star pulsating in the fundamental mode gives results which arise on account of an approximation introduced in the investigation. The same problem is dis-

cussed in a simple way free from this approximation and the work is extended to the Roche model. Anharmonic oscillations cannot account for the observed skewness in the velocity/time curve of Cepheids unless the assumed ratio of the specific heats is increased from 5/3 to about 10. A. HU.

523.841.9 : 523.872 1668

Some results of a spectrophotometric study of the Wolf-Rayet binary HD 193576. BEALS, C. S. *Mon. Not. Roy. Astr. Soc.*, 104, 4, *pp.* 205–217, 1944.—Equiv. widths are given for emission and absorption features in the spectrum of this star in the region 3 900–6 678 Å. Comparison of intensities with those in standard stars gives apparent magnitudes of 8·30 for the O-type component and 10·05 for the W companion. The corresponding absolute magnitudes are −3·07 and −1·32. Asymmetry in the emission bands at primary and secondary min. is shared by λ4 686 and the Balmer and Pickering lines, and is attributed to tidal action in an extended atmosphere. The displaced absorption lines of helium suggest envelopes of He and He^+ of radii larger and smaller respectively than the distance betw. the stars. This suggests that Wolf-Rayet emission arises in an envelope large compared with the central star. Wilson's opposite deduction [Abstr. 2252 (1942)] is due to his interpretation based on the absence of a "transit time" effect, which may be otherwise explained. A. HU.

523.85 : 530.15 *see Abstr.* 1680

523.854.12 1669

The study of selective absorption in the region of the rift of the Milky Way in Aquila. SHAJN, P. T. *Bull. Abastumani Astrophys. Obs., No.* 7, *pp.* 189–198, 1943.—Photovisual and photographic magnitudes of 1 633 stars of types B and A in 3 areas of this absorbing region are reduced to the international system. The resulting colour indices are used in conjunction with normal values obtained from bright stars in the Pleiades and Hyades to give colour excesses. These are then correlated with distance, the latter being corrected for absorption by applying a factor of 4 times the colour excess. The resulting curves show some evidence for the occurrence of discrete clouds. The average coefficient of absorption is a function of galactic latitude, of richness of stars in the 3 fields, and of richness of variable stars, which are mostly giants. The density function does not differ appreciably from zone to zone in the region. A. HU.

523.854.12 = 82 1670

Colour indices of 4535 stars in 11 Kapteyn areas. KHARADSE, E. K. *Bull. Abastumani Astrophys. Obs., No.* 7, *pp.* 99–188, 1943. *Summary in English.*—The author continues previous work [Abstr. 56 (1944)] to 5 further Selected Areas near the galactic plane and 6 in high galactic latitudes. All the material (6 293 stars) is used to evaluate the accuracy of the measures, to compare the magnitude and colour systems with the international scales, and to reach preliminary conclusions regarding the distribution of colour excess in galactic latitude and longitude. The mean coefficient of selective absorption betw. 4 200 Å and 5 500 Å in the lat. zone $\pm 10°$ is found to be 0·29 mag./kpc. The optical semi-thickness of the absorbing layer is given as 0·05 mag. Discussion of the dependence of colour excess on distance of the star from the Sun and from the galactic plane suggests that in many directions discrete clouds of absorbing matter exist at different distances. Fair agreement is found with the results of other investigations, and details of a projected extension of the Abastumani programme are given. A. HU.

523.872 : 523.841.9 *see Abstr.* 1668

523.872 : 535.14 *see Abstr.* 1748

523.877 1671

Some physical characteristics of the atmospheres of supergiants cB5–cA3. SHAJN, G. A. *Bull. Abastumani Astrophys. Obs., No.* 7, *pp.* 83–97, 1943.—In early-type supergiants the value of surface gravity derived from hydrogen-line profiles and from relative intensities of lines of neutral and ionized atoms is smaller by a factor of about 100 than the dynamical value calculated using the mass-luminosity relation. The study of radial velocities of several individual lines showing systematic displacements and the existence of a negative K term in the systematic motion of c-stars also suggest that in the atmospheres of supergiants there are forces in addition to the gas pressure which tend to counteract gravity. Selective radiation pressure in conjunction with viscous drag may cause an outward movement of some atmospheric layers which results in the observed qualitative resemblance betw. novae, Wolf-Rayet stars, P-Cygni stars and c-stars. A. HU.

523.877 : 523.841.37 *see Abstr.* 1667

523.892.1 : 061.055.5 1672

Programme for the determination of systematic corrections to fundamental catalogues from observations of minor planets. BROUWER, D. *Carnegie Instn Yearb.*, 43, *p.* 19, 1943–1944.

523.991 1673

Occultations of stars and planet by the Moon observed at the Nizamiah Observatory, Hyderabad, during the year 1943. *Mon. Not. Roy. Astr. Soc.*, 104, 4, *pp.* 239–240, 1944.—Visual observations on a 15-inch refractor of occultations of Venus and 27 stars. A. HU.

525.61 1674

The tides of the Atlantic Ocean. PROUDMAN, J. *Mon. Not. Roy. Astr. Soc.*, 104, 5, *pp.* 244–256, 1944.—After a critical review of attempts to account for the semi-diurnal Atlantic tides, a dynamical theory of the distribution of their principal harmonic component is developed. A region bounded by the parallels of latitude 45°N. and 35°S. is considered. Given the general conditions along the coasts and both the meridian-components of currents and the elevations along one of these parallels, the tides are mathematically determinate over the whole region. A number of possible oscillations is considered corresponding to different prescribed conditions, and co-tidal and co-range lines are given for each. Four free waves (N.-going and S.-going Kelvin and Poincaré waves) are combined, using amplitudes and phases chosen to fit the coastal elevations as well as possible. The agreement is fairly good, and may be improved by increasing the number of components considered. Co-tidal and co-range lines of the synthesis are shown. A. HU.

526.6 : 518.2 *see Abstr.* 1633

529 1675

The logic of the calendar. KENNON, W. L. *Amer. J. Phys.*, 13, *pp.* 24–31, *Feb.*, 1945.—A general review of problems concerning solar and lunar periods, and well-known cycles and eras.

530.12 : 517.947.4 *see Abstr.* 1630

530.12 : 523.11 1676

On a supplement to the field equations with an application to cosmology. GREGORY, C. *Phys. Rev.*, 67, *pp.* 179–184, *March* 1 *and* 15, 1945.—The addition of a set of plausible equations (the supplemental equations) to the field equations of general relativity makes possible the construction of a cosmological model possessing the postulated features of the Weyl–Robertson kind together with the consequence of a stationary universe. The red-shift phenomenon is still explainable as caused by velocity shifts via the deduction of a pseudo-variable function entailed by the consistency conditions between the two sets of equations. Under the assumptions of the smallness of the cosmological constant and the curvature, the proper constant density of energy T_4^4 is found to be connected with the recession factor k by the formula $8\pi T_4^4 = 3k^2$.

530.12 : 530.145 : 538.3 *see Abstr.* 1905

530.12 : 531.51 1677

How far can one get with a linear field theory of gravitation in flat space-time? WEYL, H. *Amer. J. Math.*, 66, *No.* 4, *pp.* 591–604, *Oct.*, 1944.—Birkhoff's recent study of a linear field theory [Abstr. 79 (1944)] is extended beyond that carried out earlier [Abstr. 487 (1945)]. The differential operators form a 5-dimensional manifold but the requirement that the field equations imply the law of conservation of energy and momentum in the simple form $\partial T_i^k/\partial x_k = 0$ (T_i^k is the energy-momentum tensor) limit the ∞^5 possibilities to ∞^2 which reduce to a regular (linear) case, L, and a singular case, L'. The case L is studied in detail. It is the same as Einstein's theory of weak fields and satisfies a principle of gauge invariance involving 4 arbitrary functions and, although its gravitational field exerts no force on matter, it is suitable for illustrating the part played by energy and momentum or charge and mass in the interaction between matter and field. The case L' is considered briefly and there is a discussion of the recent work of Birkhoff. L. S. G.

530.12 : 537.533.74 *see Abstr.* 1862

530.145 : 523.12 *see Abstr.* 1655

530.145 : 530.12 : 538.3 *see Abstr.* 1905

530.145 : 538.3 *see Abstr.* 1906

530.145 : 539.152.1 *see Abstr.* 1928

530.145.6 1678

Quantum mechanics of fields. III. Electromagnetic field and electron field in interaction. BORN, M., AND PENG, H. W. *Proc. Roy. Soc. Edinb. A*, 62, 2, *pp.* 127–137, 1944.—A continuation of previous papers [Abstr. 1017 (1944), 90 (1945)]. The classical theory of the interaction, utilizing the Lagrangian formalism, is given first and then the Hamiltonian formalism, where the time is treated differently from the spatial co-ordinates, is introduced. Interaction is considered between Maxwell's field and Dirac's field, and in this case quantization is introduced by the method of Heisenberg and Pauli. This semi-classical procedure is then replaced by a new method which is a generalized quantum mechanics using only non-commuting quantities. A main feature of the new theory is the definition of the total energy and momentum by the traces of the matrices representing the densities; this is a generalization of the apeiron sums used in Part II. The new theory admits an arbitrary apeiron distribution, while that of Heisenberg and Pauli assumes a uniform distribution. This means that all results involving this distribution are the same but the divergent integrals produced by the uniform distribution now become convergent and may lead to new results. The view is expressed that the new theory may have far-reaching consequences concerning the connection of the ultimate particles. L. S. G.

530.145.6 : 539.152.1 1679

A technique for the approximate calculation of eigenvalues as zeros of a determinant. Application to the Li^+-ion in the ground state. ERIKSSON, H. A. S. *Ark. Mat. Astr. Fys.*, 30*b*, *No.* 6, 8 *pp.*, 1944.—The eigenfunction is expanded into a series which gives rise to an infinite set of linear equations. The zeros of the determinant of these equations are the eigenvalues. As a numerical illustration the ionization energy of Li^+ is calculated, and the value obtained agrees very well with the experimental value. L. S. G.

530.145.61 : 517.534.4 *see Abstr.* 1618

530.15 : 523.85 1680

Spin in the universe. WHITTAKER, E. T. *Yearb. Roy. Soc. Edinb.*, 9 *pp.*, 1945. *Phil. Mag.*, 36, *pp.* 101–113, *Feb.*, 1945.—An address in which is traced the historical development of the notion of spin, both in astronomy and in the theory of the elementary physical particles. For the latter, the spin has a decisive influence on the statistical behaviour (Maxwellian, Fermi or Bose statistics). The application of relativity theory to problems of spin is discussed and some of the unresolved difficulties are noted. L. S. G.

530.16 1681

Causality or indeterminism. GOLD, E., HORZELSKI, J., AND WEST, G. D. *Nature, Lond.*, 155, *p.* 111, *Jan.* 27, 1945.

530.162 : 621.396.822 = 3 1682

Brownian movement and resistance noise. MATARE, H. F. *Ann. Phys., Lpz.*, 43, 4, *pp.* 271–278, 1943.—A general (fluctuation) formula appearing in Einstein's theory of the Brownian movement is used to derive Nyquist's formula for the resistance noise in an electric circuit. L. S. G.

530.9 1683

The autonomous field. STRÖMBERG, G. *J. Franklin Inst.*, 239, *pp.* 27–40, *Jan.*, 1945.—The development of the field concept is considered. Force fields should not be regarded as being caused by any particles, but are autonomous entities built of indivisible, coherent units defining probabilities in space and time. The particles are indicators of the fine structure of pre-existing fields and are associated with emergence of definite amounts of energy into the physical world of space and time. These ideas are illustrated by con-

sidering the flow of current in a wire. This theory of the autonomy of all force fields is applicable, not only to physics but to fundamental biological problems. A. J. M.

531.1 : 677.05 1684

Kinematic errors in bobbin drives on roving frames. GERHARD, S. L. *J. Appl. Phys.*, 16, *pp.* 26–31, *Jan.*, 1945.—The purpose of the paper is to illustrate the methods and usefulness of kinematic analysis in manufacturing problems—especially the problem of eliminating non-uniformity in the products of the textile industry. As an example a method is described for determining the kinematic characteristics of a machine commonly used in manufacturing textiles and it is shown how the results may be used to predict variations in the material being processed. L. S. G.

531.19 : 541.183 1685

On the application of Kirkwood's theory of order-disorder transformation to adsorption. WANG, J. S., AND MEI, J. Y. *Chinese J. Phys.*, 5, 1, *pp.* 64-88, *July*, 1944.—The phenomenon of superlattice formation on an adsorbed layer is investigated by means of Kirkwood's theory [Abstr. 928 (1938)] and compared with the results of Bethe's theory [Abstr. 3259 (1935)]. It is shown that, when the interaction energy between the adsorbed atoms is positive and the temperature is below a certain critical value, the slope of the adsorption isothermals and the heat of adsorption have a discontinuity at a certain transition θ_t, where θ_t is the fraction of the surface covered by adsorbed atoms. This transition is situated symmetrically about the value $\theta = \frac{1}{2}$, so that both θ_t and $1 - \theta_t$ are transitions. If $\theta < \theta_t$ or $\theta > 1 - \theta_t$, no superlattice is formed. The central problem in the statistical treatment of the phenomenon of adsorption is the construction of the partition function. This is carried out on the assumption that the adsorbed atoms interact with a certain energy when they are situated on neighbouring sites, and that they have no interaction when they are farther apart. L. S. G.

531.19 : 548.7 : 541.183.1 1686

Approximate partition function in generalized Bethe's theory of superlattices. WANG, J. S. *Phys. Rev.*, 67, *pp.* 98–106, *Feb.* 1 *and* 15, 1945.—An approximate expression for the partition function is obtained as an integral of the approximate energy expression in the generalized Bethe's theory. An alternative form of the energy expression is also considered, and higher approximations are treated. An application of the theory to the problem of adsorption is given. N. M. B.

531.224.8 : 624.13 *see Abstr.* 2062

531.225 : 534.01 : 519.34 *see Abstr.* 1647

531.23 1687

An application of orthogonal moments to problems in statically indeterminate structures. KINCAID, W. M., AND MORKOVIN, V. *Quart. Appl. Math.*, 1, *pp.* 334–340, *Jan.*, 1944.—The method of orthogonal moments is explained and it is an improvement on previous methods in that it effects a reduction in the amount of labour required in solving the equations of an indeterminate structure. An example is given illustrating an efficient arrangement of the work. This relates to a four-legged bent structure which is statically indeterminate of the 9th degree. L. S. G.

531.31 1688

The dynamics of a simple system. I. Observables. POWELL, F. C. *Proc. Camb. Phil. Soc.*, 41, *pp.* 57–65, *April*, 1945.—An attempt is made to examine the physical content of the set of rules governing the use of the symbols representing dynamical variables and the symbols (e.g. + and =) representing relations between such variables. The case of quantum mechanics is particularly emphasized. It is shown that with any 2 observables A and B can be associated a unique sum observable $A + B$ and a unique (real) symmetric product observable $A \cdot B$ $(= B \cdot A)$. If the system possesses the property that the time rate of change of an observable depends linearly on some observable H when the environment in which the system moves is varied, then a (real) skew product observable $A \times B$ $(= -B \times A)$ may be defined. If the equations of motion are of the 2nd order, algebraic identities may be obtained which lead to "complex" multiplication, defined by $AB = A \cdot B + A \times B$, which is associative but not commutative. Observables thus possess the properties usually ascribed to them in quantum mechanics and these properties make possible a representation by Hermitian matrices. L. S. G.

531.381 1689

Representations of rigid rotations. MORRISON, I. F., BESKIN, L. *J. Appl. Phys.*, 15, *p.* 802, *Dec.*, 1944.—Comments on a previous paper [Abstr. 98 (1945)]. Alternative presentations of the theory are given. L. S. G.

531.39 : 678 1690

Retraction and stress propagation in natural and synthetic gum and tread stocks. MROWCA, B. A., DART, S. L., AND GUTH, E. *J. Appl. Phys.*, 16, *pp.* 8–19, *Jan.*, 1945.—An experimental method is described for measuring the speed of snapback in rubber after extension and results are reported for Hevea, GR-S and GR-I gum and tread stocks. A photographic study is made of the retraction process, and a set of instantaneous photos of Hevea gum and Butyl gum at different stages of snapback are shown. The wave pulse progressing along the sample is seen very clearly. The results are discussed and explained on the basis of a recent theory [Abstr. 2622 (1944)]. L. S. G.

531.51 : 530.12 *see Abstr.* 1677

531.51 = 3 1691

Generation of the gravitational field. REICHENBÄCHER, E. *Z. Phys.*, 119, 9–10, *pp.* 630–658, 1942.—A continuation of a previous relativistic treatment of the gravitational field [Abstr. 5224 (1937)]. The differential equation connecting the two gauge invariant variables is simplified and solved in the case of a metric satisfying $g_{11}g_{44} = 1$. A physical interpretation of the Riemann Curvature is obtained by equating this to the density of the matter generating the gravitational field. Various consequences are examined. The motion of a particle is discussed, the equations of motion being solved; as a first approx. Newton's laws are derived and as a second approx. the well-known Einstein effects are obtained, although here different values arise. The new field theory leads to changes in the gravitational field in the neighbourhood of an attracting particle and these are explained. L. S. G.

531.565 1692

Loss of weight by rotation. DOZIER, C. T. *Proc. Amer. Phys. Soc., New York, Jan.*, 1945. *Abstr. in Phys. Rev.*, 67, *pp.* 203–204, *March* 1 *and* 15, 1945.—From consideration of the earth as an astronomical body with sidereal period of rotation about its polar axis, the weight of a mass at rest on the earth's equator is the resultant of the full gravitational attractive force between mass and earth diminished by the centrifugal force acting on the mass. If the mass has horizontal translation along the equator, the gravitational atrractive force will remain constant, but the centrifugal force acting on the mass will increase during easterly and decrease during westerly translation. A 40 000 lb. craft in level flight at 300 m.p.h. along the equator near sea level is 160 lb. lighter in easterly than in westerly flight. Consider a mass rotating about a vertical axis through its centre, fixed in longitude and altitude. The easterly-moving half of the mass loses weight and simultaneously the westerly-moving half gains in weight, within limits, but the loss exceeds the gain, without limits. The net loss in weight is $\propto$ the (angular velocity of rotation of the mass about its axis)^2.

531.565 1693

Loss of weight by rotation. TONKS, L. *Phys. Rev.*, 67, *p.* 195, *March* 1 *and* 15, 1945.—[See Abstr. 1692 (1945)]. By writing down the Hamiltonian for a single particle of the rotating mass, and taking its derivative with respect to the distance from the centre of the earth to the plane of rotation of the particle, the instantaneous change in weight of the particle due to the combined earth and gyroscopic rotations is calculated. It consists of (1) the centrifugal force associated with the particle in its instantaneous position by virtue of the earth's rotation only, that is, as if the gyroscopic rotation were zero; (2) a term dependent on the gyroscopic phase of the particle in a different way, but the variation is such, that in the course of one revolution of the gyroscope this term averages to zero. The only loss of weight is the commonly accepted centrifugal one.

531.565 : 531.767 1694

Gravitational ground speed indicator. DOZIER, C. T. *Proc. Amer. Phys. Soc., New York, Jan.*, 1945. *Abstr. in Phys. Rev.*, 67, *p.* 204, *March* 1 *and* 15, 1945.—The effect of torque developed by the difference in weight of the easterly- and westerly-moving halves of a mass rotating about a vertical axis through its centre and mounted in an aircraft is $\propto$ the E–W component of level flight ground speed of the plane. The mass rotates at constant angular velocity. Two such masses rotating in opposite directions are connected by linkage to indicate the torque and thus the E–W component of ground speed directly on a calibrated scale. Latitude and altitude factors are introduced. The full ground speed of the plane is derived by vector methods from this component and the known direction of flight.

531.71 : 621.317.39 1695

A change-of-capacitance method for the measurement of mechanical displacements. BRADSHAW, E. *J. Sci. Instrum.*, 22, *pp.* 112–114, *June*, 1944.—[Abstr. 1574 B (1945)].

531.714.7 1696

The gauging of involute gear teeth. *Engineering*, 159, *pp.* 46–47, *Jan.* 19, 1945.

531.72 : 539.216.1 : 539.217.5 1697

Air resistance bridge for measuring fibre properties. HERTEL, K. L. *Proc. Amer. Phys. Soc., Atlanta, April*, 1945. *Abstr. in Phys. Rev.*, 67, *p.* 308, *May* 1 *and* 15, 1945.—The ratio of the external surface of a fibre to its volume may be used as a measure of fibre fineness. The resistance to air flow by fibres confined in a tube with perforated ends is a function of the tube cross-section, length of fibre wad, air viscosity, fibre orientation, fibre surface per unit volume, and porosity of the fibre wad. A predetermined mass of fibres in a cylindrical tube with perforated ends constitutes one resistance, and three capillary tubes the other resistances of an air "Wheatstone bridge." Air pressure 2 cm. (water) produced by an aspirator bulb and slack bellows provides the potential difference, while an inclined kerosene-filled manometer takes the place of the galvanometer and indicates the balance of the bridge.

531.767 : 531.565 *see Abstr.* 1694

531.775 : 621.317.39 1698

Electronic tachometer. *Rev. Sci. Instrum.*, 16, *p.* 16, *Jan.*, 1945.—The Hewlett-Packard 505A tachometer indicates and records very high speeds of rotating parts having small energy or which cannot be mechanically connected to any measuring device. It consists of an electronic frequency meter, a photocell pick-up and a light source. The speed of a rotating part can be measured without any direct connection to the rotating part up to 50 000 r.p.s. Ten frequency ranges are provided. The accuracy is within 2% of indicated full-scale value. The power required is 115 V, 60-c/s. a.c.

531.787 : 578.087 1699

A manometric apparatus for respiratory studies of small animals. ROBBIE, W. A., AND LEINFELDER, P. J. *Science*, 101, *pp.* 48–49, *Jan.* 12, 1945.

531.788 1700

High vacuum gauges. I–IV. PIRANI, M., AND NEUMANN, R. *Electronic Engng*, 17, *pp.* 277–280, *Dec.*, 1944; 322–326, *Jan.*; 367–371, *Feb.*, *and pp.* 422–426, *March*, 1945.—A general description of gauges including a section on the principles of vacuum measurement. For the quantitative measurement of low pressure one of the following properties of the substance may be used: (1) weight, (2) elasticity, (3) heat conductivity, (4) ionization, (5) disordered or partially ordered molecular movements of the gas. Typical of (1) is the McLeod gauge and the various models of these are discussed in detail. Gauges based on elasticity either measure the distortion of a solid body under the pressure applied or they determine the time needed for damping of oscillations of a vibrating fibre. Various types of such gauges are discussed. Under (3) come Pirani's hot wire gauge and the Cambridge micro-vacuum gauge-indicator. Various types of ionization gauges are considered, e.g. the Pirani gauge of Brown-Boveri and the Philips gauge. Examples of (5) are Knudsen's gauge and Langmuir and Dushman's molecular gauge. These are discussed. L. S. G.

532.13 : 541.145 : 541.182.5 1701

Physical-chemical investigations of goldenrod rubber. IV. Increase in viscosity and formation of photogels by irradiation of goldenrod rubber in the absence of oxygen. GRAFF, M. M., AND SKAU, E. L. *J. Phys. Chem.*, 49, *pp.* 1–4, *Jan.*, 1945.—The viscosity of goldenrod rubber can be increased until gelation takes place by irradiation of its benzene solution in the presence of catalysts and in the absence of oxygen. Benzophenone, benzaldehyde, and CCl_4 seem to be the best of the activators tested.

532.13 : 662.93 1702

The flow of coal-ash slag on furnace walls. COHEN, P., AND REID, W. T. *Tech. Pap. U.S. Bur. Min.*, *No.* 663, 22 *pp.*, 1944. *See also Trans. Amer. Soc. Mech. Engrs*, 66, *pp.* 685–696, *Nov.*, 1944.—[Abstr. 1773 B (1945)].

532.13 : 677.47 1703

The fluidity of nylon solutions in *m*-cresol. II. BOULTON, J., AND JACKSON, D. L. C. *J. Soc. Dy. Col.*, *Bradford*, 61, *pp.* 40–47, *Feb.*, 1945.—A comparison is made between *m*-cresol and formic acid with regard to their suitability as solvents for viscosity measurements on nylon solutions. They are compared for flow properties, sensitivity, stability, and convenience in use; *m*-cresol is preferred. Using the technique described [Abstr. 1345 (1943)], many results for a large number of yarns have been obtained for H_2SO_4 attack and photochemical degradation. In each case, the relationship between loss in strength and rise in fluidity is independent of the origin of the nylon. In the case of photochemical degradation, there is a smaller rise in fluidity for a given loss in tensile strength than is the case for acid degradation. Measurements of fluidity of solutions of low conc. of nylon in *m*-cresol are described, and it is shown that intrinsic viscosity is dependent upon conc. over a wide range of dilutions. Data are given from which the fluidity, as defined for an 8 g./100 cm.^{3} solution of nylon in *m*-cresol, can be deduced from viscosity measurements made in more dilute solutions for yarns degraded by acid attack.

532.133 1704

The viscosity of dilute solutions of nitrocelluloses derived from chemically modified cotton celluloses of various types. BROWNSETT, T., AND DAVIDSON, G. F. *J. Text. Inst.*, *Manchr*, 36, *pp.* T1–T9, *Jan.*, 1945.—The relations between viscosity and concentration of acetone solutions of nitrocelluloses derived from hydrocelluloses, dichromate oxycelluloses, and periodic acid oxycelluloses, were investigated over the concentration range 0–0·25%. The viscosity/concentration relation is not the same for the derivatives of all 3 types of modified cotton cellulose. If, at a very low standard concentration, a nitrated hydrocellulose has the same relative viscosity as a cellulose nitrated after oxidation with periodic acid, the relative viscosities of the two products are not the same at a higher concentration, the derivative of the oxidized cellulose then having a greater viscosity than the derivative of the hydrolysed cellulose. It is suggested that the degree of association of nitrocellulose molecules of a given average chain-length, and hence the viscosity at a finite concentration, is influenced by chemical changes, other than depolymerization, resulting from the oxidation of the cellulose with periodic acid. When dichromate is the oxidant, there is only a slight difference between the viscosity/concentration relations for the nitrated oxy- and hydrocelluloses. The relation between viscosity and concentration for all 3 types is satisfactorily represented by $\log(\eta_{sp}/c) = \log[\eta] + mc$, where η_{sp} is the specific viscosity, c is the concentration, $[\eta]$ is the intrinsic viscosity, and m is a constant. H. H. HO.

532.133 : 532.712 : 541.24 1705

Intrinsic viscosities and osmotic molecular weights of cellulose acetate fractions. SOOKNE, A. M., AND HARRIS, M. *J. Res. Nat. Bur. Stand., Wash.*, 34, *pp.* 459–466, *May*, 1945.—The intrinsic viscosities and osmotically estimated number-average mol. wts. of a series of cellulose acetate fractions were measured. Within the range of chain lengths investigated (number-average molecular weight, $\bar{M}_n$, up to 130 000) the number-average mol. wts. are $\propto$ the intrinsic viscosities in acetone solutions.

532.133 : 541.24 1706

Viscosity and molecular weight. III. The heterogeneity coefficient. COPPICK, S. *Paper Tr. J.*, 119, *TAPPI Sect.*, *pp.* 256–262, *Dec.* 28, 1944.—The viscosity/conc. relationship is a function of the heterogeneity of the cellulose, and wood pulps are known to be very heterogeneous both as regards the species and the chain lengths of the component polysaccharides. Great accuracy cannot be expected in determinations of mol. wt. based on measurements of intrinsic viscosity and theoretical or empirical formulae relating viscosity, conc. and infinite-dilution functions. A heterogeneity coefficient must be introduced into such relationships, and appropriate data are given for various degrees of sulphate pulping. There appears to be little point in attempting to determine average mol. sizes to within $\pm 10\%$ by one viscosity measurement, so long as the distribution function is unknown. J. G.

532.133 : 676.1 1707

Significance and measurement of pulp viscosity. HATCH, R. S. *Pulp. Pap. Mag. Can.*, 45, *pp.* 959–960, *Dec.*, 1944.—Viscosity measurements may be used to evaluate cellulose products for use in the papermaking as well as in the textile industry. A high viscosity can be correlated directly with a high folding endurance for the paper made. The method is also used to control the ageing process which is involved in the conversion of wood pulp cellulose into viscose rayon. The determination of the viscosity of cellulose dissolved in cuprammonium solution is outlined. The recent introduction of cupriethylene diamine as the solvent for the cellulose has the advantages that it is less necessary to exclude air, and that a determination may be made in 30 min. J. G.

532.137 : 666.11 1708

Viscosity of recent container glass. ROBINSON, H. A., AND PETERSON, C. A. *J. Amer. Ceram. Soc.*, 27, *pp.* 129–138, 1944.—A high-temperature concentric cylinder viscometer is described. The calibration checks within 1% of that obtained by Lillie for a similar apparatus and provides further evidence of the reliability of this type of measurement. A medium-temperature-range fibre viscometer for

measuring the viscosity of glass in the annealing range was also constructed. The equation,

$$\log \eta = -A + \frac{B}{(T - T_o)},$$

fits the data obtained on the two instruments to within 0·5% for commercial soda-lime glasses. Complete viscosity data as a function of temperature are given for 16 commercial container glasses. These glasses show a wide range of viscosity.

532.14 : 536.423.1 : 541.6 : 535.324 *see Abstr.* 1761

532.511 1709

Integral theorems in three-dimensional potential flow. VON MISES, R. *Bull. Amer. Math. Soc.*, 50, *pp.* 599–611, *Sept.*, 1944.—Various 2-dimensional formulae of hydrodynamical theory, e.g. the Biot–Savart formula (giving the velocity induced at a given point by a vortex line of given vorticity), the Blasius formula and the Kutta-Joukowski formula are generalized to 3 dimensions. If q is the velocity distribution vector and r the position vector, a general problem solved is that of determining the general form of the function $f(q, r)$ for which

$$\int f(q, r) \,.\, dS = 0$$

when the integral is taken over the complete boundary of a region in which f has continuous first derivatives with respect to the components of r and q. L. S. G.

532.514 1710

On hydrodynamical images. Arbitrary irrotational flow disturbed by a sphere. WEISS, P. *Proc. Camb. Phil. Soc.*, 40, *pp.* 259–261, *Oct.*, 1944.—Let $\phi_0(x, y, z)$ be the velocity potential of the irrotational flow of an incompressible inviscid fluid, and suppose that the flow is disturbed by the introduction of a sphere S into the fluid, so that the potential becomes $\phi(x, y, z) = \phi_0(x, y, z) + \phi_1(x, y, z)$. The perturbing term ϕ_1 is found in terms of an arbitrary ϕ_0 by using Kelvin transformations [for the corresponding problem in 2 dimensions see Abstr. 1716 (1940)]. Examples are given relating to (i) a sphere in uniform flow or in radial flow and (ii) flow due to an infinite vortex line disturbed by a sphere. L. S. G.

532.516 : 621.891 1711

A new experimental approach to the study of boundary lubrication. DACUS, E. N., COLEMAN, F. F., AND ROESS, L. C. *J. Appl. Phys.*, 15, *pp.* 813–824, *Dec.*, 1944.—Apparatus is described for measuring the relative ability of rubbed-down monolayers of polar lubricants to maintain low friction under test conditions which do not permit replacement of the lubricant. An account is given of the preparation of the surfaces and films. Significant differences are found in the relative durabilities of a number of polar compounds. For monocarboxylic acids, the values increase with the number of C atoms per molecule. The stability of rubbed-down monolayers on polished stainless steel and on chromium is investigated. L. S. G.

532.517 1712

Note on the shearing motion of fluid past a projection. DEAN, W. R. *Proc. Camb. Phil. Soc.*, 40, *pp.* 214–222, *Oct.*, 1944.—The conformal mapping

$$z = 2i[a(1 + \zeta)^{-1} + a_0 + P_n(\zeta)],$$

where a, a_0 are constants and $P_n(\zeta)$ is a polynomial of degree n is considered and applied to the shearing motion of a fluid past a projection, a fairly general type of which may be obtained by adjusting the coefficients in $P_n(\zeta)$. Simple special cases were considered previously [Abstr. 1762 (1944)]. Now the stream function ψ is found by a simple algebraic process, avoiding contour integration, and the explicit expression is given for the case $n = 3$. By considering a special case, it is shown that the projection need not be symmetrical about an axis, and it is found that in this special asymmetric case a closed vortex is formed on one side of the projection. L. S. G.

532.525 1713

Design of spray nozzles. *Engineering*, 159, *pp.* 21–23, *Jan.* 12; 61–63, *Jan.* 26, *and pp.* 103–104, *Feb.* 9, 1945.—Scientific principles underlying the design of nozzles for spraying liquids, with special reference to the design and construction of a nozzle for spraying coke with a solution of sodium carbonate with a view to activation of the coke, are discussed. J. S. G. T.

532.543 1714

A comparison between three expressions for backwater function. PANCHANG, G. M., AND FRAMJI, K. K. *J. Univ. Bombay*, 13, *pp.* 7–14, *Nov.*, 1944.—As a result of heading-up at a cross regulator in a canal forming part of an irrigation scheme, free flow is obstructed and an afflux is created which backs up to a considerable length of the canal, the backwater length depending on the head raised (afflux) at the regulator. Employing data derived from experiments carried out on the head reach of the Dadu canal in 1938, the author finds that Love's formula is totally inadequate for computing values of the rise at different distances upstream of an artificial heading. Ruehlmann's is satisfactory for distances not exceeding about 8–10 canal miles. Gibson's formula is applied in 5 different ways of which one is found to be satisfactory for small reaches of the canal while two, though not exact for distances greater than 10 canal miles, are useful for estimating the length of the backwater curve. Values of Gibson's function are appended. J. S. G. T.

532.57 1/15

The impact tube. HODKINSON, B *Proc. Instn Mech. Engrs, Lond.*, 151, 3, *pp.* 257–264, 1944.—A simple impact tube, combined with a static tube to form a "Pitot-static" tube, can be designed to give reliable readings of the total pressure or energy of a moving fluid, except when the velocity exceeds that of sound, or when it is extremely low. With the usual form of tube, the length of the stem raises the pressure reading at the static holes, while the characteristics of the nose of the impact portion tend to give a low reading, the two effects usually approximately cancelling. Lack of parallelism of the tube to the fluid stream causes too low a reading at both the static holes and the impact opening, so that the dynamic pressure is recorded correctly to within about 1% for errors of setting up to 20°. When the static pressure is known, the kinetic energy or velocity head is obtained by subtracting the static pressure from the total pressure, while if the density is known, the velocity can be derived from the pressure measure-

ments. At velocities above that of sound, a standing wave is formed in front of the mouth of the Pitot tube, this wave representing a steep pressure rise, so that the tube reads less than the total pressure. Formulae are derived for calculating the pressure rise in the standing wave. At very low velocities, the effect of viscosity is to make the tube give readings exceeding the static pressure by an amount equal to (velocity head) [1 + (3/Reynolds number)]. Details are given of the use of the tube in research on turbine blades.

A. C. W.

532.57 : 621.317.39 1716

An alternating-field induction flow meter of high sensitivity. KOLIN, A. *Rev. Sci. Instrum.*, 16, *pp.* 109–116, *May*, 1945.—[Abstr. 1576 B (1945)].

532.582.5 : 533.662 1717

The efficiency of marine screw propellers and the drag coefficient. BAKER, G. S. *Trans. N.E. Cst Instn Engrs Shipb.*, 28 *pp.*, 1945.—A simple formula for efficiency is developed covering general characteristics containing only two unknown constants. These constants bear definite relations to particular features of the curve of efficiency plotted on a base of effective slip, which enable their value to be obtained. Using the artifice of representing a propeller by a single mean blade section at a definite fraction of the diameter, and with the usual assumptions made in screw theory, it is shown that one of the above constants depends directly upon the frictional drag of the screw, and through this relation, the mean drag coefficient of any screw can be obtained from the usual model test data. Drag data for a large number of airfoils in straight flight, at various Reynolds numbers, were examined. Screw efficiency in certain cases might be improved by the retention of laminar flow over the blades. Eddy-making in the screw is considered and a number of examples are given showing the loss of efficiency. The effect of roughness is shown by a series of tests.

532.583.4 : 629.123 1718

The fundamentals of ship form. TODD, F. H. *Trans. Inst. Mar. Engrs*, 57, *pp.* 1–29, *Feb.*, 1945.—[Abstr. 1763 B (1945)].

532.612 1719

The properties of freshly formed surfaces. IV. The influence of chain length and structure on the static and the dynamic surface tensions of aqueous-alcoholic solutions. ADDISON, C. C. *J. Chem. Soc.*, *pp.* 98–106, *Feb.*, 1945.—The vibrating-jet technique was applied to the measurement of both static and dynamic surface tensions of aq. solutions of alcohols containing from 1 to 8 C atoms. The static tensions at high conc. were used to evaluate the Szyszkowski constants, and the work of adsorption was deduced from the static tensions at great dilution. Dynamic surface tensions are recorded for aq. solutions of *n*-amyl, *n*-hexyl, *n*-heptyl, and *n*-octyl alcohols over a range of surface ages, and the migrational velocity is shown to increase with increasing chain length. Branching of the C chain (as in *iso*amyl or *tert.*-hexyl alcohol) or alteration in the position of the hydroxyl group (as in *sec.*-octyl alcohol) appears to reduce the migrational velocity, and possible reasons for this are discussed.

532.64 1720

Large contact angles of plant and animal surfaces. CASSIE, A. B. D., AND BAXTER, S. *Nature, Lond.*, 155, *pp.* 21–22, *Jan.* 6, 1945.

532.69 1721

Liqui-jector. *Rev. Sci. Instrum.*, 16, *pp.* 16–17, *Jan.*, 1945.—An apparatus for the automatic and continuous removal of condensate from compressed-air and gas lines, which separates the liquid and gas phases by utilizing the surface tension of the liquid, is described. The droplets are coalesced on the surface of a tube of coarse ceramic material with an average of 50 000 pores per in.^{2}

532.69 : 539.61 1722

Further experiments regarding the phenomenon of floating drops. BENEDICKS, C., AND SEDERHOLM, P. *Ark. Mat. Astr. Fys.* 30*B*, *No.* 3, 8 *pp.*, 1944.—A continuation of a previous paper [Abstr. 2394 (1944)]. A more detailed study is made of the influence of a low pressure and of the nature of the gas surrounding the floating drop. Ethanol gives no floating drops in a vacuum; nor does saponin solution, although in this case foam (not very stable) is formed. For petroleum, floating drops of a high stability are formed in air but not in a vacuum. L. S. G.

532.69 : 541.18.041.2 : 662.62 1723

Flocculation and flotation principles in the recovery of low-grade fuels. SAMUELS, J. O. *Inst. Fuel War Time Bull.*, *pp.* 103–111, *Feb.*, 1945.—A detailed survey of the flocculation and flotation principles in the treatment of low-grade slurries. Development of the use of the starch mol. as a flocculating reagent, leading to the Unifloc reagent as a result of work on the action of metallic salts (other than hydroxides) on the amylopectin constituent of starch, is reported, and data for 23 salt solutions are tabulated. An examination of available data on flocculation in theory and practice shows that flocculation with boiled starch, alkaline starch, and electrolytes is characterized by slowness of action, varied performance, low rate of settling and fragile nature of flocs, as opposed to the Unifloc system which is instantaneous. The action and advantages of a continuous slurry-flocculating plant are described and illustrated with tabulated data for various slurrys and coal-particle sizes; utilization of slurry filter-cake with comparative data on performance in draught furnaces is given. Froth flotation with typical analyses is discussed. N. M. B.

532.694 : 536.423.1 1724

Physical aspects of foaming in steam generation. CASSEL, H. M. *J. Appl. Phys.*, 15 *pp.*, 792–798, *Dec.*, 1944.—Steam generation from distilled water and from solutions is considered. The influence upon the activation energy of nucleus formation exerted by the contact angle at the vapour/liquid/solid phase boundaries as well as by the size and shape of submerged solids is expressed quantitatively by the reduction in the volume requirement of the nucleus. The effect of solutes in superheated liquids upon steam bubble creation and growth are discussed. The stabilization of foam in boiling electrolyte solutions is explained by the thermo-electric potential differences originating from the temperature gradient around growing bubbles. The mechanism of foam inhibition (e.g. caused by castor oil) is examined. L. S. G.

532.694.1 : 676.2 1725

Chemical defoamers in the manufacture of pulp and paper. MOREHOUSE, W. B. *Paper Tr. J.*, 120, *TAPPI*

Sect., *pp.* 99–100, *March* 8, 1945.—Types of foam encountered and the ill effects of inadequate foam control are described. No one defoaming agent can be applied successfully to all mill foam problems. The ideal foam killer should be highly conc. and yet stable on dilution, inert towards other chemical constituents of the furnish, capable of improving sheet formation, and relatively cheap in relationship to the effects produced. J. G.

532.7 : 536.422 : 536.77 *see Abstr.* 1817

532.7 : 539.266 1726

Atomic distribution function of liquid argon. WALL, C. N. *Phys. Rev.*, 67, *pp.* 285–288, *May* 1 *and* 15, 1945.—An atomic distribution curve for liquid A is characterized by a prominent first peak. This peak may be used to determine the elements of the first co-ordination shell. Frequently this peak can be closely approximated by a simple polynomial involving a parameter σ. This parameter may be determined empirically by a process of fitting. The theoretical value of σ for liquid A is compared with various empirical values obtained from the experimental distribution curve under these conditions [Abstr. 400 (1943)]. The theoretical value is somewhat smaller than the empirical value of σ obtained by fitting. [See Abstr. 2558 (1940)].

532.71/.73 : 536.653 : 536.7 *see Abstr.* 1814

532.712 : 541.24 : 532.133 *see Abstr.* 1705

532.72 : 541.183 : 539.216.1 1727

Sorption of vapours by keratin and wool. KING, G. *Trans. Faraday Soc.*, 41, *pp.* 325–332, *June*, 1945.—[See Abstr. 1204 (1940)]. The absorption and desorption rates for water, methyl alcohol, and ethyl alcohol by wool and horn keratin were investigated for those cases in which diffusion is the rate-controlling process. The results confirm the conception of a diffusion coefficient which increases with concentration, and show that this leads to the building up of a steep front, which advances through the medium as the absorption proceeds. This does not affect the parabolic form of absorption for semi-infinite media but leads to an approximately linear rate in the case of finite media.

532.739.2 1728

The solubility of hydrogen in zirconium and zirconium-oxygen solid solutions. HALL, M. N. A., MARTIN, S. L. H., AND REES, A. L. G. *Trans. Faraday Soc.*, 41, *pp.* 306–316, *June*, 1945.—A study of the solubility of hydrogen in Zr and in Zr containing oxygen in solid solution to the extent of 50 atom % was made isothermally up to 1 000°C. and at pressures up to 1 atm., precautions being taken for the elimination of surface contamination of the metal by oxide or nitride films. The isotherms exhibit critical phenomena, such as are observed in the Pd–H system, but, from the asymmetric disposition of the 2-phase region and from the observed effects of oxygen on the shape of the isotherms, must involve more than one solution process. The results also reflect the existence of the known lattice transition in Zr.

532.739.2 : 541.123.3 : 535.324.2 1729

The ternary system isobutyl-alcohol–benzene–water at 25°C. ALBERTY, R. A., AND WASHBURN, E. R. *J. Phys. Chem.*, 49, *pp.* 4–8, *Jan.*, 1945.—In continuation of the investigations of the solubility relationships for the ternary systems made up of benzene, water, and the lower alcohols [Abstr. 1046 (1945)], the system containing isobutyl alcohol has been studied. The ternary solubility curves and tie-lines for the system isobutyl alcohol–benzene–water were determined at 25°C. The solubility of water in isobutyl alcohol at 25°C. was determined by the sealed-tube method, and the solubility of isobutyl alcohol in water by a refractive-index method.

532.77 : 541.123.3 1730

Ternary mixtures of three isomeric heptanes. MILLER, V. A. *Industr. Engng Chem.* (*Analyt. Edit.*), 17, *pp.* 5–12, *Jan.*, 1945.—Describes a method based on a refinement of the solution temperature of the hydrocarbon mixture in diethyl phthalate and nitrobenzene, by which the composition of a mixture containing 2,4- and 2,2-dimethylpentane with 2,2,3-trimethylbutane may be determined quantitatively, the first two components within 3% and the last component within 0·3%.

533.1 : 536.5 *see Abstr.* 1806

533.15 1731

On the slip of a diffusing gas mixture along a wall. KRAMERS, H. A., AND KISTEMAKER, J. *Physica, 's Grav.*, 10, *pp.* 699–713, *Oct.*, 1943.—The usual boundary condition, that the velocity of a gas bounded by a wall is equal to that of the wall at every point of its surface, is not exactly satisfied when there exists a concentration gradient parallel to the wall. The slip effect which occurs is studied and an approx. theoretical expression is derived for the diffusion slip, using a method similar to Maxwell's method for calculating the viscosity slip and the thermal slip. Some experiments performed with a mixture of H_2 and air are described. These have for their purpose the measurement of the pressure gradient in a capillary tube in which a stationary state of diffusion exists. Using the pressure gradient, the diffusion slip is calculated and the value obtained is larger than the theoretical value by a factor of about 1·4. L. S. G.

533.275 : 621.317.39 1732

Dew point of flue gases. WOOTTON, W. R. *Elect. Rev., Lond.*, 136, *pp.* 861–864, *June* 15, 1945.—[Abstr. 1577 B (1945)].

533.3 : 621.3 : 517.93 *see Abstr.* 1625

533.5 : 539.16.08 : 621.316.721.076.7 : 621.385.2 1733

An a.c. operated leak detector and ionization gauge. NELSON, R. B. *Rev. Sci. Instrum.*, 16, *pp.* 55–57, *March*, 1945.—[Abstr. 1644 B (1945)].

533.5 : 621.316.7.076.7 1734

Device for electronic control of reduced pressure. OLIVER, G. D., AND BICKFORD, W. G. *Rev. Sci. Instrum.*, 16, *pp.* 130–131, *May*, 1945.

533.52 1735

High-vacuum pumping unit. *J. Sci. Instrum.*, 22, *pp.* 38–39, *Feb.*, 1945.

533.56 1736

A new design for a high-vacuum pump. SIEGBAHN, M. *Ark. Mat. Astr. Fys.*, 30*B*, *No.* 2, 4 *pp.*, 1944.—A modified type of molecular pump is described, which may be of special value where very high pumping speeds are needed. It has a flanged rotating disc

and the pumping speed is ∝ the speed of rotation and is practically independent of the pressure over a very large range. At 8 800 r.p.m. the pumping speed was found to be 48 litres/sec. The best ultimate vacuum so far measured is 2.10^{-6} mm. Hg. L. S. G.

533.6.07 1737

Giant west coast wind tunnel for testing full-size planes. *J. Franklin Inst.*, 239, *pp.* 157–158, *Feb.*, 1945.

533.662 : 532.582.5 *see Abstr.* 1717

534.01 : 531.225 : 519.34 *see Abstr.* 1647

534.01 : 621.3.018 1738

Periodic processes in free pseudo-linear oscillatory systems. BULGAKOV, B. V. *J. Franklin Inst.*, 235, *pp.* 591–616, *June*, 1944.—The problems solved relate to mechanical or electrical systems with many degrees of freedom governed by pseudo-linear differential equations, periodic solutions of which, representing steady oscillations, are obtained by a method due to Poincaré. The solutions are applied to explain the self oscillations of a follow-up system, by which is meant a contrivance (e.g. the gyro-compass) which makes a certain "follow-up" axis, reproducing with a min. lag all angular displacements of another "leading" axis, mechanically independent of the first. L. S. G.

534.113 : 517.946.9 *see Abstr.* 1629

534.121.1 1739

The symmetrical vibrations of a thin elastic plate. SNEDDON, I. N. *Proc. Camb. Phil. Soc.*, 41, *pp.* 27–43, *April*, 1945.—A general theory of the vibrations, wider than that given previously [Abstr. 1147 (1941)], is presented. The free vibrations of a very large plate are studied and a relation is found between the prescribed initial displacement of the plate and the velocity of its centre of symmetry during the subsequent motion. The theory of the forced vibrations produced by a force distributed uniformly over the area of a circle is given and the bending of large elastic plates caused by normal impact is discussed. A similar process is given for thin plates of finite radius and numerical examples are discussed showing the effect on the displacement of the plate produced by the finite radius of the plate and by the variation of the area of application of the external force. The Hankel transform method [Abstr. 1621 (1945)] is used throughout to reduce the partial differential equation governing the displacement to an ordinary linear differential equation which may be solved more easily. L. S. G.

534.13 1740

New method of calculating natural modes of coupled bending-torsion vibration of beams. MYKLESTAD, N. O. *Trans. Amer. Inst. Elect. Engrs*, 67, *pp.* 61–67, *Jan.*, 1945.—An extension of earlier work (*J. Aeronaut. Sci.*, April, 1944, pp. 153–162) to take care of coupled bending-torsion vibrations. This problem is important as a means of interpreting ground-vibration tests on aeroplane wings, which may be considered as a symmetric beam with free ends. The method also makes it possible to consider the entire plane as an elastic body both in symmetric and in antisymmetric vibration, and to find the effective inertia of a propeller in determining the torsional vibration characteristics of the engine. It may be applied to the vibration of turbine blades and propellers in general, when the centrifugal force is taken into consideration.

534.133 : 534.321.9 1741

Curved quartz crystals as supersonic generators. LABAW, L. W. *J. Acoust. Soc. Amer.*, 16, *pp.* 237–245, *April*, 1945.—The ultrasonic beam radiated from a 1 cm. radius X-cut quartz disc is examined experimentally as a function of the spherical curvature of the crystal, at a frequency of 1 110 kc/s The experimental data show that it is possible to obtain a greater excess pressure amplitude close to the generator from a curved crystal than is possible from a flat crystal having the same area and thickness using the same input power. The quartz plates of small curvature do not produce a marked focusing action but give a larger ultrasonic amplitude at large distances from the generator. The flat crystal gives the smallest angle of spread of the ultrasonic beam. The resonant frequency for any of the 5 crystals studied did not differ by more than 20 kc/s (2%) from that to be expected from the thickness.

534.14 : 534.3 1742

Certain applications of physical principles to the playing of musical instruments. SWANN, W. F. G. *J. Franklin Inst.*, 239, *pp.* 1–26, *Jan.*; 79–86, *Feb.*, *and pp.* 163–184, *March*, 1945.—The instruments dealt with were chiefly of the violin group and the piano. The tension in a steel violin string is the same as in a gut string if their radii are as 1 to 2·24. The volume of tone obtained depends on the velocity of the bow and not appreciably on the pressure, and the technique of staccato is explained as a uniform bow speed combined with an oscillation of the hand holding it. The second part treats of the properties of the ear. The ear can reconstruct a missing fundamental out of the remaining overtones. Records were used to illustrate the rôle of overtones in determining the musical quality of piano, 'cello and French horn and in reconstructing the fundamental. The carrying power of the sound from a given instrument is reduced by the presence of a basic substratum of noise, and is increased when there are in the sound strong overtones in the frequency region for which the ear has optimum sensitivity. The third part is devoted to the question whether a player can modify the quality of tone of a note on the piano. Different forms of "touch" have no effect in changing the quality of tone of a string struck by the hammer with the same force however produced. G. E. A.

534.22 1743

An experimental determination of the velocity of sound in dry CO_2-free air and methane at temperatures below the ice point. QUIGLEY, T. H. *Phys. Rev.*, 67, *pp.* 298–303, *May* 1 *and* 15, 1945.—The fixed-path acoustic interferometer was used. Acoustic resonance in a limited column of gas, coupled to a driven X-cut quartz crystal of fundamental frequency of about 600 kc/s, is produced by temperature variation. The procedure is such that differences in temperature readings, when the temperature is rising and when it is falling, are reduced to an amount in keeping with the other errors of measurement. No molecular acoustic dispersion has been observed so that the results are made available with special reference to their value for computations of specific heats. The

results are given, within experimental error, by the formulae: for air,

$$v^2 = 3{\cdot}8762 \times 10^2T + 806 + 1{\cdot}8043 \times 10^5T^{-1} - 2{\cdot}0364 \times 10^7T^{-2} + 3{\cdot}007 \times 10^{-2}T^2$$

and for methane,

$$v^2 = 6{\cdot}6176 \times 10^2T + 1{\cdot}0016 \times 10^6T^{-1} - 1{\cdot}3846 \times 10^8T^{-2}.$$

534.231 : 534.26 1744

Motion of a rigid sphere in an acoustic wave field. WOLF, A. *Geophysics*, 10, *pp.* 91–109, *Jan.*, 1945.—A rigid sphere in the field of plane acoustic waves in a fluid or in an elastic solid medium is subjected to harmonic forces in the direction of propagation of the waves, and proportional to their amplitude. The response curve is a function of the ratio of the circumference of the sphere to λ, and of the ratio of the mass of the sphere to the mass of the displaced medium. In an elastic solid, Poisson's ratio must also be considered. The response curve in fluids decreases continuously with decreasing λ. In elastic solid media, the curve has a max. due to resonance effects. In general, the greater the mass of the sphere the smaller the response except close to resonance in elastic solid media. The scattering of acoustic waves by a rigid sphere is determined. The potential of scattered waves is developed in a series of spherical harmonics; only the first-order coefficients are affected by the motion of the sphere.

534.26 : 534.231 *see Abstr.* 1744

534.3 : 534.14 *see Abstr.* 1742

534.321.9 : 534.133 *see Abstr.* 1741

534.321.9 : 591.185.5 1745

How bats guide their flight by supersonic echoes. GRIFFIN, D. R. *Amer. J. Phys.*, 12, *pp.* 342–345, *Dec.*, 1944.—Jurine in the 18th century found that plugging the ears of bats caused them to lose most of their ability to avoid obstacles in the dark. His explanation was not generally accepted. Hartridge in 1920 suggested that bats made use of supersonic sounds for purposes of safety when flying and Galambos and the author found that bats emit an intense supersonic cry of frequency varying between 30 kc/s and 70 kc/s with max. intensity about 50 kc/s. When approaching an obstacle, bats emit their cries, but their ability to avoid obstacles is much reduced when their ears are plugged or their mouths are gagged. The term echolocation is suggested for the bats' process, which is compared with the echometer used on a ship for depth-finding or for the location of schools of fish. G. E. A.

534.512.1 1746

The behaviour of liquids in a vibrating air column. HOWATSON, A. F. *Phil. Mag.*, 36, *pp.* 20–31, *Jan.*, 1945.—An experimental study is made of the effect of stationary air-waves on a liquid layer on the bottom of a Kundt tube, the frequencies used being in the lower audible region (300–1 500 c/s). A loudspeaker unit driven by a valve oscillator and power amplifier is used as the source of sound, the oscillator being of the beat frequency type. The principal liquids used are acetone, water, ether, methylated spirits and liquid paraffin, and the effect of viscosity upon the shape of the liquid surface is examined in the case of the latter. A theoretical study of the form of the liquid surface is made and to test this theory experiments are carried out to determine the amplitude of vibration and the particle velocity at an antinode when the intensity produces a marked curvature of the liquid surface. The formation of spouts and vortex effects are considered. L. S. G.

534.845.1 1747

Sound absorption characteristics of Indian materials. I. CHATTERJEE, S., AND DUTT, N. *Indian J. Phys.*, 18, *pp.* 135–143, *June*, 1944.—Watson's method was modified to measure the absorption coeff. of test samples at various angles of incidence from 15° to 75° over the frequency band 64 to 8 192. The measurements were made in a special double sound chamber with the source on one side of a partition, the detector on the other, and the test material in a window-like opening in the partition. Max. coeff. is reached at an angle about 60°; white and silk cotton attain max. values at 1 000 c/s., cocoanut fibres at 2 000 and jute fibres at 500 c/s. G. E. A.

535.14 : 523.872 1748

The ageing of light. MILNE, E. A. *Nature, Lond.*, 155, *p.* 234, *Feb.* 24, 1945.—Red-shifts in the spectra of the galaxies are usually interpreted as Doppler effects consequent on recession. Alternatively, they have been interpreted as an "ageing" of light with time, by which the wavelength of a photon steadily increases. The two interpretations are shown to be equivalent.

535.21 : 539.172 *see Abstr.* 1962

535.215 : 537.525.8 *see Abstr.* 1847

535.232 : 535.6.08 : 535.241.3 *see Abstr.* 1751

535.232/.237 : 621.326.3/.4 1749

Radiating characteristics of tungsten and tungsten lamps. FORSYTHE, W. E., AND ADAMS, E. Q. *J. Opt. Soc. Amer.*, 35, *pp.* 108–113, *Feb.*, 1945.—Gives tables of (*a*) the spectral and total emissivities of tungsten between 1 200°K. and 3 400°K., (*b*) the spectral radiant intensities per 100 candles for 7 lamps operating at colour temperatures between 2 750°K. and 3 475°K. and for lamps operating at 2 360°K.. 2 848°K. and some other colour temperatures. The range of wavelength in (*a*) is 0·3 μ to 4 μ and in (*b*) from 0·35 μ to 2·6 μ. The spectral radiant intensities are given in μW/cm.^{2} at 1 m., per 10 mμ interval. J. W. T. W.

535.233 = 3 1750

A relativistic proof of Wien's displacement law. VON LAUE, M. *Ann. Phys., Lpz.*, 43, 3, *pp.* 220–222, 1943.—A new proof is given which is simpler than previous proofs. It involves the consideration of a monochromatic polarized pencil of rays. L. S. G.

535.241.3 : 535.232 : 535.6.08 1751

Illuminants for colorimetry and the colours of total radiators. HARDING, H. G. W. *Proc. Phys. Soc., Lond.*, 57, *pp.* 222–238, *May*, 1945.—The colours of total radiators are discussed and methods of estimating the colour-temperature to be assigned to a colour not on the locus of the colours of total radiators are outlined. The filter method of calibrating tungsten lamps at the N.P.L. is given, with an indication of the probable accuracy of the calibration. The history and properties are given for the 3 standard illuminants A, B and C recommended for colorimetry by the

Commission Internationale de l'Eclairage in 1931. Other illuminants, such as the equal-energy illuminant E, are mentioned, and the colours of them are compared with those of daylight.

535.243 : 535.247.4 1752

A new form of photo-electric spectrophotometer. DRABKIN, D. L. *J. Opt. Soc. Amer.*, 35, *pp.* 163–169, *Feb.*, 1945.—Describes a spectrophotometer with several features of novel design allowing flexibility of performance and insuring stability. Attention is paid to stability of the light source and of the amplifier. The good performance is due not only to a properly balanced circuit but also to a number of unique methods of mounting the photo-cell, electrometer tube, electrical circuit and controls. A. H.

535.247 1753

Photometer for luminescent materials. TEELE, R. P. *J. Res. Nat. Bur. Stand., Wash.*, 34, *pp.* 325–332, *April*, 1945. *J. Opt. Soc. Amer.*, 35, *pp.* 373–378, *June*, 1945.—A photometer that provides for the determination of low luminances, with due regard for the characteristic behaviour of the eye at such values, is described.

535.247 : 623.46 1754

A recording microphotometer: its application to the design of reflector-type gunsights. CARLSON, F. E., AND POTTER, W. M. *Illum. Engng, N.Y.*, 39, *pp.* 754–767, *Dec.*, 1944.—Describes a microphotometer designed to give, photo-electrically, a record of the variation of brightness over the lines of the reticle in a reflector-type gunsight. An image of the reticle is formed in the plane of a rotating disc with a small hole which allows the light from a small portion of the image to enter a sphere with photocell and amplifier equipment. The sensitivity of the cell and amplifier is 1 mm. deflection for 8×10^{-8} lumens entering the sphere. J. W. T. W.

535.247.4 1755

Transmission photometer. *Rev. Sci. Instrum.*, 16, *pp.* 17–18, *Jan.*, 1945.—A transmission photometer embodying a light sensitive cell, for measuring the amount of light transmitted through very small areas of spectrographic plates, and suitable for use in spectrographic, microcolorimetric and microchemical analysis, and for measuring light transmission through solutions, is described.

535.247.4 1756

A photo-electric method of measuring directly the ratio of two illuminations. GLÜCKAUF, E. *J. Sci. Instrum.*, 22, *pp.* 34–36, *Feb.*, 1945.—Describes a circuit containing two photo-emissive cells and a valve amplifier by means of which it is possible to measure directly the ratio of the illuminations falling on the cells, independently of fluctuations in the abs. values of these illuminations. The apparatus described gives very accurate results so long as the ratio lies between 0·25 and 4 and the spectral distributions of the lights are identical. J. W. T. W.

535.247.4 : 535.243 *see Abstr.* 1752

535.247.4 : 591.148 1757

A luminometer for measuring bacterial luminescence. GRINER, A. M., TYTELL, A. A., AND KERSTEN, H. *Rev. Sci. Instrum.*, 16, *pp.* 10–14, *Jan.*, 1945.—An a.c.-operated photocell instrument is described. The circuit, which employs an electronically stabilized power supply and a feedback amplifier, is similar to one previously described [see Abstr. 2326 (1942)].

535.31 : 628.952 1758

The projection of light. BENFORD, F. *J. Opt. Soc. Amer.*, 35, *pp.* 149–156, *Feb.*, 1945.—[Abstr. 1758 B (1945)].

535.317 : 522.61 1759

Achromatized plate-mirror systems. LINFOOT, E. H. *Proc. Phys. Soc., Lond.*, 57, *pp.* 199–209, *May*, 1945.—A variant of the Schmidt–Cassegrain optical system is described in which the single aspheric plate is replaced by two plates, of different glasses and opposite asphericities, whose colour-errors compensate each other. The use of two plates makes it possible to obtain not only apochromatism but also flat-fielded anastigmatism with both mirrors spherical. Design data are given for such 2-sphere, 2-plate anastigmats and their distortion is shown to be small. The effect of relaxing the strict anastigmatism condition is considered and it is shown that the admission of a small amount of Seidel astigmatism leads to a large extension of the range of available systems. Two aplanat types are selected which seem well suited to astronomical application.

535.32 : 544.6 : 545.82 1760

Spectrochemical methods of analysis. *Industr. Engng Chem. (Analyt. Edit.)*, 17, *pp.* 65–88, *Feb.*, 1945.—A symposium containing the following papers:—Introductory remarks. Barnes, R. B.; Analytical applications of emission spectrometry. Churchill, J. R. [Abstr. 1762 (1945)]; Mass spectrometry. Washburn, H. W., Wiley, H. F., Rock, S. M., and Berry, C. E. [Abstr. 1765 (1945)]; Light absorption spectrometry. Mellon, M. G. [Abstr. 1770 (1945)].

535.324 : 532.14 : 536.423.1 : 541.6 1761

Method for calculating the properties of hydrocarbons and its application to the refractive indices, densities, and boiling points of the paraffin and monoolefin hydrocarbons. TAYLOR, W. J., PIGNOCCO, J. M., AND ROSSINI, F. D. *J. Res. Nat. Bur. Stand., Wash.*, 34, *pp.* 413–434, *May*, 1945.—A method is described for calculating the properties of hydrocarbons which involves the summation of contributions from component parts of the molecule, together with contributions from interactions between adjacent component parts. For the paraffin hydrocarbons, the calculations were made in terms of the difference in the value of the property between a given normal paraffin and its isomers, and the required constants were evaluated from data on 33 paraffins, C_5 to C_8. For these paraffins, the average deviation of the calculated from the experimental values is $\pm 0{\cdot}00074$ g./ml. in density, $\pm 0{\cdot}00042$ in refractive index (n_D at 20°C.), and $\pm 0{\cdot}55$ deg. C. in the normal b.p. In the case of the monoolefin hydrocarbons, the calculations were made in terms of the difference in the value of the property between a given monoolefin and the corresponding paraffin having the same carbon skeleton, and the required constants were evaluated from data on 58 monoolefins, C_5 to C_7. For these monoolefins, the average deviation of the calculated from the experimental values is $\pm 0{\cdot}0031$ g./ml. in density, $\pm 0{\cdot}0020$ in refractive index (n_D at 20°C.), and $\pm 1{\cdot}33$ deg. C. in the normal b.p.

535.324.2 : 541.123.3 : 532.739.2 *see Abstr.* 1729
535.33 : 669 1762

Analytical applications of emission spectrometry. CHURCHILL, J. R. *Industr. Engng Chem.* (*Analyt. Edit.*), 17, *pp.* 66–74, *Feb.* 22, 1945.—A number of techniques, involving qualitative and semi-quantitative tests on a wide variety of materials, are described. Specific examples illustrate the use in the identification of alloys, in seeking explanations for differences in physical and chemical properties, in the analysis of coatings and platings, in corrosion investigations, and in a variety of other special applications.
535.33–31 : 577.16 : 547.96 1763

Ultraviolet spectra of biologically important molecules. ANSLOW, G. A. *J. Appl. Phys.*, 16, *pp.* 41–49, *Jan.*, 1945.—A review of the comprehensive studies that have been made of the spectra of vitamins and proteins. A summary is also given of the irradiation effects produced in simple organic molecules and in large molecules, such as occur in proteins. Evidence is given for a new interpretation of the short wavelength absorption occurring in certain simple molecules and the possible application of this in a discussion of the protein structure problem. L. S. G.
535.331 : 535.338.3 = 3 1764

Spectra of highly ionized sodium and magnesium. SÖDERQVIST, J. *Ark. Mat. Astr. Fys.*, 30*A*, 2, *No.* 11, 20 *pp.*, 1944.—Wavelengths, classifications and term values are given for the extreme ultra-violet spectra of Na IX, VIII and VII, and Mg X, IX and VIII. The lines lie mostly in the region 44 Å–140 Å. A. HU.
535.336.2 1765

Mass spectrometry. WASHBURN, H. W., WILEY, H. F., ROCK, S. M., AND BERRY, C. E. *Industr. Engng Chem.* (*Analyt. Edit.*), 17, *pp.* 74–81, *Feb.*, 1945.—The observed experimental correlation between mass spectra and structure of hydrocarbon molecules is illustrated by the spectra of the octanes. The large variations of spectra with minor variations in arrangement of atoms in a molecule are responsible for the applicability of the mass spectrometer to analysis of isomeric paraffin mixtures containing as many as 10 components. The analysis of a mixture from its mass spectrum can be obtained from the solution of linear simultaneous equations. In samples encountered in the C_1 through C_5 range of hydrocarbons, many components or groups of components can be determined from mass spectrum peaks which receive no contribution from other components in the mixture. The resulting simplifications in computing the analyses are illustrated by examples. A short description of instrument operation is included.
535.336.2 : 537.591.1 = 4 *see Abstr.* 1881
535.336.2 : 539.155.2 *see Abstr.* 1936
535.336.2 : 541.123 : 539.155.2 *see Abstr.* 1937
535.338 : 539.17 : 537.531 *see Abstr.* 1849
535.338.1 : 545.828 1766

The spectrographic detection of selenium in the d.c. arc flame. FELDMAN, C. *J. Opt. Soc. Amer.*, 35, *pp.* 180–184, *Feb.*, 1945.—Se may be detected by means of the line 2 413·517 Å. In the presence of Te the lower limit for the detection of Se is 0·01%. A. H.
535.338.1 : 545.828 : 669.3 1767

The spectrochemical analysis of copper-base alloys. JAYCOX, E. K. *J. Opt. Soc. Amer.*, 35, *pp.* 175–179, *Feb.*, 1945.—This method covers the analysis of Cu-base alloys for Al, Pb, and Sn (0·30 to 15·0%); Fe, Mn, Be, and Ni (0·30 to 5·0%); and Zn (0·30 to 40·0%). Samples are taken into solution with a mixture of HNO_3 and HF or HNO_3 and HCl. The volume is adjusted so that the conc. of the alloy is 50·0 mg./ml. A portion of this solution is mixed with 19 parts of $Cu(NO_3)_2$ solution. Spectra are obtained of aliquots of each sample and of a series of standard solutions dried on porous graphite electrodes and excited in the d.c. arc. Determinations of the amounts of constituent elements present in the samples are made by measuring the ratio of intensities of a line of the constituent element to that of a Cu control line, by the general internal standard procedure.
535.338.3 1768

Forbidden lines λ2 967·5 and λ2 269·8 of mercury Hg I. MROZOWSKI, S. *Phys. Rev.*, 67, *pp.* 161–165, *March* 1 *and* 15, 1945.—The structure of λ2 967·5 ($6^1D_2 \rightarrow 6^3P^\circ_0$) and λ2 269·8 ($6^3P^\circ_2 \rightarrow 6^1S_0$) of neutral Hg was studied with a high resolving power in order to get evidence for their perturbational nature. It was predicted that these lines should be emitted only by the odd isotopes of mercury. The emission would be of the electric-dipole type, the selection rule $\Delta J = 0, \pm 1$ being partially invalidated by the weak interaction of the outer electrons with the nuclear magnetic moment. Only λ2 655·8 was analysed in the past and definitely shown to belong to this category. The structure of λ2 967·5 was fully resolved in the third order of a 30 ft. Chicago grating. The structure of λ2 269·8 was obtained by means of an aluminized Fabry-Perot étalon and a medium-size quartz spectrograph. All components predicted for both cases were observed, except a very weak one for λ2 269·8. The distances and intensities agree with theoretical predictions, hence establishing the nuclear perturbational nature of the forbidden transitions in the spectra of unperturbed atoms of Zn, Cd, and Hg.
535.338.3 : 535.331 = 3 *see Abstr.* 1764
535.338.3 : 537.531 *see Abstr.* 1850
535.338.33 : 537.531 *see Abstr.* 1851
535.338.42 1769

The spectrum of manganese hydride, MnH. II. The structure of the $A^7\Pi$ and $X^7\Pi$ states. NEVIN, T. E. *Proc. R. Irish Acad.*, 50*A*, 7, *pp.* 123–137, *Jan.*, 1945.—A continuation of a previous paper [Abstr. 107 (1943)] on the structure of the λ5 677 and λ6 237 bands of MnH involving a transition $^7\Pi \rightarrow {}^7\Sigma$. It appears that the $^7\Sigma$ state involved is the ground state of the molecule and the transition is referred to as $A^7\Pi \rightarrow X^7\Sigma$. A theoretical calculation is made of the splitting of the $^7\Sigma$ state (caused by the magnetic interaction of the individual electron spins) and the results agree well with experiment. There is a discussion of the Λ-doubling in the $^7\Pi$ state and of the perturbations which affect the lower rotational levels of the multiplet components and cause them to be arranged in an abnormal order. A list of the molecular constants of the two states is given. L. S. G.
535.338.42 : 536.61–1 : 539.132 *see Abstr.* 1921
535.342 1770

Light-absorption spectrometry. MELLON, M. G. *Industr. Engng Chem.* (*Analyt. Edit.*), 17, *pp.* 81–88, *Feb.*, 1945.—The analytical applications of light

absorption spectrometry involve determination of the absorptive capacity of materials for radiant energy in the range 400–750 mμ. Qualitative uses depend upon the kind of absorption—that is, the nature and contour of the transmittance wavelength curve. In colorimetry this involves the hue of the system. Quantitative uses depend upon the intensity of absorption—that is, the height of the characteristic portion of the curve. In colorimetry this involves luminance and purity, which in turn depend upon the amount of the absorbing constituent present.

535.343.3 1771

The absorption spectrum of methylglyoxal. Woo, S. C., AND CHANG, S. T. *Trans. Faraday Soc.*, 41, *pp.* 157–163, *March*, 1945.—The existence of the λ4 300 Å absorption max. due to the conjugated carbonyl groups is proved for anhydrous methylglyoxal in non-aqueous solvents. A new method for the preparation of anhydrous methylglyoxal in non-aqueous solvents is described. The molecular extinction coefficient of the λ4 300 Å max. for anhydrous methylglyoxal, CH_3COCHO in acetone, is log $\varepsilon = 1 \cdot 14$ at λ425 mμ, and in ether, log $\varepsilon = 1 \cdot 14$ at λ440 mμ.

535.345.6 1772

A graphical correlation of transmittances and thicknesses in optical filters. McLEOD, J. H. *J. Opt. Soc. Amer.*, 35, *pp.* 185–186, *Feb.*, 1945.—A graph is computed from the relationship

$$tDg + Ds = \log_{10}(1/p),$$

where t is the thickness of the glass, Dg is the optical density of the glass per unit thickness, Ds is the optical density corresponding to the two surface reflections (taken as 0·038 for refractive index 1·52), and p is the fraction of light transmitted.

535.361.2 1773

Fresnel reflection of diffusely incident light. GERSHUN, A. *J. Opt. Soc. Amer.*, 35, *pp.* 162–163, *Feb.*, 1945.—The reflectances for diffusely incident light on the plane boundary between two non-conducting media are connected by the relation:

$$n^2(1 - R) = n'^2(1 - R'),$$

where R and R' are the reflectances for the light, coming from media, having refractive indices n and n', respectively. This relation may be considered as a particular case of one general photometric invariant.

535.39 : 535.87 1774

Practical applications of metallic and non-metallic films on optical elements. LYON, D. A. *J. Opt. Soc. Amer.*, 35, *pp.* 157–161, *Feb.*, 1945.—Discusses some recent developments in the application of films to front surface reflectors, semi-reflectors, beam-splitters and transmission elements. A. H.

535.43 : 537.531 *see Abstr.* 1853

535.435 1775

Molecular theory of the scattering of light in fluids. ZIMM, B. H. *Proc. Amer. Phys. Soc., New York, Jan.*, 1945. *J. Chem. Phys.*, 13, *pp.* 141–145, *April*, 1945. *Abstr. in Phys. Rev.*, 67, *p.* 201, *March* 1 *and* 15, 1945.—A direct molecular theory of the scattering of light by fluids of isotropic molecules is developed, utilizing recent advances in the statistical mechanics of condensed phases. The extent of the interference between the wave trains scattered from different molecules of the fluid is calculated with the aid of spatial molecular distribution functions. The integrals of these functions which are encountered are simply related to the concentration and volume derivatives of the free energy. The results are the same, in first approximation, as those of the continuous theory based on fluctuations.

535.435 : 517.512.2 : 537.531 *see Abstr.* 1854

535.515 : 541.182.5 : 537.29 *see Abstr.* 1834

535.6 : 541.183.1 *see Abstr.* 2024

535.6.08 : 535.232 : 535.241.3 *see Abstr.* 1751

535.61-1 : 535.338.42 : 539.132 *see Abstr.* 1921

535.66 1776

Colour control of surface coatings with master and working standards of colour. GRANVILLE, W. C. *Illum. Engng, N.Y.*, 39, *pp.* 818–824, *Dec.*, 1944.—Describes a system in which spectral reflection measurements and visual inspection are combined in the maintenance of master and working standards to ensure constancy of colour in a colour-printed product such as a package label. J. W. T. W.

535.683.1 : 667.211 : 677.31 = 3 1777

Fastness properties of natural brown colouring matters on wool. III. NAUMANN, K. *Melliand Textilber.*, 24, *pp.* 82–84, *Feb.*, 1943.—The following properties are tabulated for wool dyed with aq. extracts of birch and oak barks, walnut leaves (all with an alum mordant), walnut shells (unmordanted), amianthus (as a Fe lake) and of buckthorn berries (mordanted with Cu): colour, fastness to light, rubbing, ironing, H_2O, washing, felting, sweat, S, alkali, hot pressing, and carbonization. In each case comparison is made with a mixture of synthetic dyes having the same shade. Only walnut leaves and shells and amianthus have any real practical possibilities, and they give shades ranging from full bronze to red brown. J. G.

535.7 : 612.84 1778

Persistence of vision. EDRIDGE-GREEN, F. W. *Nature, Lond.*, 155, *p.* 178, *Feb.* 10, 1945.

535.7 : 628.972 1779

A mathematical analysis of glare. SPENCER, D. E. *J. Opt. Soc. Amer.*, 34, *pp.* 769–770, *Dec.*, 1944.—Glare criteria are found for the following three conditions: (i) the eyes fixed on the task with a non-uniform surround, (ii) the eyes adapted to a glare source and then shifted to the work, (iii) the eyes adapted to the work and suddenly moved to encounter a glare source (this effect is evaluated by means of a photochemical theory of vision). The results are used to establish criteria for the limitation of brightness in interior lighting. J. W. T. W.

535.733 1780

The change from trichromatic to dichromatic vision in the human retina. HARTRIDGE, H. *Nature, Lond.*, 155, *pp.* 657–662, *June* 2, 1945.—For objects of small size, fixated on the fovea centralis, trichromatic vision is replaced by dichromatic vision [see Abstr. 1782 (1945)]. This effect has now been found all over the useful retina and the paper gives the results of studies of the effect of such conditions as (*a*) angle of view, (*b*) area and shape of test object, (*c*) background, (*d*) brightness of test object, (*e*) depth of tint, etc. A discussion of these results and of their bearing on a theory of the nature of the dichromatism is given. J. W. T. W.

535.733.1 1781

A photo-receptor mechanism for the modulation theory of colour vision. FRY, G. A. *J. Opt. Soc. Amer.*, 35, *pp.* 114–135, *Feb.*, 1945.—Suggests a form of Troland's modulation theory, postulating five different types of exciting substances in each photo-receptor. One determines the basic frequency and hence the brightness, while the other four, which are grouped in pairs, perform the modulation. The theory and its results are applied to various phenomena of colour vision. J. W. T. W.

535.733.1 : 612.84 1782

Colour vision of the fovea centralis. HARTRIDGE, H. *Nature, Lond.*, 155, *pp.* 391–392, *March* 31, 1945.—The author finds that the dichromatism of the central part of the fovea, previously reported by various workers, applies equally to other parts of the retina so long as the area stimulated is sufficiently small. He describes experimental results which show that this dichromatism is not due to blue-blindness. J. W. T. W.

535.81 1783

A proposed method of specifying appearance defects of optical parts. MCLEOD, J. H., AND SHERWOOD, W. T. *J. Opt. Soc. Amer.*, 35, *pp.* 136–138, *Feb.*, 1945. [See Abstr. 1457 (1945)].

535.824.3 1784

Phase-difference microscopy. LINFOOT, E. H. *Nature, Lond.*, 155, *p.* 76, *Jan.* 20, 1945.—[See Abstr. 1802 (1942)].

535.824.3 1785

Phase-retarding areas. COX, A. *Nature, Lond.*, 155, *pp.* 425–426, *April* 7, 1945.—[See Abstr. 1784 (1945)].

535.824.3 = 3 1786

Phase contrast microscopy. BOSSHARD, E. *Schweiz. Brauerei-Rundschau*, 55, *pp.* 131–136, *Oct.*, 1944.—The optical principles of this method of obtaining sharper contrasts between normally invisible differences in detailed structure, at high magnifications, are outlined. In the Zeiss instrument a ring-shaped phase plate is inserted in the cement layer holding the upper achromatic correcting lens of the objective. A diaphragm giving a ring-shaped light source is used, and the eyepiece is replaced by an auxiliary microscope which is used to obtain coincidence of the ring-shaped images of the diaphragm and of the phase plate. The latter renders visible the change in the amplitude of the light waves from the source resulting from the variations in structure between one part of the preparation and another. Photomicrographs of organisms from beer, moulds, epithelial cells from mucous membrane, chromosomes, trypanosomes and a brain section are reproduced, comparing the bright field and phase contrast methods; they show that the 2 methods are complementary. Since colourless unstained organisms may be examined in this way, the method is particularly useful for living organisms which are affected by stains. J. G.

535.826 : 679.5 1787

Preparation of thin sections of synthetic resins and wood-resin composites, and a new macerating method for wood. FRANKLIN, G. L. *Nature, Lond.*, 155, *p.* 51, *Jan.* 13, 1945.

535.826.7 1788

Microscope stain for mixtures of unbleached fibres. NOLL, A. *Papierfabrikant*, 41, *pp.* 261–265, 1943.—The stain is a solution of 0·1 g. of pure methylene blue or Lauth's violet in a mixture of 25 ml. each of glycol monoacetate and of a 4% aq. solution of aniline sulphate. If free from impurities and stored in the dark, it is stable for some months. The staining reactions are: groundwood pulp, yellow to brown; soda pulp, deep blue; sulphite pulp, little or no colour. J. G.

535.87 : 535.39 *see Abstr.* 1774

535.88 1789

High-intensity projector for stereoscopic screen projection. *J. Sci. Instrum.*, 22, *p.* 39, *Feb.*, 1945.

536.2.08 1790

The flow of heat through granular material. WADDAMS, A. L. *J. Soc. Chem. Ind., Lond.*, 63, *pp.* 337–340, *Nov.*, 1944.—The method used to measure the thermal diffusivities of granular materials consisted in observing the axial rise in temperature after the walls of the retaining cylinder had been heated by steam. Preliminary investigations were made to assess the accuracy of the method. Using assumed values for the density and specific heat, apparent thermal conductivities are obtained for various sizes of steel spheres and rods, lead spheres and calcite granules. The surface condition of the spheres has an appreciable effect. The apparent conductivity increases with the particle size, the increase becoming more marked at about $\frac{1}{4}$ in. dia., where convection becomes an appreciable factor. R. W. P.

536.21 : 662.99 1791

Economic thickness of thermal insulation for intermittent operation. BRADLEY, C. B., ERNST, C. E., AND PASCHKIS, V. *Trans. Amer. Soc. Mech. Engrs*, 67, *pp.* 93–102, *Feb.*, 1945.—Economic thickness is defined as the thickness yielding the smallest sum of cost of heat loss and fixed cost of insulation. By means of the electrical-analogy method, curves are developed which permit the ready determination of the heat losses in intermittent operation for any temperature, any single-material wall, any intermittency, any length of period, and any film conductance. The application of the curves is illustrated by an example. The influence of intermittency on the economic thickness is discussed for one specific case. The limitations of the method and prospect of obtaining results avoiding the limitations are considered.

536.212 1792

Heat flow. JACKSON, R., SARJANT, R. J., WAGSTAFF, J. B., EYRES, N. R., HARTREE, D. R., AND INGHAM, J. *Iron and Steel*, *pp.* 786–793, *Dec.* 7, 1944.—[See Abstr. 2163 (1944)]. Actual measurements were taken inside large steel masses under conditions of industrial heating or cooling. The technique is applicable to a wide variety of conditions and is highly accurate. M.-V.

536.212.3 : 628.8 1793

Thermal insulation. IV. The thermal insulation of buildings. BILLINGTON, N. S. *J. Inst. Fuel*, 18, *pp.* 62–69, *Feb.*, 1945. *Inst. Fuel War Time Bull.*, *pp.* 175–177, *April*, 1945.—The supply of heat to a room serves to make good the heat lost through the walls,

roof, windows, and floor, and to warm the fresh air necessary for ventilation. The actual rate of heat transmission through each square foot of the wall, etc., depends on the difference of temperature between the outside air and the air within the building, and on the thermal transmittance of the construction. Details are given of the properties of the various types of insulating material available, and the use of closed air-spaces is emphasized. The economics of insulation are discussed, there being a limiting thickness beyond which it is not profitable to go. The exclusion of solar heat is necessary for comfort, while for intermittent heating, the inner surfaces of a building should be of low thermal capacity. Pattern-staining is a thermal effect, which, together with permanent condensation, can be avoided by adequate thermal insulation. A. C. W.

536.22.08 : 621.317.39 1794

On the measurement of the thermal conductivity of liquids. HUTCHINSON, E. *Trans. Faraday Soc.*, 41, *pp.* 87–90, *Feb.*, 1945.—A simple form of the hot-wire method is described for the measurement of the thermal conductivity of liquids. Equilibrium is reached in about 2 min. and values agree to within 3% with other reliable data. Present values (cal./cm. sec. °C. $\times 10^{-5}$) are: water 143 ± 2, glycerol $67{\cdot}2 \pm 1{\cdot}0$, chloroform 31·8, carbon tetrachloride 38·0, acetone 40·7, ethyl alcohol 43·6, ethyl iodide $25{\cdot}9$ ($\pm$ 0·5 for last six, at 18°C.). R. W. P.

536.242 1795

Conduction of heat in a slab in contact with well-stirred fluid. JAEGER, J. C. *Proc. Camb. Phil. Soc.*, 41, *pp.* 43–49, *April*, 1945.—Using the Laplace transform method, a solution of the problem of conduction is given in the case where one face of the slab is at zero temperature or is insulated and the other face is in contact with a fluid which is so well stirred that its temperature is constant throughout its mass. Two cases are considered, (i) heat supplied at a constant rate to the fluid, both fluid and slab being initially at zero temperature and (ii) the fluid initially at a temperature V_0 and the slab initially at zero. The solutions contain 3 dimensionless parameters; a numerical discussion is given in the case in which the heat capacity of the fluid is small compared with that of the slab (e.g. if heat is supplied at a const. rate to a room containing well stirred air). Previous solutions obtained for this case are discussed [Abstr. 2345 (1943)]. L. S. G.

536.247 1796

Variable heat-transfer rate correction in multi-pass exchangers, shell-side film controlling. GARDNER, K. A. *Trans. Amer. Soc. Mech. Engrs*, 67, *pp.* 31–38, *Jan.*, 1945.—The change in temperature of the fluid streams within a heat exchanger, through the consequent alteration of their physical properties, may cause the over-all heat-transfer coefficient to vary between rather wide limits; this represents the chief source of error in mean-temperature-difference formulae. Equations are developed for multi-pass exchangers in which the shell-fluid film controls. The results are independent of the number of tube passes, and the numerical data given are therefore those for the limiting case of crossflow with both fluids mixed, since this proves to be more amenable to direct mathematical treatment.

536.413.3 1797

On Grüneisen's equation for thermal expansion. HUME-ROTHERY, W. *Proc. Phys. Soc. Lond.*, 57, *pp.* 209–222, *May*, 1945.—The practical use of Grüneisen's relations as a means for calculating changes in volume from changes in thermal energy is discussed. The correct form is described. The methods used for deducing the constants involved are discussed critically, and a simple and accurate method is described. For the cubic metals Ag, Cu and Al there is good agreement between observed and calculated changes in volume between the abs. zero and a temperature of the order $^2/_3$ of the m.p. as the abs. scale, whilst for Fe there is good agreement up to the temperature at which the magnetic transformation begins. For the hexagonal metals Mg and Zn, the equation fails at very low temperatures if the substance has a negative coefficient of expansion in one direction (e.g. Zn), but is otherwise satisfactory for the calculation of changes in volume up to a temperature of the order $^2/_3$ of the abs. m.p.

536.42 : 679.5 = 3 1798

On the thermal behaviour of micro- and macro-molecular substances and its modifications. UEBERREITER, K. *Kolloid Z.*, 102, *pp.* 272–291, *March*, 1943.—In polymerization and condensation, intermolecular forces depend on chain length whereas infra-molecular forces do not. The transition from micro- to macromolecular behaviour takes place at a chain length of about 50–100 C atoms. The interaction between inter- and infra-molecular forces causes a state like a liquid with fixed structure observable in macromolecular substances. According to the state of their infra-molecular forces, they may be rubberlike substances, thermoplastics or non-thermoplastic substances. The causes of the thermal behaviour of the macromolecules and the influence of electrostatic forces and of solvation in the softening processes are discussed. R. N.

536.421.1 1799

Melting point of alpha-alumina. GELLER, R. F., AND YAVORSKY, P. J. *J. Res. Nat. Bur. Stand., Wash.*, 34, *pp.* 395–403, *April*, 1945.—Results are given of 7 m.p. determinations on α-alumina of high purity in an oxidizing atmosphere and under atmospheric pressure. There was detectable contamination of the specimens by vapours of other elements in the furnace atmosphere, but the results are believed to show that the m.p. is within the range 2 000° to 2 030°C.

536.421.4 1800

Experimental confirmation of predicted water-freezing rates. SEBAN, R. A., AND LONDON, A. L. *Trans. Amer. Soc. Mech. Engrs*, 67, *pp.* 39–44, *Jan.*, 1945.—Test data on an actual system are presented, and the agreement with the predicted values [Abstr. 613 (1944)] validates the approximations of the analysis. Measurements of time of complete freezing in food products of high water content indicate applicability of the analysis, although with less accuracy than in the case of pure water.

536.421.4 : 536.51 *see Abstr.* 1807

536.422 : 532.7 : 536.77 *see Abstr.* 1817

536.423.1 : 532.694 *see Abstr.* 1724

536.423.1 : 541.6 : 532.14 : 535.324 *see Abstr.* 1761

536.423.15 : 541.123.28 1801

The partial pressure of carbon dioxide over aqueous solutions containing caustic soda and sodium carbonate. DEE, T. P. *J. Soc. Chem. Inst., Lond.*, 64, *pp.* 1–5, *Jan.*, 1945.—By means of an equation relating it to known equilibrium constants and activity coefficients, the v.p. of CO_2 at 20° over a solution containing 1% of NaOH and 14·6% of Na_2CO_3, is shown to be of the order 10^{-11} atm., and therefore too low to interfere with the scrubbing of a gas mixture intended to lower the CO_2 pressure to 10^{-6} atm. Calculations are made on the dissociation of Na_2CO_3 in industrial steam generators, where figures are known which give the v.p., but the equilibrium constants are unknown. The temperature relation between the low- and high-temperature figures is of the usual type for v.p.

536.423.15 : 541.123.3 1802

Vapour pressure of the ternary system acetic-acid–benzene-carbon-tetrachloride. MCMILLAN, W. R., AND MCDONALD, H. J. *J. Phys. Chem.*, 49, *pp.* 10–20, *Jan.*, 1945.—The v.p. of the system were obtained by determining the b.p. at 3 different pressures of 51 samples covering the ternary diagram. The b.p. of the system at 1 atm. pressure and the v.p. at 60°C. are given.

536.46 1803

Further studies of the structure and stability of burner flames. VON ELBE, G., AND MENTSER, M. *J. Chem. Phys.*, 13, *pp.* 89–100, *Feb.*, 1945.—It is shown that a combustion zone cannot vanish within a combustible stream. The depth of penetration of the quenching of the explosive reaction by the burner wall is calculated from values of burning velocity and critical boundary velocity gradient for flashback; and is compared with the limiting distance between plane-parallel plates and the limiting tube diameter for flame propagation. The thermal expansion of the gas normal and parallel to the combustion zone is discussed. An experimental analysis and discussion of partial entrance of the combustion zone into the burner tube (tilted flame) and partial attachment to the burner rim are given. New data have been obtained on H_2 and C_2H_2 flames. For instantaneous flashback, the boundary velocity gradients are independent of tube diameter, as expected; these gradients are not a satisfactory criterion for flame stability because flashback can be readily induced by tilted flames. An equation for the limit of the tilted-flame range is given. The compression of C_2H_2–O_2 streams by the combustion zone has been measured. The burning velocities calculated from these and additional thermodynamic data agree well with those determined from gas flow and cone surface. [Abstr. 1450 (1943)].

536.46 : 621.3–213.4 1804

Flameproof enclosure of electrical apparatus. RAINFORD, H. *Min. Elect. Mech. Engr*, 25, *pp.* 280–286, *March, and pp.* 292–299, *April*, 1945.—[Abstr. 1437 B (1945)].

536.468 : 541.124.3 1805

Organic material and ammonium nitrate in fertilizer mixtures. DAVIS, R. O. E., AND HARDESTY, J. O. *Industr. Engng Chem.*, 37, *pp.* 59–63, *Jan.*, 1945.—Experiments show that spontaneous combustion occurs in a base mixture of 1 400 lb. superphosphate, 400 lb. ammonium nitrate, and 50 lb. of an organic meal after storage for several weeks at 30°C. Tests with different mixtures show that the presence or formation of free acid initiates exothermic reactions which between 90° and 110°C. result in spontaneous combustion.

536.5 : 533.1 1806

Temperature measurements in high-velocity air streams. HOTTEL, H. C., AND KALITINSKY, A. *J. Appl. Mech.*, 12, *A25–A32, March*, 1945.—When a stream of air is partially stopped by an inserted temperature probe, the temperature increase due to the conversion of kinetic energy affects the reading of the probe. Tests dealing with the effect of probe shape and air velocity on the recovery factor, and with the influence of radiation on the accuracy of the measurements, are reported. Bare-wire probes gave recovery factors of approx. 0·65 in transverse flow and, in axial flow, approached 0·87 as the air velocity increased. With a spherical enlargement at the thermocouple junction, recovery approached 0·75. Recovery of twisted-wire couples varied from 0·72 to 0·83. Two probes were developed, having high recovery (above 0·98 as velocity approaches sonic) and satisfactory insensitivity to yaw and radiation errors.

536.51 : 536.421.4 1807

Freezing temperature of benzoic acid as a fixed point in thermometry. SCHWAB, F. W., AND WICHERS, E. *J. Res. Nat. Bur. Stand., Wash.*, 34, *pp.* 333–372, *April*, 1945.—The f.p. of benzoic acid is reproducible with a precision comparable to that of the ice point and superior to that of the steam point as usually observed. For use in the calibration of thermometric instruments, the acid is contained in a partially evacuated glass cell provided with a thermometer well. When thus confined, and if not heated excessively, the substance maintains a constant composition for long periods of time. When properly manipulated, the acid in a given cell exhibits a f.p. reproducible from day to day within 0·001 deg. The triple point of pure benzoic acid is 122·362° ± 0·002°C. An appendix deals with a method of calculating temperatures, in the ranges −190° to 0°C. and 0° to 660°C., from observations with a platinum thermometer. For this purpose, power-series equations are used.

536.52 : 621.317.727 1808

An electronic potentiometer pyrometer. FRASER, J. J. *Electronic Engng*, 17, *pp.* 340–344, *Jan.*, 1945.—[Abstr. 1588 B (1945)].

536.63 : 536.75 : 621.317.41 1809

Caloric data deduced from measurements of the susceptibility of $Gd_2(SO_4)_3 . 8H_2O$ compared with calorimetric results. VAN DIJK, H. *Physica, 's Grav.*, 10, *pp.* 248–260, *April*, 1943.—The susceptibility was measured with an induction coil surrounding a coaxial cylinder of the material in a field $\perp$ to the axis of the cylinder. Using the results, the isothermic differences in entropy and specific heat were calculated, using standard thermodynamic formulae, and the values for the specific heat were compared with results obtained from calorimetric measurements. Agreement is good within the limit of the experimental accuracy (about 2%). L. S.-G.

536.63 : 536.77 1810

Heats and free energies of formation of the paraffin hydrocarbons, in the gaseous state, to 1 500°K. PROSEN, E. J., PITZEN, K. S., AND ROSSINI, F. D. *J. Res. Nat. Bur. Stand., Wash.*, 34, *pp.* 403–412, *April*, 1945.—Values are presented for the heats of formation and the free energies of formation, from solid carbon (graphite) and gaseous hydrogen, of all the normal paraffin hydrocarbons and of the isomeric paraffins from the butanes through the octanes, in the gaseous state, to 1 500°K.

536.653 1811

Heat values in the system SO_3-H_2O. DEE, T. P. *J. Soc. Chem. Ind.*, 64, *pp.* 40–44, *Feb.*, 1945.—A survey is made of the heats of mixing at 15°C., and it is shown that they give straight-line relations when plotted against the mol. fraction of SO_3. This enables the differential heats of solution at 15° to be calculated, except that an assumption has to be made for the region close to 100% H_2SO_4. Specific-heat values for H_2SO_4 from 70 to 100% w/w are surveyed, and the rates of variation with temperature of the heats of mixing for acids from 80 to 100% H_2SO_4 and oleums up to 80% free SO_3 are calculated for temperatures between 20° and 100°C. Differential heats of solution in the above ranges of concentration and temperature are also calculated. Applications of the data are illustrated by examples.

536.653 : 532.71/.73 : 536.7 *see Abstr.* 1814

536.653 : 678 : 536.73 *see Abstr.* 1816

536.662 1812

Heats of combustion. III. The heats of combustion of some polynitroparaffins. MILLER, A. J., AND HUNT, H. *J. Phys. Chem.*, 49, *pp.* 20–21, *Jan.*, 1945.

536.666 : 541.182.6 1813

Thermal transitions of the alkali palmitates. VOLD, R. D., AND VOLD, M. J. *J. Phys. Chem.*, 49, *pp.* 32–42, *Jan.*, 1945.—Transition temperatures are reported for the complete series of alkali palmitates between 25°C. and the m.p., together with their approx. heat effects. The sets of transitions are closely related, though not exactly parallel. For all, one of the transitions can be identified as that at which microscopic external crystal form gives way to a measure of fluidity. For Li palmitate this temperature is the m.p. to isotropic liquid, 223°C.; for the remainder of the sequence, loss of microscopic crystallinity occurs at progressively lower temperatures and occurs before complete melting. The temperature of formation of neat soap, for all soaps having this form, is very nearly independent both of the nature of the cation and of the length of the fatty radical, and is therefore believed to involve a special spatial equilibrium of attractive and repulsive forces between the chains.

536.7 : 536.653 : 532.71/.73 1814

Statistical thermodynamics of high-polymer solutions. I. Theory for dilute solutions. ALFREY, T., AND DOTY, P. *J. Chem. Phys.*, 13, *pp.* 77–83, *Feb.*, 1945.—The energy interactions on a molecular scale in high-polymer solutions are considered and included in the configurational partition function. This gives expressions for the heat of mixing and the entropy of mixing which reflect the effect of solvent-solute interaction. One result is an explicit expression for the temperature dependence of osmotic pressure.

536.7 : 678 1815

The thermodynamics of rubber at small extensions. ELLIOTT, D. R., AND LIPPMANN, S. A. *J. Appl. Phys.*, 16, *pp.* 50–54, *Jan.*, 1945.—Disagreement is expressed with previous analysis regarding the extension of rubber. A new criterion for an ideal elastometer is introduced and, on this basis, the data of Meyer and Ferri indicate that rubber is ideal for extensions up to 166%. The structural changes in rubber during extension are discussed and it is pointed out that the new criterion implies that the valence angles do not store an appreciable amount of energy when the rubber is stretched. But the molecular orientation and the interatomic displacements do influence the energy required for extension. L. S. G.

536.73 : 536.653 : 678 1816

The interaction between rubber and liquids. VII. The heats and entropies of dilution of natural rubber by various liquids. FERRY, J., GEE, G., AND TRELOAR, L. R. G. *Trans. Faraday Soc.*, 41, *pp.* 340–350, *June*, 1945.—[See Abstr. 138 (1945)]. Calorimetric measurements of the heats of mixing of seven liquids with dihydromyrcene are used to estimate the heats of dilution of rubber by these liquids. Combining the results with free energies calculated from v.p. gives entropies of dilution which show significant deviations from the present statistical theory. A thermodynamic study of rubber + methyl alcohol shows similar but larger deviations.

536.75 : 621.317.41 : 536.63 *see Abstr.* 1809

536.77 : 536.422 : 532.7 1817

Energy in liquid state. SOONAWALA, M. F. *Indian J. Phys.*, 18, *pp.* 209–211, *Aug.*, 1944.—Potential energy is calculated for water between 30°C. and 365°C., assuming the surface of the liquid to be a potential barrier for the passage of a molecule from the liquid to the vapour state. The changes in the free energy and the internal energy and the rate of variation of the former with temperature are calculated for the same range of temperature. Similar values are suggested for other liquids but at their critical temperatures only.

536.77 : 536.63 *see Abstr.* 1810

536.791.2 1818

Thermomechanical effect in liquid helium II. GOGATE, D. V. *Nature, Lond.*, 155, *p.* 235, *Feb.* 24, 1945.—[See Abstr. 1049 (1944)].

537.12 1819

Remarks on the self-energy problem. HEITLER, W. *Proc. R. Irish Acad.*, 50*A*, 1, *pp.* 1–6, 1944.—The infinite electrostatic self-energy of a point charge may be avoided by either modifying the field for distances smaller than a critical radius (e.g. the non-linear theory of Born, in the case of an electron [Abstr. 1875 (1934)], or by considering that the field strength retains its classical value for all distances but that the particles' own field does not contribute to its rest mass. In the latter case the self-energy of the particle is subtracted. The subtraction method has been used previously [Abstr. 2558 (1942)] and an argument is now given for favouring the subtraction theory. This is based on the work of Heitler and Peng [Abstr. 213 (1944)] regarding the production of mesons in fast collisions between 2 nucleons. L. S. G.

537.12 1820

A theory of the creation of electric charge. WATSON, W. H. *Canad. J. Res. A*, 23, *pp.* 33–38, *March*, 1945.—The theory is based on equations previously proposed [Abstr. 1905 (1945)] associating with ordinary electromagnetic fields a field which may change the rest-mass of the particles on which it acts. The sources of the new field component

$$\left(N = -\operatorname{div} a - \frac{1}{c^2}\frac{\partial \phi}{\partial t}\right)$$

are places where charge is being created or destroyed. A new interpretation is given to the length e^2/mc^2, and it is proposed that the c.m. potentials (ϕ, a) be given absolute values in the theory of fields containing electrons. Thus the mass of an electron is determined by the length of the potential four-vector at the place where it is created, and

$$mc = e\sqrt{\frac{\phi^2}{c^2} - a^2}.$$

The introduction of the N-component into quantum electrodynamics is discussed.

537.12 : 539.154.2 1821

The Rydberg constants and the value of e/m. HSUEH, C. W. *Proc. Amer. Phys. Soc., Pasadena, California, Dec.* 16, 1944. *Abstr. in Phys. Rev.*, 67, *p.* 66, *Jan.* 1 *and* 15, 1945.—The wavelengths of the H-α and D-α lines were measured with a Fabry–Perot interferometer directly against the primary standard, 6 438·4696 IÅ. The results of the measurements are: 6 562·85337 ± 0·000221 IÅ for H-α, and 6 561·06811 ± 0·00005 IÅ for D-α. From the above values, the Rydberg constants R_H, for deuterium R_D, for He R_{He}, and for infinite mass R_∞, and also the values of e/m and E, the atomic weight of electron, were calculated. They are as follows:

$$R_H = 109\,677{\cdot}5795 \pm 0{\cdot}0037 \text{ cm.}^{-1},$$
$$R_D = 109\,707{\cdot}4226 \pm 0{\cdot}0008 \text{ cm.}^{-1},$$
$$R_{He} = 109\,722{\cdot}2694 \pm 0{\cdot}0024 \text{ cm.}^{-1},$$
$$R_\infty = 109\,737{\cdot}3111 \pm 0{\cdot}0041 \text{ cm.}^{-1},$$
$$e/m = (1{\cdot}75883 \pm 0{\cdot}00022) \times 10^7 \text{ e.m.u./g.},$$
$$E = (5{\cdot}48740 \pm 0{\cdot}00069) \times 10^{-4}.$$

537.122 1822

Classical theory of the point electron. SCHÖNBERG, M. *Phys. Rev.*, 67, *p.* 122, *Feb.* 1 *and* 15, 1945.—By consideration of the field produced by a point charge as being made up of the attached field and the radiated field, a theory is outlined which leads to the Lorentz–Dirac classical equations of motion and to a finite field energy without introducing any energies or momenta of a non-electromagnetic nature besides the kinetic ones. There are no subtractions of infinite quantities. A. J. M.

537.122 1823

The radiation field of a point electron. LOPES, J. L., AND SCHÖNBERG, M. *Phys. Rev.*, 67, *pp.* 122–123, *Feb.*1 *and* 15, 1945.—Dirac's definition of the radiation field of a point electron ($F^{\mu\nu}_{\text{rad, }D} = F^{\mu\nu}_{\text{ret}} - F^{\mu\nu}_{\text{adv}}$, where $F^{\mu\nu}_{\text{rad, }D}$ is the tensor of the radiation field, $F^{\mu\nu}_{\text{ret}}$ that of the retarded field, and $F^{\mu\nu}_{\text{adv}}$ that of the advanced field) is discussed, and a new and more advantageous definition is proposed, according to which $F^{\mu\nu}_{\text{rad}} = \frac{1}{2}(F^{\mu\nu}_{\text{ret}} - F^{\mu\nu}_{\text{adv}})$. A. J. M.

537.122 1824

The electron's self-energy. SCHÖNBERG, M. *Phys. Rev.*, 67, *p.* 193, *March* 1 *and* 15, 1945.

537.221 : 678.7 1825

Electrostatic properties of rubber and GR-S. HAVENHILL, R. S., O'BRIEN, H. C., AND RANKIN, J. J. *J. Appl. Phys.*, 15, *pp.* 731–740, *Nov.*, 1944.—A description is given of a new electrostatic modulator which is used in conjunction with a standard audio amplifier and output meter to measure the contact potentials of rubber and GR-S both compounded and uncompounded and also certain compounding ingredients. The electrostatic lines of force established between the charged specimen and the grid of the amplifier are cut or modulated at audiofrequency by a motor-driven fan, the resulting a.c. voltage being amplified and measured on the output meter. The device is used in conjunction with a mirror-surfaced metal plunger system for contacting the rubber samples. Contact potential data are given which bear out the formulation of an electrostatic contact potential theory of reinforcement in which the reinforcement is explained on the basis of contact potentials and the resultant electrostatic attractive forces which exist between the rubber and the reinforcing agent. Organic materials having a highly positive charge (e.g. polymerized trimethyldihydroquinoline, and Flectol H, an acetone-aniline condensation product) have been found to increase the tensile strength of GR-S pure gum type compounds as much as fivefold and nearly to double the tensile strength of high zinc-oxide loaded GR-S compounds. L. S. G.

537.224 1826

On the experiment of the dissectible condenser. GROSS, B. *Amer. J. Phys.*, 12, *pp.* 324–329, *Dec.*, 1944.—[See Abstr. 2599 (1944)]. The principles underlying Franklin's experiment with the dissectible capacitor are discussed. Contrary to common belief, the positive result of this experiment has no bearing on the location of the energy of the electric field, nor is it connected with the so-called anomalous behaviour of dielectrics. The true explanation is that the phenomenon is caused by leakage of charge from the plates to the surface of the dielectric, and the mechanism is similar to the permanent polarization of Eguchi's electret. A. M. T.

537.224 1827

Observations and experiments on condensers with removable coats. ZELENY, J. *Amer. J. Phys.*, 12, *pp.* 329–339, *Dec.*, 1944.—The spark obtained from a highly charged dissectible capacitor after it has been taken apart and reassembled is dependent, in the main, upon charge getting from the charged coat to the surface of the glass dielectric. When the glass is dry, a positive result is not obtained unless the charging potential exceeds 3 000 V, but in humid conditions where the glass will possess appreciable surface conductivity, transfer of charge occurs at low charging potentials. In the dry condition, the charge passes from the metal coating to the glass by disruptive discharges across the air gaps as may be demonstrated by use of Lichtenberg figures and luminous effects. A. M. T.

537.226 : 621.3.011.5 : 621.315.616.95 1828

The dielectric properties of dammar and mastic resins. BHATTACHARYA, G. N. *Indian J. Phys.*, 18, *pp.* 159–171, *June*, 1944.—[Abstr. 1520 B (1945)].

537.226 : 621.3.011.5 : 621.315.616.95 1829

The dielectric dispersion of a few natural resins in non-polar solvents. BHATTACHARYA, G. N. *Indian J. Phys.*, 18, *pp.* 192–197, *June*, 1944.—[Abstr. 1521 B (1945)].

537.226.1 : 539.133 = 82 *see Abstr.* 1923

537.226.2 1830

The dielectric properties of β-lactoglobulin in aqueous glycine solutions and in the liquid crystalline state. SHAW, T. M., JANSEN, E. F., AND LINEWEAVER, H. *J. Phys. Chem.*, 12, *pp.* 439–448, *Nov.*, 1944.—The permittivity ε' and loss factor ε'' of solutions of β-lactoglobulin (L) in aq. 0·48, 1·5, and 2·5 molar glycine, and the permittivity of β-lactoglobulin liquid crystals were measured between 0·01 and 5·0 Mc/s. The data show a broader frequency range of dispersion and absorption and a smaller value of ε''_{max} than is predicted by the Debye theory for a system characterized by a single relaxation time. The disparity between the experimental data and the Debye theory increased with the concentration of L. Permittivities for zero and infinite frequencies were obtained by the Cole circular-arc method of extrapolation. The frequency dependence of ε' and ε'' is well represented by the empirical equation of Cole and Cole. The relaxation time varied from 7·5 to 25×10^{-8} sec. for a change in L conc. of 3·5 to 94·0 g./l. The dipole moment is estimated to be $790 \pm 26 \times 10^{-18}$ e.s.u.

537.226.8 1831

On permanent charges in solid dielectrics. I. Dielectric absorption and temperature effects in carnauba wax. GROSS, B., AND DENARD, L. F. *Phys. Rev.*, 67, *pp.* 253–259, *April* 1 *and* 15, 1945.—Isothermic and non-isothermic current/time curves are measured. It is shown that a considerable part of the absorbed charge can be frozen in, if the temperature is reduced to a value sufficiently inferior to that prevailing during the charging period before the system is short-circuited. The frozen charge dissipates extremely slowly, if the temperature is kept low, but it is liberated rapidly if the temperature is raised again. The effect is explained by the increase of the charging and discharging rates with increasing temperature. It is closely related to the permanent moment of the electret.

537.228.1 : 541.57 1832

Calculation of the piezo-electric effect in ionic lattices of the zinc-blende type. JAFFE, H. *Proc. Amer. Phys. Soc., Cleveland, Ohio, Sept.* 11–12, 1944. *Abstr. in Phys. Rev.*, 66, *pp.* 357–358, *Dec.* 1 *and* 15, 1944.—The ratio, r, of piezo-electric polarization to applied shearing strain is calculated for an ionic crystal of the zinc-blende structure type on the assumption that the applied shearing strain will leave the distance between nearest-neighbour ions unchanged. This completely determines the relative displacement between positive and negative ions: the resultant polarization is $P_z = rx_y = ne/a^2 \,.\, x_y$, where ne is the charge per ion and a the lattice constant. ZnS ($a = 5{\cdot}43$ Å), $r = 1{\cdot}08$ coulomb/m². for $n = 2$. The polarity of the observed effect agrees with the derivation for the ionic lattice.

537.228.1 : 548.0 1833

Piezo-electric constants of crystals—group-theoretical treatment. SAKSENA, B. D. *Indian J. Phys.*, 18, *pp.* 177–181, *June*, 1944.—A simple method, based on the theory of groups, for obtaining the number of piezo-electric constants and their relations for all classes of crystal symmetry is given. Piezo-electric moduli and constants are third order tensors. The piezo-electric moduli which connect the components of the stress tensor with those of the electric moment vector are 18 in number. The transformation matrix is given, and gives rise to 18 equations giving the relation between the various moduli. The number of piezo-electric coefficients for various point groups is obtained. The effect cannot exist in crystals having a centre of symmetry, and in cubic crystals belonging to point group 0 with no centre of symmetry. A. J. M.

537.29 : 541.182.5 : 535.515 1834

Electrical anisotropy of xerogels of hydrophile colloids. II. SHEPPARD, S. E., AND NEWSOME, P. T. *J. Chem. Phys.*, 12, *pp.* 513–519, *Dec.*, 1944.—An improved, though still relative, quantitative expression is derived for the electrical anisotropy (E. A.). The E. A. is a linear function of the elongation up to a certain limit, as is also the optical birefringence. The relation of electrical to optical anisotropy is studied in greater detail. A discussion in terms of atomic model structures is given of the hypothesis that E. A. in the compounds studied is due to the formation of continuous parallel chains of H bridges, having electronically conducting character. The materials studied were: polyvinyl acetate and its hydrolysed stages down to polyvinyl alcohol, cellulose acetate and its hydrolysed stages down to (hydrate) cellulose. [See Abstr. 2046 (1944)].

537.311.33 1835

Semi-conducting properties of stannous sulphide. ANDERSON, J. S., AND MORTON, M. C. *Nature, Lond.*, 155, *p.* 112, *Jan.* 27, 1945.—[See Abstr. 2359 (1943)].

537.311.33 : 621.314.632 : 549.214 1836

The rectifying property of carborundum. KENDALL, J. T. *Metrop.-Vick. Gaz.*, 21, *pp.* 17–20, *Jan.*, 1945.—[See Abstr. 1120 (1944)].

537.311.33 : 621.396.822 1837

Voltage fluctuations in semi-conductors. DAVYDOV, B., AND GUREVICH, B. *J. Phys., U.S.S.R.*, 7, 3, *pp.* 138–140, 1943.—In the absence of applied p.d., the voltage fluctuation is given by the well-known formula for the Johnson effect. With applied p.d. it increases as the square of the current. The results are confirmed by experimental data. E. R. A.

537.311.4 : 621.316.86 1838

Resistance of carbon to carbon contact. PIETENPOL, W. B., AND WALZ, F. C. *Proc. Amer. Phys. Soc., New York, Jan.*, 1945. *Abstr. in Phys. Rev.*, 67, *p.* 201, *March* 1 *and* 15, 1945.—[Abstr. 1555 B (1945)].

537.312 1839

Resistance of liquid and solidified selenium. BORELIUS, G., PIHLSTRAND, F., ANDERSSON, J., AND GULLBERG, K. *Ark. Mat. Astr. Fys.*, 30*A*, *No.* 14, 30 *pp.*, 1944.—Experiments are described for measuring the resistance and its variation with temperature. Full practical details are recorded together with the

following results. The specific resistance (ρ) is related to the temperature (T) by the formula $\log \rho = A + B/T$ where A and B are constants depending upon the state of the Se. For pure liquid Se, A varies between 0 and -6 while B varies from 2 500 to 7 000, there being an approx. relation $A = 4 - B/600$. This relation is not disturbed when certain impurities are added to the liquid although the values of A and B alter. If molten Se is kept for some days in a vertical tube, it becomes inhomogeneous, B attaining lower values near the bottom. The above results for liquid Se are explained on the hypothesis that molten Se is often a mixture of 2 structurally different forms, a heavier one with a low value of B and a lighter one with a higher value of B. The properties of liquid Se are similar to those of liquid S. Rapid cooling of liquid Se (with high values of B) to room temperature gives vitreous Se of very high resistance. L. S. G.

537.312 : 537.323 1840

Thermo-electric power of liquid and solidified selenium. Borelius, G., and Gullberg, K. *Ark. Mat. Astr. Fys.*, 31*A*, *No.* 17, 10 *pp.*, 1945.—A continuation of a previous paper [Abstr. 1839 (1945)]. Apparatus is described for measuring the thermo-electric power and results are reported relating to (i) liquid Se, (ii) fine crystalline spherolite Se, and (iii) coarse-grained crystalline Se_2. In the latter case there is good agreement with previous work by Hochberg and Sominski [Abstr. 3814 (1938)], and the results agree with the theory (e.g. Wilson's theory of semi-conductors). L. S. G.

537.312 = 3 1841

On extremely dehydrated gelatin foils and their electric conductivity. Gombay, L. *Kolloid Z.*, 100, *pp.* 350–355, *Sept.*, 1942.—As the photo-electric properties of gelatin dyestuff phosphors [Abstr. 1967 (1943)] are strongly influenced by the water content of the gelatin, the dehydration of gelatin foils in vacuo and by heating was investigated. Part of the water (capillary water) is loosely bound and its amount is not dependent on the foil thickness; the rest (colloidal water) is strongly bound to the gelatin and is only slowly removed by dehydration, especially from the interior layers of the foil. Dehydration in vacuo is reversible; dehydration by heating is irreversible and is accompanied by a change of structure. The conductivity of gelatin foil decreases markedly with increasing dehydration, particularly on the removal of the capillary water. A current flowing through gelatin freed from capillary water produces a charge which is rapidly neutralized by a polarization current. R. N.

537.312.62 1842

On the theory of the intermediate state of superconductors. Landau, L. *J. Phys., USSR*, 7, 3, *pp.* 99–107, 1943.—A quantitative analysis of the laminar structure of the superconductor in the intermediate state is given. The behaviour of the superconductor with a transversal slit in magnetic field is investigated. An explanation of the hysteresis effect in the transition to the intermediate state is advanced. E. R. A.

537.312.8 1843

The spontaneous magnetization and electrical resistance of the alloy Ni_3Mn. Komar, A. *J. Phys., USSR*, 7, 5, *pp.* 229–234, 1943.—In the case of Ni_3Mn and NiMnFe, the difference between the electrical resistance of disordered alloys and partly ordered ones has a linear dependence on the energy of the spontaneous magnetization. A short critical review is given of the literature concerning the question of the connection between the electrical resistance and the real magnetization of metals and alloys. E. R. A.

537.323 : 537.312 *see Abstr.* 1840

537.521.7 = 4 1844

Contribution to the problem of the concentration of the discharge channel. Szpor, S. *Receuil trav. sci. Polonais internés en Suisse*, 2, 10 *pp.*, 1944.—A brief general discussion is presented of the various physical phenomena occurring in a leader channel which affect the concentration or dispersion of the discharge channel, both the axial and radial macroscopic distribution of electrons and positive ions at the tip and along the stem of the discharge channel being considered. The photoelectric effect on the concentration of the pilot streamer is emphasized. A mathematical treatment of the electromagnetic and electrostatic terms, involving a number of assumptions, leads to the conclusion that electromagnetic effects are responsible for the concentration of the final channel and, to a certain extent, of the leader channel of the lightning stroke but not of the ordinary spark discharge. R. H. G.

537.525.5 1845

The continuum at the mercury arc cathode. Smith, C. G. *Proc. Amer. Phys. Soc., New York, Jan.*, 1945. *Abstr. in Phys. Rev.*, 67, *p.* 201, *March* 1 *and* 15, 1945.—Micro-photographs of the arc spot on a quiescent Hg surface were secured by employing an arc gliding lengthwise over a long bead of Hg held between magnetic poles in a vacuum. The arc moved in the characteristic retrograde direction. The photographs show a well delineated source of light in the Hg surface or within 0·0005 cm. of it, the intensity of which greatly exceeds that anywhere in the plasma. The continuous spectrum originates only at the cathode and doubtless comes from within the liquid from the electronically excited region that gives rise to the electron emission of the apparently cool Hg [see Abstr. 187 (1943)].

537.525.5 : 621.314.65 1846

Stability of low-pressure mercury arcs as a function of current. Copeland, P., and Sparing, W. H. *J. Appl. Phys.*, 16, *pp.* 302–308, *May*, 1945.—[Abstr. 1505 B (1945)].

537.525.8 : 535.215 1847

Production of the eigat- (light-) effect under X-rays. Joshi, S. S. *Curr. Sci.*, 13, *p.* 278, *Nov.*, 1944.

537.53 1848

Evidence for the production of a non-ionizing radiation other than neutrons and gamma-rays by 10 eMV deuterons. Groetzinger, G., Kruger, P. G., and Smith, L. *Proc. Amer. Phys. Soc., New York, Jan.*, 1945. *Abstr. in Phys. Rev.*, 67, *pp.* 202–203, *March* 1 *and* 15, 1945.—An arrangement of 2 G-M counters in coincidence shielded by various thicknesses of Pb up to 19 cm. thickness was used to investigate non-ionizing radiations produced by a cyclotron. The cyclotron was enclosed by watertanks of 120 cm. thickness. Electrons were found of

energies >5 eMV; their number as a function of the Pb thickness indicates that they are produced by a radiation far more penetrating than γ-rays.

537.531 : 535.338 : 539.17 1849

Adaptation of the Cauchois spectrograph to artificial radioactive sources. EDWARDS, J. E., POOL, M. L., AND BLAKE, F. C. *Phys. Rev.*, 67, *pp.* 150–152, *March* 1 *and* 15, 1945.—The usual X-ray methods for determining the wavelength of X-rays from radioactive materials are difficult to use because of the low intensity of the rays. It has been found possible to use the Cauchois curved crystal spectrograph for the purpose. Mica and quartz crystals were used, the mica being the more efficient for the shorter wavelengths (0·8 to 0·2 Å). The method was applied to the investigation of the 12·8 hr. activity of Cu^{64}, the 2·7 day activity of In^{112} and the 6·7 hr. activity of $Cd^{107, 109}$. In the last case it is confirmed that no Cd lines or general radiation are emitted, but the X-rays are those characteristic of Ag. A. J. M.

537.531 : 535.338.3 1850

The adaptation of the Cauchois spectrograph to artificial radioactive sources. EDWARDS, J. E., POOL, M. L., AND BLAKE, F. C. *Proc. Amer. Phys. Soc., Chicago, Dec.* 1 *and* 2, 1944. *Abstr. in Phys. Rev.*, 67, *p.* 60, *Jan.* 1 *and* 15, 1945.—Quartz and mica crystals were used in the transmission type curved-crystal spectrograph to photograph characteristic $K\alpha$ and $K\beta$ X-ray lines from radioactive sources. Quartz crystals were most efficient from 0·7–1·9 Å. Mica crystals proved to be more efficient for 0·36–1 Å. Spectrographs with curvatures of 8 in. and 15 in. were used with both mica and quartz crystals. Broad sources resulting from chemical separations may be used. Line sharpness is decreased by the broad source but the $K\alpha$ lines of 2 neighbouring elements are easily identified. The characteristic Ag X-rays associated with the decay of 6·7 hr. $Cd^{107, 109}$ were photographed with a mica spectrograph. The Ni X-rays associated with the decay of Cu^{64} were identified with a quartz spectrograph.

537.531 : 535.338.33 1851

The Cu *K* absorption edges of the cuprous halides. BEEMAN, W. W., FORSS, J., AND HUMPHREY, J. N. *Phys. Rev.*, 67, *pp.* 217–222, *April* 1 *and* 15, 1945.—The X-ray *K* absorption edges of Cu in crystalline CuCl, CuBr, and CuI were measured with a double crystal spectrometer. Near the edge the experimental curves are analysed into component absorption lines. The most intense absorption max. is due to excitation of the *K* electron into the 4*p* level of the absorbing ion. However, the line structure is too complex to be completely explained by the unperturbed optical levels of Zn^+ or by any perturbation of these levels arising from crystalline fields. It is suggested that the excited electron is shared with neighbouring ions even in the lowest states.

537.531 : 535.43 1852

Low angle X-ray scattering. FANKUCHEN, I., AND JELLINEK, M. H. *Proc. Amer. Phys. Soc., New York, Jan.*, 1945. 2 *Abstr. in Phys. Rev.*, 67, *p.* 201, *March* 1 *and* 15, 1945.—Two single crystals were used, one as a monochromator and the other as an analyser. The specimen is placed between the two crystals and a Geiger counter circuit is used to record the X-ray intensity as a function of the setting of the analysing crystal.

537.531 : 535.435 : 517.512.2 1853

Some improvements in practical Fourier analysis and their application to X-ray scattering from liquids. DANIELSON, G. C., AND LANCZOS, C. *J. Franklin Inst.*, 233, *pp.* 365–380, *April, and pp.* 435–452, *May*, 1942.—In harmonic analysis the practical evaluation of the Fourier coefficients is facilitated by the use of a matrix scheme, all the cosine coefficients being evaluated by one matrix and all the sine coefficients by another. Examples of the method are given. It is shown that by a certain transformation process it is possible to double the number of ordinates with only slightly more than double the labour. This is a valuable feature. The times taken for Fourier analyses are approx. 10 min. for 8 coefficients, 25 min. for 16 coefficients, 60 min. for 32 coefficients and 140 min. for 64 coefficients. A method is given for testing the convergence of the Fourier Series and an application is made to the X-ray analysis of molten LiCl. The results are in very good agreement with those previously obtained. L. S. G.

537.531 : 548.55 1854

Double Bragg reflections of X-rays in a single crystal. DAVISSON, C. J., AND HAWORTH, F. E. *Phys. Rev.*, 67, *p.* 120, *Feb.* 1 *and* 15, 1945.

537.531.8 : 539.172 1855

The nuclear excitation of silver and cadmium. WIEDENBECK, M. L. *Phys. Rev.*, 67, *pp.* 92–97, *Feb.* 1 *and* 15, 1945.—The X-ray and electron excitation of Ag and Cd is studied in the region from their thresholds to 3·3 eMV. The thick-target X-ray excitation curve for Ag shows the threshold to be $1{\cdot}18 \pm 0{\cdot}03$ eMV and higher activation levels are found at 1·59, 1·95, 2·32, 2·76, and 3·13 eMV, respectively. The half-life of the metastable state of Ag is $40{\cdot}4 \pm 0{\cdot}2$ sec. Both the thick-target X-ray excitation curve and the electron excitation curve for Cd indicate that the threshold for these processes is $1{\cdot}25 \pm 0{\cdot}03$ eMV while other activation levels are found at 1·68, 2·08, and 2·56 eMV. The energy of the metastable level of Cd, as determined from data on the absorption in Al of the conversion electrons emitted in the process, is 195 ekV and the half-life of the metastable level is $48{\cdot}7 \pm 0{\cdot}3$ min.

537.531.85 1856

Note on the influence of damping on the Compton scattering. POWER, S. C. *Proc. R. Irish Acad.*, 50*A*, 8, *pp.* 139–142, *Jan.*, 1945.—The quantum treatment of the influence of the damping leads to an integral equation whose solution was recently obtained by Wilson [Abstr. 2402 (1941)]. The latter's method is criticized and a new method is given which involves the expansion of the solution according to powers of e^2. Wilson's result that, contrary to classical expectation, the damping has a negligible influence, is however confirmed. L. S. G.

537.531.85 : 539.156 *see Abstr.* 1938

537.531.9 : 539.172 *see Abstr.* 1963

537.533 1857

A theorem of Larmor and its importance for electrons in magnetic fields. BRILLOUIN, L. *Phys. Rev.*, 67, *pp.* 260–266, *April* 1 *and* 15, 1945.—The importance of a well-known theorem, originally due to Larmor,

is emphasized. It enables a definition of "momentum" and "moment of momentum" for electrons in a magnetic field, hence the possibility of writing the conservation of these quantities when the geometry of the structure is convenient. As examples of the method, two special cases are discussed: a plane electron beam and a cylindrical electron beam with longitudinal magnetic field. In both cases it is found that the space-charge density of the beam is entirely controlled by the magnetic field and that the max. current is obtained for a suitable optimum magnetic field.

537.533.72 : 591.86 *see Abstr.* 2059

537.533.72 : 616.314 1857a

Study of tooth structures with the electron microscope. GEROULD, C. H. *Proc. Electron Microscop. Soc. Amer., Chicago, Nov.*, 1944. *Abstr. in J. Appl. Phys.*, 16, *p.* 264, *April*, 1945.—A description of the preparation of tooth surfaces is given with the various steps in the preparation of the final silica replica film. A method is described to enable one to recognize better specific tooth regions in the electron microscope. A brief discussion is included on the interpretation of electron micrographs of tooth structures using either qualitative or quantitative stereoscopy.

537.533.72 : 621.3.012.8 1858

Computation of electron trajectories in electrostatic lenses of rotational and plane symmetry. ZLOTOWSKI, I., AND PREBUS, A. F. *Proc. Amer. Phys. Soc., New York, Jan.*, 1945. *Abstr. in Phys. Rev.*, 67, *p.* 203, *March* 1 *and* 15, 1945.—Network analysis is applied to the specification of the cardinal points of electrostatic lenses. The advantages of this method of numerical integration of the lens trajectory equation are shown by comparing it with other methods currently in use. The requisite axial potential distributions of the lenses are obtained from accurate electrolytic trough measurements. Data of practical value are provided which show the dependence of optical properties on electrode parameters of some familiar types of electrostatic lenses. The inverse problem of determining the axial potential distributions corresponding to a given trajectory is investigated.

537.533.72 : 621.3.012.8 : 621.3.09 1859

The application of network analysis to some electron-optical problems. PREBUS, A. F., ZLOTOWSKI, I., AND KRON, G. *Proc. Amer. Phys. Soc., New York, Jan.*, 1945. *Abstr. in Phys. Rev.*, 67, *p.* 202, *March* 1 *and* 15, 1945.—By suitable correlation of the variables, the trajectory equation

$$\phi(z)\cdot\frac{d^2r}{dz^2}+\tfrac{1}{2}\phi'(z)\cdot\frac{dr}{dz}+\tfrac{1}{4}\left[\phi''(z)+\frac{e}{2mc^2}H^2(z)\right].r=0$$

of an electron lens may be identified with the differential equation describing the dependence of the voltage distribution upon the impedance characteristics of a simple type of ideal inhomogeneous transmission line. By choosing the specific impedances as functions of the independent variable z and the parameters $H(z)$ and $\phi(z)$, the values of the dependent variable $r(z)$ correspond to voltages along the line. The equivalent network provides a rapid means of obtaining accurate numerical solutions of the trajectory equation.

537.533.72 : 621.385.833 1860

The second meeting of the Electron Microscope Society of America. *Proc. Electron Microscop. Soc. Amer., Chicago, Nov.*, 1944. *J. Appl. Phys.*, 16, *pp.* 263–266, *April*, 1945.—A symposium of papers with the following titles: Two new RCA electron microscopes, Smith, P. C., and Picard, R. G.; A discussion of the illumination in the electron microscope, Hillier, J., and Baker, R. F.; Magnification calibration of electron microscopes, Matheson, L. A., and Heidenreich, R. D. [Abstr. 1650 B (1945)]; Chemical electron microscopy, Phelps, R. T., Langer, A. L., and Gulbransen, E. A. [Abstr. 2038 (1945)]; Examination of resin-treated fibres with the electron microscope, Reynolds, D. H., and Rich, J. A. [Abstr. 1974 (1945)]; A pigment dispersion method for electron microscopy, O'Brien, H. C., Jr. [Abstr. 2022 (1945)]; Techniques useful with pigmented rubber cements, Willisford, L. H. [Abstr. 2023 (1945)]; Electron microscope studies of catalysts, Turkevich, J. [Abstr. 2015 (1945)]; Structure of certain muscle fibrils as revealed by the use of electron stains, Hall, C. E., Jakus, M. A., and Schmitt, F. O. [Abstr. 2059 (1945)]; Fine structure in the fibre-axis macroperiod of collagen fibrils, Schmitt, F. O., Hall, C. E., and Jakus, M. A. [Abst.. 1975 (1945)]; Study of tooth structures with the electron microscope, Gerould, C. H. [Abstr. 1857a (1945)]; Thin-section technique for electron microscopy, O'Brien, H. C., Jr., and McKinley, G. M. [Abstr. 1651 B (1945)]; Types of morphology found in bacterial viruses, Anderson, T. F., Delbruck, M., and Demerec, M. [Abstr. 2047 (1945)]; On the artifacts produced by the use of distilled water as an intermediate medium in the mounting of bacterial specimens for the electron microscope, Hillier, J., and Kurkjian, A. [Abstr. 2048 (1945)]; Electron microscopy of some animal viruses, Sharp, D. G., Taylor, S. R., McLean, I. W., Jr., Beard, D., and Beard, J. W. [Abstr. 2049 (1945)]; Observations on the structure of pyocyaneus bacteriophage, Schultz, E. W., Thomassen, P. R., and Marton, L. [Abstr. 2050 (1945)]; Observations of bulges on acetobacter, Gray, C. H., Marton, L., and Tatiun, E. L. [Abstr. 2046 (1945)]; An unfamiliar pattern of bacteria morphology, Smith, W. E., and Mudd, S. [Abstr. 2045 (1945)]; Availability of electron micrograph for instruction in microbiology, Morton, H. E. [Abstr. 2051 (1945)]; Electron diffraction, Brockway, L. O. [Abstr. 1861 (1945)]; General electric electron diffraction apparatus, Bachman, C. H. [Abstr. 1652 B (1945)]; Crystal interference phenomena in electron microscope images, Heidenreich, R. D., and Sturkey, L. [Abstr. 2029 (1945)]; Further developments on the electron micro-analyser, Hillier, J., and Baker, R. F.; Study of age-hardening alloys with the electron microscope using formvar replicas, Cu–Be and Fe–Mo, Harker, D. [Abstr. 1777 B (1945)]; Correlation of MgO particle-size determination by electron microscope and X-ray diffraction, Birks, L. S., and Friedman, H. [Abstr. 2030 (1945)]; A modified replica technique applied to the study of organic and inorganic surfaces, Barnes, R. B., Burton, C. J., and Scott, R. G. [Abstr. 1653 B (1945)]; On the silica replica technique with the electron microscope, Baker, R. F., and Nicoll, F. H.; Polaroid vectographs for use in electron microscopy, Hord, P. E.

537.533.73 1861

Electron diffraction. BROCKWAY, L. O. *Proc. Electron Microscop. Soc. Amer., Chicago, Nov.*,

1944. *Abstr. in J. Appl. Phys.*, 16, *p.* 265, *April*, 1945.

537.533.74 : 530.12 1862

The scattering of fast β-particles by electrons. KAR, K. C., AND BASU, C. *Indian J. Phys.*, 18, *pp.* 223–242, *Aug.*, 1944.—A general relativistic treatment is given of the problem of collision of 2 particles of unequal masses, one being initially at rest, and general expressions connecting energies, momenta and angles of deflection, in C- and L-systems are derived. The relativistic wave statistical formula for the intensity of electron-electron scattering is derived. It is shown to be in better agreement than Möller's with the experiment of Champion. A general relativistic theory of scattering for unequal masses is developed.

537.533.74 : 539.165 1863

A convenient method of measuring the intensity of nuclear scattering of fast β-particles in the cloud chamber. O'CEALLAIGH, C., AND MACCÁRTHAIGH, M. D. *Proc. Roy. Irish Acad.*, 50*A*, 3, *pp.* 13–27, *July*, 1944.—The stereoscopic reprojection method previously used for determining the scattering angle, θ, is replaced by a more convenient and rapid method. This consists in measuring, not θ, but the projection, ϕ, of θ upon a plane at right angles to the optic axis of the camera. This method was previously used [Abstr. 4671 (1938)] without the help of a proper mathematical analysis. The latter is now provided. The problem solved is: given a theoretical scattering formula, $P(\theta)d\theta$, for the probability that an electron will be scattered once through an angle lying between θ and $\theta + d\theta$, to find the corresponding formula $P(\phi)d\phi$. The advantages of the new method (e.g. accuracy) are discussed. L. S. G.

537.533.8 1864

Absolute *K*-ionization cross-section of the nickel atom under electron bombardment at 70 kV. SMICK, A. E., AND KIRKPATRICK, P. *Phys. Rev.*, 67, *pp.* 153–161, *March* 1 *and* 15, 1945.—Ni sheets approx. 5×10^{-6} cm. thick were bombarded with 70 kV electrons and the intensity of the resulting $K\alpha$ radiation was measured by a special air-filled ionization chamber connected to a calibrated quadrant electrometer. Isolation of the $K\alpha$ line was effected by Ross filters of Co and Fe, supplemented by additional filters for evaluation of a correction for the continuous background radiation. After due consideration of the effects of electron scattering in the target and all relevant X-ray absorptions, it was concluded from the observed intensities that the cross-section of the Ni atom for *K* ionization by 70 kV electrons is $(3{\cdot}38 \pm 0{\cdot}2) \times 10^{-22}$ cm.^{2} From this result and Williams' equation for electron energy loss, it is deduced that the efficiency of production of Ni *K*-radiation by electrons of 70 ekV energy is 0·35%.

537.533.8 1865

Pair electrons formed in the field of an electron. OGLE, W. E., AND KRUGER, P. G. *Phys. Rev.*, 67, *pp.* 282–285, *May* 1 *and* 15, 1945.—The observation of pair electrons which were formed in the field of an electron is reported. These triplets were photographed in a cloud chamber which was irradiated with γ-rays from radioactive Na. Measurements on the tracks of the triplets show that energy and momentum are conserved in the process.

537.533.8 : 537.583 1866

Enhanced thermionic emission. JOHNSON, J. B. *Phys. Rev.*, 66, *p.* 352, *Dec.* 1 *and* 15, 1944.—A new type of electron emission from oxide-coated thermionic cathodes is disclosed. The target is bombarded by primary electrons from a gun in which the high voltage electron stream can be turned on by a small auxiliary voltage. Emission which persists after the end of the bombardment is of thermionic origin; it varies with the temperature of the target and increases with bombarding voltage and current density.

537.533.8 = 82 1867

Investigation of the auto-electronic emission of thin dielectric films. ZERNOV, D. V., ELINSON, M. I., AND LEVIN, N. M. *Bull. Acad. Sci. USSR, Dep. Tech. Sci., No.* 3, *pp.* 166–181, 1944.—Experiments on secondary emission from Al, Al_2O_3, Cs_2O and MgO provide curves of characteristics and oscillograms of the secondary current under various conditions. Preparation of the elements, experimental lay-out and incidental optical phenomena are described.

E. R. A.

537.534.72 1868

The electron optics of mass spectrographs and velocity focusing devices. HUTTER, R. G. E. *Phys. Rev.*, 67, *pp.* 248–253, *April* 1 *and* 15, 1945.—The well-known results of the theory of mass spectrometers and velocity focusing devices are derived again by a different method which is simpler than the ones previously used and which brings out more clearly the electron optical nature of the deflecting and focusing properties of the fields employed.

537.534.74 : 539.185.9 1869

High-energy neutron-proton scattering and the saturation problem. HULTHÉN, L. *Phys. Rev.*, 67, *pp.* 193–194, *March* 1 *and* 15, 1945.

537.534.9 : 539.185 : 539.152.1 *see Abstr.* 1932

537.56 : 551.594.12 1870

Charge neutralization by atmospheric ions. POLLARD, W. G. *Proc. Amer. Phys. Soc., New York, Jan.*, 1945. *Abstr. in Phys. Rev.*, 67, *p.* 203, *March* 1 *and* 15, 1945.—The neutralization of an insulated, charged, conducting object immersed in a neutral ion atmosphere in which the mobilities of both ions are constant and independent of the field is considered. The object becomes surrounded by an opposite ion sheath whose volume increases exponentially with time to a limiting value just sufficient to have contained a charge at the original plasma density equal and opposite to that initially carried by the object. The total charge in the sheath increases to a maximum and then drops to zero. The sum of the sheath and object charges decays exponentially but individually they are more complex functions of time. In the plasma the density of both kinds of ion remains constant at its initial value and the field is that which would be produced by the object if it carried the sheath charge in addition to its own. A general solution for the field and charge density in the sheath as functions of position and time which join continuously with the plasma values over the moving sheath boundary is obtained.

537.568 1871

The equilibrium of small ions and nuclei. NOLAN,

P. J., AND GALT, R. I. *Proc. R. Irish Acad.*, 50*A*, 5, *pp.* 51–67, *Sept.*, 1944.—Experiments are described on the equilibrium of small ions in air containing condensation nuclei [Abstr. 2575 (1943)]. A large vessel is used so that the diffusion correction (obtained from a previous experiment using the same vessel and pure air) is small. The equilibrium equation $q = \alpha n^2 + bnZ$ is verified and it is found that b increases with the age of the nuclei. The values of b for small positive and negative atmospheric nuclei aged 0–3 hr., are $3{\cdot}4 \times 10^{-6}$ and $4{\cdot}3 \times 10^{-6}$ respectively. After 48 hr. these become $8{\cdot}4 \times 10^{-6}$ and $9{\cdot}2 \times 10^{-6}$. Values of the recombination coefficients are deduced for small ions and nuclei (charged and uncharged). Evidence is obtained for the validity of both the Nolan, de Sachy and the Whipple formulae. The effect of multiply charged nuclei on the equilibrium of ionization is discussed. The values of b for some flame nuclei (coal gas and methylated spirits) are determined, the extreme values being $14{\cdot}6 \times 10^{-6}$ and $1{\cdot}8 \times 10^{-6}$. L. S. G.

537.583 1872

An investigation of short-time thermionic emission from oxide-coated cathodes. SPROULL, R. L. *Phys. Rev.*, 67, *pp.* 166–178, *March* 1 *and* 15, 1945.—Valve circuits were developed to measure thermionic current as a function of time for times ranging from 0·2 to 300 μsec. The decay with time of the temperature-saturated electron emission from oxide-coated cathodes was observed. Simultaneously with the application of anode voltage to an experimental diode, the thermionic c.d. rose to an initial value and subsequently decayed to a steady value 1/5 to 1/15 of the initial value. The rate of decay was ∝ the c.d., the decay requiring about 20 μsec. at 1 200°K. and about 500 μsec. at 900°K. The initial current exhibited a greater anode-voltage effect than did the steady-state current. The range of decay was independent of the thickness of cathode coating over the region 1 to 30 mg. of oxide per cm². An electrolytic conduction hypothesis of the decay process is proposed. The form of the observed current as a function of time agreed with the form predicted by this theory. The observed rate of decay, as interpreted on the basis of the electrolytic conduction hypothesis, indicated that within a single crystal of BaO or SrO between 0·05 and 0·5 of the total conduction current is ionic. The possible connection of this decay and the flicker effect is noted.

537.583 : 537.533.8 *see Abstr.* 1866

537.591 1873

Committee on co-ordination of cosmic-ray investigations. FLEMING, J. A. *Terr. Magn. Atmos. Elect.*, 49, *pp.* 251–253, *Dec.*, 1944.

537.591 1874

Committee on co-ordination of cosmic-ray investigations. Progress report for the period July 1943 to June 1944. *Carnegie Instn Yearb.*, 43, *pp.* 53–64, 1943–1944.—[See Abstr. 2204 (1944) and 1873 (1945)].

537.591 = 4 1875

On the average life of mesons of cosmic radiation. OPECHOWSKI, W. *Physica, 's Grav.*, 10, *pp.* 473–480, *July*, 1943.—It is pointed out that the average life (τ) of a meson at rest, determined directly, differs from that determined from the ratio τ/μ where μ is the rest mass of the meson. An explanation of this is given. The disparity disappears if it is assumed that the penetrating component of cosmic radiation contains, besides mesons having $\tau = 1{\cdot}5 \times 10^{-6}$ sec., considerable quantities of particles which are probably mesons with a much greater average life ($>10^{-3}$ sec.). Evidence is given for the existence of such particles. L. S. G.

537.591.1 1876

Further studies on the origin of cosmic rays. Helium annihilation rays and the cause of their variability with time. MILLIKAN, R. A., NEHER, H. V., AND PICKERING, W. H. *Phys. Rev.*, 66, *pp.* 295–302, *Dec.*, 1944.—Evidence that a new band of rays interpreted as He annihilation rays come in vertically at about the predicted latitude is reported. The possible composite character of the so-called Si annihilation band and of the so-called oxygen annihilation band is discussed. An explanation of the cause of the large variability in the cosmic-ray intensities found in high-altitude electroscope flights in the U.S.A. is advanced. A new and more accurate determination of the value of the field sensitive and the non-field sensitive components of the incoming cosmic rays is made. [See Abstr. 2202 (1943)].

537.591.1 1877

The mesotron momentum spectrum at 4·35 km. altitude. HALL, D. B. *Phys. Rev.*, 66, *pp.* 321–325, *Dec.*, 1944.—The mesotron momentum spectrum was determined from the shape of the absorption curve in Pb as measured by G–M counter telescopes. A large number of low-energy mesotrons were found, resulting in a sharp max. of the momentum spectrum lying between 1 and 2×10^8 eV/c. A simple power law is not adequate to describe the spectrum in the entire region investigated.

537.591.1 1878

The energy spectrum of the primary cosmic radiation. KUSAKA, S. *Phys. Rev.*, 67, *pp.* 50–51, *Jan.* 1 *and* 15, 1945.—Experimental results [Abstr. 1840 (1942)] are compared with the theoretical calculations based on the geomagnetic theory of Lemaitre and Vallarta. The agreement is within the statistical error if the distribution in number of the primaries is taken to be a curve following the inverse-cube law for high energy and flattening out on the low-energy side at about 6 BeV.

537.591.1 1879

Investigation of bursts observed in two thin-walled ionization chambers. KINGSHILL, K. L., AND LEWIS, L. G. *Proc. Amer. Phys. Soc., Chicago, Dec.* 1 *and* 2, 1944. *Abstr. in Phys. Rev.*, 67, *p.* 62, *Jan.* 1 *and* 15, 1945.—Coincidences in time between bursts of ionization occurring in each of two thin-walled ionization chambers were measured at Chicago. The cumulative size frequency distribution curve for all bursts recorded in each chamber agrees with data obtained by previous investigators. The ratio of burst rates found at Echo Lake and at Chicago for bursts caused by 50 or more cosmic-ray particles was approx. 10 : 1. For bursts caused by more than 150 particles the corresponding ratio is 200 : 1. Since burst coincidence rates measured in two ionization chambers showed a similar altitude effect when the chambers were separated by a distance of 1 m., it can

be assumed that both the large single bursts and the coincidence bursts are caused by the same type of atmospheric shower. The rate of occurrence of burst coincidences was very small compared with the rate for bursts occurring in a single chamber. Provided that the cascade theory of showers is valid for electron energies $> 10^{13}$ eV, it is concluded that sea-level showers exhibiting such narrow high density regions cannot originate from primary electrons.

537.591.1 1880

Measurement of the specific ionization of fast mesotrons with an ionization chamber and a linear amplifier. DUNLAP, W. C., JR. *Phys. Rev.*, 67, *pp.* 67–73, *Feb.* 1 *and* 15, 1945.—The ionization of single cosmic-ray particles capable of penetrating 12 cm. of Pb was measured with an ionization chamber and a linear amplifier. Measurements made at 14·7 atm. with A indicate an average specific ionization of 71 ion pairs per cm. at N.T.P. The results apply to mesotrons with an energy $> 2 \times 10^8$ eV. The specific ionization of max. frequency of occurrence is approx. 67 ion pairs per cm. in A. The average value for the ionization obtained with the ionization chamber at 14·7 atm. is 10% less than the total ionization. The average value corresponds to the value 48 ion pairs per cm. in air at N.T.P. as measured by a method that includes only collisions involving 10^4 eV or less.

537.591.1 : 535.336.2 = 4 1881

On the determination of the mass of the charged particles of cosmic radiation. GORODETZKY, S. *Ann. Phys., Paris*, 19, *pp.* 5–70, *Jan.–March*, 1944.—The difficulties involved in an attempt to measure the mass by means of the mass spectrograph are discussed. The method of elastic collision with an electron may be used and this is discussed in detail, including the necessary quantitative analysis. A photograph is made of the collision which takes place in a Wilson cloud chamber, using a magnetic field. The mass is calculated by the use of purely geometric quantities (e.g. the radius of curvature of the path) obtained directly from the negative. The method has the advantage of using only a minimum number of assumptions: conservation of energy and momentum and the law relating to an electric charge moving in a magnetic field. For mesons, the mass obtained is $(240 \pm 20)m_0$ where m_0 is the rest-mass of the electron. This is compared with the results obtained by the ionization method. The conditions that favour a collision which permits a measurement of the mass are studied and the probability of obtaining such a collision is calculated. The general formulae are also applied to a collision between two electrons and some results (relating to a collision of a meson with an electron) are given which were obtained with a Wilson cloud chamber and the Bellevue magnet. The method may also be applied to the γ-radiation of ThC″. The ionization method for determining mass is discussed at some length. L. S. G.

537.591.15 1882

Showers of penetrating particles. SALA, O., AND WATAGHIN, G. *Phys. Rev.*, 67, *pp.* 55–56, *Jan.*, 1945.—Comparative studies of the showers indicate that when the particles pass through an absorber of H_2O, the latter acts as a source of secondary radiation. Groups of particles penetrating more than 30 cm. of Pb are produced in a layer of H_2O 80 cm. thick. Comparison of frequencies at altitudes of 1 750 and 750 m. shows that the shower producing radiation is rapidly absorbed in a layer of 1 000 m. of air. This radiation could not, therefore, be responsible for the production of penetrating particles under clay at a depth of 50 m. water equivalent, as formerly observed. Several types of showers of penetrating particles produced by different kinds of rays may exist. A. J. M.

537.591.15 1883

Extensive penetrating showers. JÁNOSSY, L., ROCHESTER, G. D., AND BROADBENT, D. *Nature, Lond.*, 155, *pp.* 142–143, *Feb.* 3, 1945.—It is suggested that extensive air showers are of two types: (1) large electron cascades, which may contain a few mesons (Auger showers), and (2) extensive penetrating showers with a large density of penetrating particles, probably accompanied by soft secondary particles. These results agree with experiments with an arrangement of counters. Extensive penetrating showers cannot be explained in terms of the theory of Hamilton, Heitler, and Peng. A. J. M.

537.591.15 1884

Study of cosmic-ray air showers with the method of coincident bursts in two unshielded ionization chambers. LEWIS, L. G. *Phys. Rev.*, 67, *pp.* 228–237, *April* 1 *and* 15, 1945.—Cosmic-ray bursts of ionization occurring in each of two unshielded, thin-walled ionization chambers were recorded simultaneously on a single piece of photographic film. This recording made it possible to study events in each chamber separately, and also to determine when a burst, occurring in one chamber, was coincident in time with a burst in the other. The graphic relation between the size of bursts and their frequency is given for a single chamber and for the coincident bursts. The relation, between burst coincidence frequency and separation of the chamber for several burst sizes, is given in a separate graph. A study of these sets of curves reveals the presence of many high-density cosmic-ray air showers of heretofore unsuspectedly small lateral spread. These showers cannot originate at the top of the atmosphere but must be a secondary phenomenon.

537.591.15 1885

Theoretical calculations on extensive atmospheric cosmic-ray showers. WOLFENSTEIN, L. *Phys. Rev.*, 67, *pp.* 238–247, *April* 1 *and* 15, 1945.—Large cosmic-ray showers in air, investigated with ionization chambers and coincidence counters, have been explained hitherto as originating from primary electrons of very high energy. In recent experiments at an altitude of 3 100 m., Lewis measured the frequency of coincident bursts in two unshielded ionization chambers. The theoretical cumulative frequency $H(P, D)$ of such coincidences is calculated as a function of the electron density P and the separation D of the chambers for this altitude and for sea level. The cumulative size-frequency distribution $H(P)$ for bursts in a single chamber is also computed. All calculations are based on the cascade theory of showers and the theory of the multiple scattering of electrons. The theoretical frequencies compared with those of experiments show (1) a much smaller

abs. value, (2) a much slower drop as the chambers are separated, (3) a different form for the cumulative size-frequency distributions, and (4) a smaller increase with altitude. The large number of narrow showers of high energy observed must originate much nearer to the chamber than the top of the atmosphere if they are to be explained by the cascade theory. It is concluded that the assumption of primary electrons is of little help in explaining the experimental results.

537.591.5 1886

The multiple production of mesotrons in paraffin at high altitudes. STROUD, W. G., AND SCHEIN, M. *Proc. Amer. Phys. Soc., Chicago, Dec.* 1 *and* 2, 1944. *Abstr. in Phys. Rev.*, 67, *p.* 62, *Jan.* 1 *and* 15, 1945.—The number of mesotron showers, involving 3 or more particles, under 3 and 6 cm. of paraffin, were measured and compared with the curve for the mesotron intensity as a function of atm. pressure. At altitudes between 13 and 16·5 km., 10% of the recorded penetrating particles are accompanied by mesotron showers of at least 3 particles below the paraffin. The angular divergence of these showers is between 9° and 20°. Showers of penetrating particles were also detected below 6 cm. of paraffin + additional 8 cm. of Pb. More than 20% of the penetrating particles are accompanied by mesotron showers below the paraffin + Pb.

537.591.5 1887

Investigation of extensive atmospheric showers in the stratosphere. AUGER, P., ROGOZINSKI, A., AND SCHEIN, M. *Proc. Amer. Phys. Soc., Chicago, Dec.* 1 *and* 2, 1944. *Abstr. in Phys. Rev.*, 67, *p.* 62, *Jan.* 1 *and* 15, 1945.—To measure the frequency of extensive atmospheric showers at high altitudes, a counter apparatus of large linear dimensions (10 m.) was constructed and sent to the stratosphere. The apparatus consisted of six large G–M counters (area 125 cm.^{2}) arranged in a horizontal plane. The maximum separation between counters was 7 m. Another set of 4 small counters (area 15 cm.^{2}), separated by 50 cm. distance, was placed in the middle between the large counters. Six different combinations of 3-fold coincidences were registered simultaneously. The coincidence circuits had a resolving time of 2×10^{-6} sec. From sea level to 15 km. the shower rate increases by a factor of 4 for showers of 2 m. average spread and by a factor of 30 for showers of 50 cm. average spread. In the high altitude no coincidences occurred between the set of small counters and any of the large ones.

537.591.5 1888

The azimuthal variations of cosmic radiation at 22° latitude. GILL, P. S. *Phys. Rev.*, 67, *pp.* 347–350, *June* 1 *and* 15, 1945.—Four triple-coincidence cosmic-ray telescopes directed at a common-zenith angle of 60° were mounted on a turntable. Each telescope represented a vertical plane 90° from that of its neighbour. In each was inserted 10·2 cm of Pb. By 180° reversals each telescope was interchanged in its position with the one directly opposite. Countings were made at settings of the table for every 10° of azimuth angle. Azimuthal variations in the N.W. and N.E. quadrants check qualitatively those theoretically predicted by Hutner. The data are still not sufficient to warrant quantitative comparison. The E.-W. asymmetry does not coincide with magnetic E.-W. plane, but occurs at 280°–100° plane.

537.591.5 1889

A study of time variations in the cosmic-ray directional intensity distribution. YEATER, M. L. *Phys. Rev.*, 67, *pp.* 74–91, *Feb.* 1 *and* 15, 1945.—A statistical analysis of directional-intensity measurements at St. Louis, 1943. The variations, occurring within periods of 12–24 hr., seem most pronounced near zenith angles of $\pm 20°$ and $\pm 70°$ in the E.–W. plane, and are not found in the N.–S. plane. These observations may be explained by the effect of terrestrial magnetic fluctuations in modifying the allowed cones of certain primary cosmic-ray particles, these particles having energies grouped near 0·2 Störmer and 0·6 Störmer. If this hypothesis is correct, the E.–W. positional symmetry constitutes evidence that positive and negative particles with the same e/m exist in the primary cosmic radiation. The time variations are variations in the fine structure pattern, but independent of the static prominences previously reported. The method for rapid exploration of the cosmic-ray directional intensity distribution is described. The multidirectional cosmic-ray telescope used is discussed.

537.591.8 1890

The relativistic increase in ionization of cosmic-ray electrons. HAZEN, W. E. *Proc. Amer. Phys. Soc., Pasadena, California, Dec.* 16, 1944. *Abstr. in Phys. Rev.*, 67, *p.* 65, *Jan.* 1 *and* 15, 1945.—Preliminary experiments [Abstr. 2853 (1938)] were continued with improved technique and a stronger magnetic field (4 500 gauss). The min. ionization obtained from 35 tracks of P^{32} β-rays with $H\rho > 4\,500$, is 40 ion pairs per cm. in air at N.T.P. The average ionization of 15 cosmic-ray electrons with $H\rho$ of $1–8 \times 10^5$ is 53. These figures for ionization are for the ionization produced as a result of all collisions in which the primary electron loses less than ~600 eV. Theory predicts an increase of 40%.

537.591.8 1891

The relativistic increase in ionization of high-energy electrons and mesotrons. HAZEN, W. E. *Phys. Rev.*, 67, *pp.* 269–272, *May* 1 *and* 15, 1945.—[See Abstr. 1890 (1945)]. The ionization by electrons and mesotrons was determined from drop counts along diffuse tracks that were photographed in a Wilson cloud chamber. It is believed that uncertainties in condensation efficiency and curvature do not contribute significantly to the errors. The relativistic increase in ionization for electrons agrees with theory but the average ionization of all penetrating particles is less than that predicted for a purely mesotronic composition. The minimum ionization by a singly charged particle is 38 ion pairs per cm. in dry air at N.P.T. when energy transfers greater than 600 eV are excluded.

537.712 : 621.3.081 1892

Conversion of non-rationalized c.g.s. to rationalized m.k.s. units in electromagnetism. JEHLE, H. *Proc. Amer. Phys. Soc., Providence, R.I., Oct.* 28, 1944. *Abstr. in Phys. Rev.*, 66, *p.* 353, *Dec.* 1 *and* 15, 1944.—The standard method of conversion from one unit to another by substitution breaks down for electro-

static flux and for **D**. The difficulty may be overcome by keeping consistently to the substitution method for converting units; and choosing the units of electrostatic flux in c.g.s., non-rationalized m.k.s., and rationalized m.k.s., respectively, as: 1 statlorentz $= 1$ lorentz$/3 . 10^9 = 1$ coulomb$/4\pi . 3 . 10^9$. The "statlorentz" does not involve any change of numerical values.

538.112 : 538.69 *see Abstr.* 1917

538.124 1893

On the energy and mechanical relations of the magnetic field. LIVENS, G. H. *Phil. Mag.*, 36, *pp.* 1–20, *Jan.*, 1945.—A critical examination is made of the basic physical concepts relating to the magnetic field and of the mathematical expression of the relations existing between these concepts. In particular it is shown that the expression $\mu H^2/8\pi - (BH)/4\pi$ rather than $\mu H^2/8\pi$ represents in all cases the distribution of the energy in the magnetic field which must serve as the force-function. Assuming a law of linear induction, it is proved that $\mu H^2/8\pi$ represents under all conditions the part of the energy of the field which is conserved. The general results obtained are applied to the details of 3 special cases. In the later part of the paper an argument is given in favour of a complete inversion of the rôles of **B** and **H**; it is more consistent with experience to take **B** as the fundamental force-vector. Then **H** becomes the induced vector. L. S. G.

538.21 1894

Magnetic properties of augite. SIGAMONY, A. *Proc. Indian Acad. Sci. A*, 20, *pp.* 261–265, *Nov.*, 1944.—The magnetic properties of 4 crystals of augite, 3 of them twinned in the (100) plane were studied. The crystals were axially ferromagnetic, with low intensity of magnetization. Saturation was not reached at fields as high as 5800 oersteds. They were anisotropic magnetically at low fields and tended to become isotropic at high fields. The coercive force was large in all cases.

538.21 1895

Magnetism of germanium. RAO, S. R. *Curr. Sci.*, 14, *pp.* 19–20, *Jan.*, 1945.

538.21 : 548.0 1896

Magnetic studies on molybdenite. DUTTA, A. K. *Indian J. Phys.*, 18, *pp.* 249–255, *Aug.*, 1944.—Measurements were made of the magnetic anisotropy of single crystals of molybdenite, using the torsional method of Krishnan and his collaborators, and further measurements enabled determinations to be made of the principal susceptibilities. Results are given for 5 different crystals and are discussed with reference to the crystal structure as revealed by X-ray diffraction photographs. A. W.

538.213.029.5 1897

The magnetic permeability of iron wires at radio-frequencies. SMITH, A. W., DICKEY, F. P., AND FOOR, S. W. *J. Appl. Phys.*, 16, *pp.* 57–60, *Jan.*, 1945.—The permeability was measured in fields of low intensity and at frequencies corresponding to wavelengths of 54 to 1150 metres. The value obtained diminish with increase in frequency and size of the wire. The results do not confirm the existence of an anomalous dispersion of permeability previously reported. The permeability was determined from the change in inductance of a specimen coil in an oscillating circuit resulting from the introduction of the sample, which consisted of from 1 to 20 wires enclosed in a glass tube. L. S. G.

538.214 1898

Paramagnetic dispersion at radio frequencies in a few gadolinium salts. BROER, L. J. G., AND GORTER, C. J. *Physica, 's Grav.*, 10, *pp.* 621–628, *Oct.*, 1943.—Graphs of the ratio of the h.f. susceptibility to the static susceptibility in various parallel magnetic fields are given as function of the frequency (ν) where $\nu < 5$ Mc/s. These graphs relate to the hydrated sulphate, oxalate and acetate of Gd between liquid-air and room temperatures. No dispersion was obtained in the case of Gd oxide or hydrated Dy sulphate. The results, which are experimental, are discussed in relation to theoretical formulae [Abstr. 3855 (1938)]. L. S. G.

538.214 1899

The magnetic study of quinhydrone. LAL, S., AND KHAN, N. *Curr. Sci.*, 13, *p.* 312, *Dec.*, 1944.—Experiments showed that the sum of the molecular susceptibilities of quinone and quinol is $-102{\cdot}07 \times 10^{-6}$, nearly $= \chi_m$ for quinhydrone ($-102{\cdot}05 \times 10^{-6}$).

538.214 : 621.317.41 1900

An apparatus for the study of paramagnetic dispersion at radio frequencies. BROER, L. J. F., AND SCHERING, D. C. *Physica, 's Grav.*, 10, *pp.* 631–644, *Oct.*, 1943.—The various components of the apparatus are described in detail and the precautions necessary in the construction and operation are noted. The paramagnetic sample, when moved into or out of the magnetic field of a r.f. oscillator, varies the generated frequency because of its susceptibility. The variation of frequency is measured when the temperature, longitudinal magnetic field or oscillator frequency, is varied. For this purpose a second, slightly different (constant), frequency is generated and, as a result of mixing, an audio frequency is obtained, the change of which is equal to the variation of the measuring frequency. The variable oscillator is of the push-pull type and includes a built-in damping apparatus and buffer amplifier. L. S. G.

538.22 : 548.0 1901

Magnetic studies on potassium permanganate. MOOKHERJI, A. *Indian J. Phys.*, 18, *pp.* 187–191, *June*, 1944.—The magnetic properties of single crystals of $KMnO_4$ have been investigated. Krishnan and Banerji's torsion method of determining the magnetic anisotropy was used. The principal susceptibilities along the *a*, *b*, and *c* crystallographic axes were determined by the balancing method. The results are discussed from the viewpoint of crystal structure. The (MnO_4) group is the paramagnetic unit in $KMnO_4$. Its anisotropy is 4·9%. On the Van Vleck theory, the feeble paramagnetism of $KMnO_4$ is due to the fact that the $(MnO_4)^-$ ion contains an even number of electrons and will contribute nothing to the paramagnetism. The latter is produced by fluctuations of orbital moment which occur when there is more than one centre of force. A. J. M.

538.221 1902

The structure of a ferromagnetic and the permeability/frequency curves. POLIVANOV, K. M.

J. Phys., USSR, 7, 1, *pp.* 18–28, 1943.—Deals with the magnetic permeability of a substance as a function of frequency, and a new method is suggested, based on the theory of Arkadiew, for the determination of the permeability of a substance from two measurements when the samples are isotropic and homogeneous. An analysis is made of the influence of microscopic non-homogeneity. E. R. A.

538.24 : 621.3.013.8 1903

Changes in the *B*/*H* curves of iron on sending direct electrical current through the specimen during magnetization. SARNA, H. R., AND SHARMA, O. P. *Indian J. Phys.*, 18, *pp.* 243–248, *Aug.*, 1944.—[Abstr. 1450 B (1945)].

538.3 1904

An historical note on a paradox in electrodynamics. ROBERTSON, I. A. *Phil. Mag.*, 36, *pp.* 32–43, *Jan.*, 1945.—The paradox relates to the forces between 2 electrons moving, at a certain instant, in mutually perpendicular directions. An application of the Biot-Savart law yields a force on one electron but not the other. A critical examination of the paradox is made and attention is drawn to a formula, in existence since the beginning of electrodynamics, which is superior to that at present in use and which is particularly suitable for dealing with this paradox which has aroused a good deal of discussion [Abstr. 1632 (1944)]. L. S. G.

538.3 : 530.12 : 530.145 1905

Discontinuous motion of an electric particle. WATSON, W. H. *Canad. J. Res. A*, 23, *pp.* 39–46, *March*, 1945.—Deals with a world-track which consists of a discrete series of events at which the particle may be found. The electric potential may change very rapidly in the vicinity of the null-cone with its vertex at the point-instant singularity, without requiring the usual electric current to sustain the wave of potential, provided that the electromagnetic field tensor is revised in accordance with equations [Abstr. 636 (1940)] to represent the non-optical radiation of energy and momentum. Such forms of potential represent the switching-on and -off of charge. Inertial mass, energy, and momentum are associated with the wave. Different possibilities for discontinuous motion of an electric particle occur, depending on the modes of its successive creations and annihilations. The model discussed exhibits the essential separation of space-time into two regions, in one of which the field is static and in the other it vanishes, and leads to new insight into the structure of electromagnetic field singularities as boundaries of the field which we may think of as propagated like electromagnetic waves in a wave-guide. Connection of these ideas with quantum theory is briefly discussed.

538.3 : 530.145 1906

Auxiliary conditions and electrostatic interaction in generalized quantum electrodynamics. PODOLSKY, B., AND KIKUCHI, C. *Phys. Rev.*, 67, *pp.* 184–192, *March* 1 *and* 15, 1945.—Paralleling a work of Fock we are able to eliminate the auxiliary conditions in our generalized quantum electrodynamics. As in the work of Fock, this leads to a determination of both the electrostatic self-energy and electrostatic particle-particle interaction. Both turn out to be finite and in agreement with results obtained classically. [See Abstr. 2060 (1944)].

538.3 : 538.69 *see Abstr.* 1918

538.3 : 621.396.671 : 621.392.5 = 3 1907

Reciprocity theorem of the electromagnetic field. DÄLLENBACH, W. *Arch. Elektrotech.*, 36, *p.* 572, *Sept.* 30, 1942.—A correction [Abstr. 1138 (1943)].

538.56 = 4 1908

On the angular momentum of an electromagnetic wave. HUMBLET, J. *Physica, 's Grav.*, 10, *pp.* 585–603, *July*, 1943.—The expression for the angular momentum of electromagnetic radiation is decomposed into 3 terms. The first two correspond to orbital momentum and spin momentum respectively while the third is a surface term. The flux of angular momentum is given in a form corresponding to this decomposition and this permits calculation of the flux without it being necessary to know the terms of certain potentials and fields (e.g. longitudinal fields). An application is made to the radiation from an electric dipole and also to a plane wave. It is noted that an ambiguity exists in the definition of the angular momentum of a rigorously plane wave.

L. S. G.

538.566 : 621.392 1909

Electromagnetic waves in a bent pipe of rectangular cross section. RIESS, K. *Quart. Appl. Math.*, 1, *pp.* 328–333, *Jan.*, 1944.—[Abstr. 1664 B (1945)].

538.614 1910

Faraday rotations in solutions containing ions of elements of the first transition group. BOSE, A. K. *Indian J. Phys.*, 18, *pp.* 199–208, *Aug.*, 1944.—Faraday rotations of paramagnetic solutions containing some of the elements of the first transition group were measured photographically in the visible range and specific magnetic rotations were calculated from the formula $V = \Sigma[V_m]g_m$, where Σ is the summation over the different types of substances present, V = Verdet's constant, V_m = specific rotation, g_m = number of g./cm.^{3} in the solutions. The following solutions have been studied: $NiCl_2$ in water and HCl solutions; $CoCl_2$ in water and HCl solutions; $TiCl_3$ in HCl solution, and $V(ClO_4)_2$. From the nature of specific rotations at different wavelengths the existence of some fine structure of absorption bands of the paramagnetic ions in solutions at respective regions can be known [Abstr. 4037 (1939)]. From the study of specific rotations of Ti^{+++} and Co^{++} near their respective absorption regions, the existence of doublet structure of the band is found.

538.65 1911

Note on the effect of a magnetic field on the torsion modulus of some paramagnetic metals. SCHULTZ, B. H. *Physica, 's Grav.*, 10, *pp.* 629–630, *Oct.*, 1943.—A theoretical discussion is given, from which it appeared probable that the elastic constants (including the torsion modulus) of Pd, Pt and W would change in the presence of a sufficiently strong magnetic field. Experiments failed to detect any such change. The metals, in the form of wires 0·1 mm. dia., were heated and stretched in vacuo. The max. field strength was 16 500 Gauss. The method (a differential one) was so sensitive that a relative change of 2×10^{-7}, 3×10^{-7} and 6×10^{-7}, respectively, for Pd, Pt and W, would have been detected. L. S. G.

538.69 1912

The motion of small particles in magnetic fields. KANE, G., AND REYNOLDS, C. B. *Science*, 100, *pp.* 503–504, *Dec.* 1, 1944.—A record of qualitative experiments carried out at flux densities up to 20 000 gauss in numerous liquids and gases. The pole pieces were circular, 8 mm. in dia., the field vertical, and the observation by microscope, usually with dark field illumination. Spiral tracks were observed, the direction being reversed in every case by reversing the field. A permanent magnet gave similar results. Colloidal dispersions of copper, iron, nickel and manganese were destroyed by application of a homogeneous magnetic field. A theoretical interpretation is to follow. G. F. F.

538.69 1913

New evidence for the magnetic current. EHRENHAFT, F. *Proc. Amer. Phys. Soc., Chicago, Dec.* 1 *and* 2, 1944. *Abstr. in Phys. Rev.*, 67, *p.* 63, *Jan.* 1 *and* 15, 1945.—In a homogeneous electric field through which flows a constant electric current, a single magnetic pole circulates. If the single magnetic pole also bears an electric charge, this movement is a spiral (electrodynamics). Observation discloses that in a constant vertical homogeneous magnetic field, single test bodies move in a spiral path in gases as well as in liquids with velocities that are measurable in the dark field of the microscope. These velocities are of the order of 10^{10}–10^{12} smaller than the velocity of light, showing that they bear electric as well as magnetic charges (magnetodynamics). If they bear a magnetic charge alone, their movement is polar. Covering the vertical magnetodes of the electromagnet with glass caps, the opposing faces of which are fitted with Pt surfaces, one obtains in the space between the caps, vertical homogeneous fields where the electric and magnetic force lines are parallel to one another. When the two fields are in action simultaneously a circulation of the liquid can be observed with the microscope and a twisting of the stream of electrically evolved gas bubbles rising from the lower Pt surface occurs.

538.69 1914

Magnetic saturation of microscopic particles. KANE, G. *Proc. Amer. Phys. Soc., Chicago, Dec.* 1 *and* 2, 1944. *Abstr. in Phys. Rev.*, 67, *p.* 63, *Jan.* 1 *and* 15, 1945.—Microscopic particles of Ni have been observed to move in the direction of the lines of force in a vertical homogeneous magnetic field when illuminated by a strong beam of light. The velocity of the particles is a function of the field strength. The direction of motion reverses with a reversal of the magnetic field. For low field intensities, the velocity is $\propto$ to the field strength. For higher intensities, the velocity either approaches a lim. value or reaches a max. with increasing field and then decreases. Increase of field strength may even reverse the sense of direction of the motion. All of these motions can be accounted for if it is assumed that the force acting on a particle is qH, where q is the magnetic charge and H the effective field strength.

538.69 1915

The rotation of electrolytes under the influence of a magnetic field. REYNOLDS, C. B. *Proc. Amer. Phys. Soc., Chicago, Dec.* 1 *and* 2, 1944. *Abstr. in Phys. Rev.*, 67, *pp.* 63–64, *Jan.* 1 *and* 15, 1945.—The rotation of solutions of $CuSO_4$, H_2SO_4, and $FeCl_2$ under the influence of a magnetic field has been reported. The author has repeated this experiment using many additional electrolytes of ferro-, para-, and diamagnetic materials organic and inorganic in nature. The rotations are not explained by the Lorentz force, concentration gradient, or pure electrochemical action.

538.69 1916

Motion of electrolytes in a magnetic field. SWARTZ, C. E. *Proc. Amer. Phys. Soc., New York, Jan.*, 1945. *Abstr. in Phys. Rev.*, 67, *p.* 201, *March* 1 *and* 15, 1945.—Investigation of the rotation of certain electrolytes ($FeCl_3$, HCl, $SnCl_3$) between and in contact with magnetic poles, has been carried out with many variations on the original Ehrenhaft experiments. These variations do not differ fundamentally from the original experiments because the rotation and sense of rotation are unaffected by some inhomogeneity of the field. Ferromagnetic substances need not be used; the rotation is dependent on a chemical reaction. These rotations can be explained by assuming potential differences throughout the solution caused by the presence of the metal. This assumption has been verified by means of a special potentiometer and probe arrangement.

538.69 : 538.112 1917

The measurement of single magnetic charges and the electrostatic field around the permanent magnet. EHRENHAFT, F. *Proc. Amer. Phys. Soc., New York, Jan.*, 1945. *Abstr. in Phys. Rev.*, 67, *pp.* 201–202, *March* 1 *and* 15, 1945.—It has been observed in the microscopic dark field that in a magnetic condenser with horizontal homogeneous field established by an Alnico 5 permanent magnet, test bodies of various substances fall vertically and undeflected in gases, or are deflected at various measurable angles to either condenser plate, their paths crossing the centre line. Observing these falling bodies, the N. and S. magnetic charge of a single test body can be measured. [Abstr. 281 (1945)]. Applying a horizontal inhomogeneous axially symmetrical magnetic field, the force of charge qH exceeds the force of polarization so that even diamagnetic particles move to the denser lines of force. The general path of a body bearing simultaneously electric and magnetic charges is a helix in the constant field of a permanent magnet. The region of observation is shielded electrostatically. The electric field is created by the permanent magnet.

538.69 : 538.3 1918

Theoretical implications of the magnetic current. KANE, G. *Proc. Amer. Phys. Soc., New York, Jan.*, 1945. *Abstr. in Phys. Rev.*, 67, *p.* 202, *March* 1 *and* 15, 1945.—The wave equations for electromagnetic waves travelling in a conducting medium may be deduced from the field equations. Such wave equations contain terms in E and H in addition to the usual first and second derivatives of E and H with respect to time. The theoretical necessity of a magnetic current can be demonstrated by a process of reasoning similar to that which led Maxwell to the hypothesis of a displacement current.

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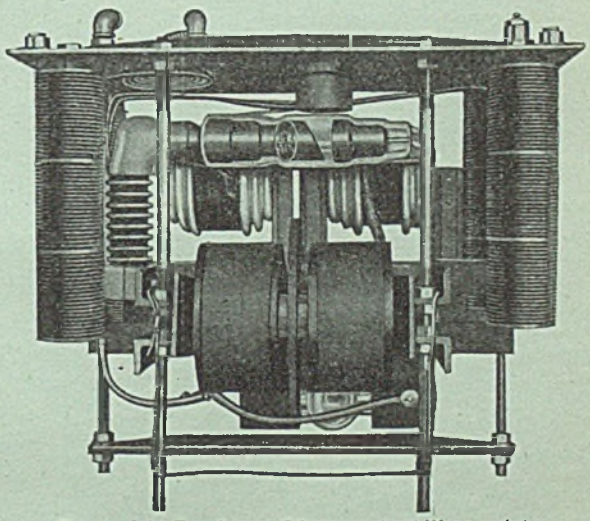

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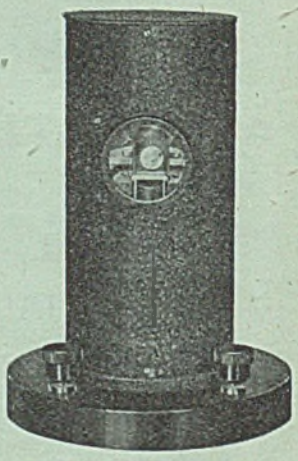

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