Suggestions and criticisms are invited. Mozart's "Magic Flute" will supply some items of music, especially on March 1. Admission will be free, without ticket.

SECONDARY education in the United States in 1921 and 1922 is reviewed in Bulletin, 1923, No. 12, of the Bureau of Education, Washington. The outstanding achievement within the past few years has been an extension downwards of the secondary school system in many parts of the United States, especially in cities. Typically, the extension has taken the form of substituting for the normal sequence of 4 years of high school work following 8 years (ages 6 to 14) of elementary schooling, a system sometimes described as the 6-3-3, meaning 6 years (ages 6 to 12) of elementary schooling followed by 6 years of secondary school work divided into two administrative units of 3 years each, namely, the junior high school and the senior high school units. Essentially the change implies that the passage from the elementary to the secondary type of curriculum should synchronise with the commencement of the physical changes of adolescence. It is generally agreed in America that at this stage the pupil needs in his studies change, variety, and human interest rather than completeness and logical arrangement, and that consequently in place of the traditional seventh and eighth grade courses there should be a general survey of the chief departments of knowledge: "English literature, general social science, general mathematics, general science, foreign languages for those who desire them, music, art, physical education, and the practical arts." This holds good both for those who are to leave school at 15 and for those who are to pass on to the senior high school.

A STATISTICAL survey of education in the United States is given in Bulletin No. 16 of 1923 of the Federal Bureau. It shows the following total enrolments in 1919-20 (in thousands): kindergarten 511, elementary 20,383, secondary 2430, university, college, and professional school 462, teachers' college and normal school 163; grand total 23,950, being 22·7 per cent. of the total population. Included in the above are the following enrolments in private, that is non-state, institutions: kindergarten 30, elementary 1486, secondary 229, university etc. 281, teacher-training 14. The estimated cost of all this education, except private elementary and private secondary, is 1301 million dollars, or, in dollars per head: elementary 39, secondary 127, university, college, and professional 460, teachers' college 131, other normal schools 189. The figures are exclusive of city evening, private commercial, nurse-training, and Indian and Alaskan schools. Enrolments in these amounted to 587, 336, 55, and 32 thousands respectively. Gifts and bequests to education in 1920 reached the unprecedented total of 67 million dollars, the highest previous record being 37 million in 1916. The extent to which women teachers have taken the place of men during the past 40 years in elementary and secondary schools is strikingly shown in a table in another Bulletin, No. 29 of 1922, giving the percentage of men teachers in 1880 and at the end of each subsequent quinquennium up to 1920: 43, 37, 35, 33, 30, 24, 21, 20, 14. The average annual salaries in dollars of all teachers, men and women, in the same years are given as 195, 224, 252, 286, 325, 386, 485, 543, 871, but the last figure includes supervisors and non-teaching principals. During the past 50 years the ratio of pupils in secondary schools, compared with the total enrolment in elementary and secondary schools combined, increased from 1·2 to 10·2 per cent.

Societies and Academies.

LONDON.

Institute of Metals (Manchester Meeting), September 10.—Sir Henry **Fowler**: The use of non-ferrous metals in engineering (Autumn Lecture). Of the non-ferrous metals used by engineers, the one which has been in longest use is copper, and it is at present the one most closely associated with engineering work. The uses to which its comparatively simple alloys with tin and zinc can be put are endless. The next in importance is tin, which, alloyed with copper, lead, and antimony, gives us those white metals which are used to make bearings in machines. Aluminium is still most generally used in connexion with aeronautics.

September 11.—E. A. **Bolton**: The cause of red stains on sheet brass. The stains occur through reactions of copper oxides in the scale formed during annealing and in the pickling medium. Cupric oxide, contrary to the usual opinion, is as harmful as cuprous oxide. The presence of these oxides may be due to careless washing after pickling, resulting in the presence of acid and salts during annealing, the presence of iron in the brass or upon its surface, the use of impure rolling oils, etc. The main cause of the oxidation of the copper is the use of old-fashioned annealing furnaces in which the flames impinge directly upon the brass. Possible remedies for the red-stain trouble are suggested.—H. W. **Brownsdon**: Brinel hardness numbers. Brinel numbers for non-ferrous metals should be expressed in figures that are comparable. This could be done if balls and loads are used for which the ratio L/D^2 (the load in kilograms divided by the square of the ball diameter in millimetres) is constant. Some one ratio for L/D^2 should always be used for one class of alloys; for the copper alloys with Brinell hardness numbers from about 40 to 200, the choice should rest between the ratio 5 as standardised in the United States or the ratio 10 which is favoured in some quarters in Great Britain.—A. H. **Mundey** and John **Cartland**: Stereotyping. Stereotyping is generally regarded by printers as almost a trade secret. The process was invented by a practical metallurgist, William Ged, an Edinburgh goldsmith, in 1750. Stereotyping was traced from the plaster-of-Paris process to the use of papier-maché flong, and from the simple stereo plates for flat-bed machines to the elaborate requirements of the modern newspaper. A high degree of accuracy is demanded in the mechanical and metallurgical details in order to produce the good results which are a commonplace to everyone.—J. D. **Hannah** and E. L. **Rhead**: Crystallisation effect on galvanised iron sheets. Manufacturers of galvanised iron and steel goods always seek to produce a zinc-covered surface having large characteristic spangles. Small spangles or lack of spangles is disliked. The metal—iron or steel—has practically no influence on the result if the temperatures are satisfactorily maintained. Pure zinc does not yield large spangles, and too high a temperature interferes by producing large quantities of a zinc-iron compound which crystallises in needles on the metal. The presence of tin or aluminium does not produce the desired result, but lead is effective. The separation of the impure zinc into conjugate solutions, lead-rich and zinc-rich, at the dipping temperature, and the method of subsequent crystallisation, may be the causes of these effects.—R. C. **Reader**: Effects of rate of cooling on the density and composition of metals and alloys. The densities of pure metals, and of alloys which solidify at a constant temperature, are not affected by the rate at which they solidify.

With alloys which solidify over a range of temperature, the slower the rate of solidification the lower is the density, and when they are prepared in cylindrical chill moulds, they are less dense in the centre than at the outside. When prepared in chill they are richer on the outside in the component of the lower melting point.—A. H. **Mundey** and C. C. **Bissett**: The effect of small quantities of nickel upon high-grade bearing metal. Nickel is now added to the well-known bearing metal consisting of tin 93 per cent., antimony 3·5 per cent., copper 3·5 per cent. Tensile, compression, and hardness tests gave no indication of improvement. The comparison of hardness at varying increased temperatures exhibited no improvement. In the case of the alloy with no nickel, the hard copper-tin constituent is very marked in its characteristic crystalline formation as seen under the microscope. The presence of nickel even in small quantities results in a great diminution of this crystalline structure.—Hikozo **Endo**: The measurement of the change of volume in metals during solidification. In the casting process it is very important to know to what extent a change of volume occurs during solidification. In 1888, Vincentini and Omodei calculated the change of volume of some fusible metals during solidification from the change of density at the melting point. E. Wiedemann, Paul Pascal, and Louis Hackspill also used this method. M. Toepler studied the change of volume by means of a dilatometer; he suggested a relation of the change of volume of a metal at melting point to its atomic weight. K. Bornemann and F. Sauerwald measured the density of metals at various high temperatures, using the principle of Archimedes, by means of a mixture of sodium and potassium chlorides as liquid. The method of investigation now used for metals having melting points up to 1100° C., which was suggested by Prof. K. Honda, consists in the measurement of the change of buoyancy of a metal suspended in an inactive liquid during its solidification or melting by means of a thermobalance.

September 12.—Marie L. V. **Gayler**: The constitution and age-hardening of the quaternary alloys of aluminium, copper, magnesium, and magnesium silicide. Alloys containing up to 6 per cent. copper, 4 per cent. magnesium, and 4 per cent. magnesium silicide were used. When copper, magnesium, and magnesium silicide are present in aluminium, any two of these components have a marked effect on the solubility of the third and ultimately $CuAl_2$ and Mg_2Si are both thrown out of solution. If copper and magnesium are present in a ratio greater than 12 to 5 approximately, then the alloys when quenched from high temperatures age-harden at room temperature, owing to the difference in the solubility of Mg_2Si at the quenching and ageing temperature. Age-hardening of alloys of the "Duralumin" type is due primarily to Mg_2Si, and the addition of magnesium and copper is important since both reduce the solubility of Mg_2Si at high and low temperatures and consequently reduce the maximum age-hardness due to Mg_2Si.—Ulick R. **Evans**: The electro-chemical character of corrosion. There are two main types of corrosion: (1) that accompanied by evolution of hydrogen is characteristic of reactive metals placed in acid solutions, but the velocity varies greatly with the degree of purity of the metal; (2) slower corrosion, determined by the diffusion of oxygen to the metal, and comparatively independent of the purity. When a metal is immersed in a solution of potassium chloride, alkali is produced at the cathodic portions, the chloride of the metal at the anodic portions, and the hydroxide is precipitated where these meet. The electric current produced accounts for the greater part of the corrosion actually observed. Generally the cathodic areas are those to which air has free access, while the anodic areas are those protected from aeration. Corrosion usually proceeds most rapidly at the comparatively unaerated places—hence the intense corrosion observed in "pits" and over areas covered up by porous corrosion-products.—Douglas H. **Ingall**: Experiments with some copper wire; cohesion a function of both temperature and cold work. Five samples of copper wire were used: soft annealed and four degrees of cold work given by 25, 40, 50, and 75 per cent. reduction of area by drawing. The cohesion at high temperatures was determined by placing given loads on the wire at atmospheric temperature, heating the wire and determining the temperature at which it broke. All the samples gave similar graphs in which with rise of temperature the cohesion decreased along a straight line to a constant critical temperature of 350° C., beyond which the cohesion was represented by a sharply descending curve. The equations to the straight lines $C = a - bT$ and to the curves $TC^n = k$ (where C = cohesion and T = temperature) showed that the percentage increase of the constant b and the percentage decrease of the constant n were represented by the corresponding percentage reductions for any given cold worked wire, with the exception of 75 per cent. reduced wire. At the critical inflection temperature the material was comparatively extremely fragile.—D. **Hanson**, C. B. **Marryat**, and Grace W. **Ford**: Investigation of the effects of impurities on copper. Pt. I.—The effect of oxygen on copper. The effect of oxygen, up to a concentration of 0·36 per cent., on *pure* copper, was investigated. The mechanical properties are not much affected by small quantities of oxygen, and copper containing as much as 0·1 per cent. differs very slightly from pure copper. The electrical conductivity does not fall rapidly, and values exceeding 100 per cent. of the International Standard are obtained in all annealed materials containing less than 0·1 per cent. of oxygen. This is due to the low solubility of the oxide in solid copper. The oxygen-bearing metals can be considered as a heterogeneous mixture of pure copper and finely divided particles of cuprous oxide. There is a soft ductile copper matrix, in which harder particles of cuprous oxide are distributed so as to form a mechanical mixture.—Hugh **O'Neill**: Hardness tests on crystals of aluminium. Brinell tests showed that at low loads the different crystallographic planes resist penetration to different degrees, and give indentations of different shapes. In the Brinell sense the (110) face is the "hardest" and the cube (001) face appears to be the "softest." But the load required to immerse the ball is apparently the same in all cases. Crystal boundaries are without any appreciable effect in increasing the resistance of aluminium to penetration.—H. I. **Coe**: The behaviour of metals under compressive stresses. Compression tests carried out on small cylinders of metals show that with successive increments of loads plastic flow occurs, after the elastic limit has been exceeded, at an increasing rate. At a certain load the rate of flow changes abruptly, metals such as tin and lead becoming perfectly plastic, harder metals becoming more plastic than under preceding loads and immediately succeeding loads. The term "critical plasticity" is used to indicate the change in the rate of plastic deformation which most metals exhibit at a particular load. Annealed metals flow at a comparatively low load and the rate of flow increases up to the load corresponding to critical plasticity; when worked, they are more resistant to compressive stresses until they approach the load corresponding to a critical plasticity, when they suddenly collapse and a marked temporary flow occurs.—Albert M.

Portevin and Pierre **Chevenard**: A dilatometric study of the transformations and thermal treatment of light alloys of aluminium. Dilatometric methods, using the recording differential dilatometer, permit of the study of the transformations and the mechanism of heat-treatment of the light alloys of aluminium-magnesium-silicon, and in general, of alloys containing two-phase, univariant transformations. The study of the constant temperature transformations by the differential dilatometer, using a high sensitivity apparatus, leads to general expressions representing the phenomena as functions of time and temperature. Quenching and tempering in these alloys can be interpreted by the known variations in the solubility of Mg_2Si in the solid state, without assuming any further transformations.—P. **Soldau**: Equilibrium in the system gold-zinc (based on investigations of electrical conductivity at high temperatures). The alloys of gold and zinc belong to the type of AR-brasses, where A is a metal belonging to the first and R to the second group of the periodic system. These alloys are of considerable practical importance, as in their chemical nature they are very close to the ordinary brasses. For the determination of electrical conductivity at high temperatures, a special apparatus was constructed which was checked by determining the transformation temperatures in iron and steel and comparing the results with those obtained by other methods.

PARIS.

Academy of Sciences, September 3.—M. A. d'Arsonval in the chair.—Alfred **Errera**: A theorem of linkages.—Alexandre **Rajchman**: The Riemannian theory of trigonometrical series.—M. **Puthomme**: Contribution to the study of the secondary X-rays. Two metallic wires, in the form of a cross, give a single sharp radiographic image, but if a metallic screen such as a sheet of lead, be placed between the X-ray bulb and the wires, then three images are observed, one on each side of the initial image. The two additional images are due to secondary rays starting from the edges of the lead screen. The fact that a needle imbedded in the body may sometimes give a faint extended image rendering it difficult to locate is probably due to the same phenomenon.—E. F. **Terroine**, P. **Fleuret**, and Th. **Stricker**: The rôle of the deficient proteids in supplying the minimum nitrogen requirement. Experiments on the nitrogen assimilated by growing pigs from ammonium citrate and from gelatin. The amount assimilated varies greatly with the individual animal. Gelatin proved to be superior to ammonium citrate as a source of nitrogen.—Mme. **Randoin**: Study of the vitamins in molluscs. The presence of the antiscorbutic factor in the oyster. From experiments on guinea pigs it is concluded that the addition of oysters in suitable quantity to a diet not containing vitamin-C is sufficient to prevent symptoms of scurvy.—M. **Athanassopoulos**: The tunny fish of Greece.

Official Publications Received.

Arkiv för Matematik, Astronomi och Fysik utgivet av K. Svenska Vetenskapsakademien, Band 17, No. 19. Meddelande från Lunds Astronomiska Observatorium, No. 102: Contributions to the Analytical Theory of Sampling. By S. D. Wicksell. Pp. 46. (Stockholm: Almquist and Wiksells Boktryckeri A.-B.; London: Wheldon and Wesley, Ltd.; Berlin: R. Friedlander und Sohn; Paris: C. Klincksieck.)

Meddelanden från Lunds Astronomiska Observatorium. Serie II, Nr. 29: Flächenhelligkeiten von 566 Nebelflecken und Sternhaufen, nach photometrischen Beobachtungen am 49 cm. Refraktor der Universitäts-Sternwarte, Strassburg (Elsass), 1911–1916. Von Carl Wirtz. Pp. 63. Serie II, Nr. 30: Star-gauges by William Herschel and John Herschel. Edited by C. V. L. Charlier. Pp. 29. (Lund: Scientia Publisher.)

Kungl. Fysiografiska Sällskapets Handlingar, Band 34, Nr. 2. Meddelanden från Lunds Astronomiska Observatorium. Serie II, Nr. 31: Star-gauges at the Observatory of Lund. By C. V. L. Charlier, F. A. Engström, P. B. Fänge, K. A. W. Gyllenberg, C. I. Lundahl, K. G. Malmquist, J. B. Ohlsson, S. D. Wicksell. Edited by C. V. L. Charlier. Pp. x+207. (Lund: C. W. K. Gleerup; Leipzig: Otto Harrassowitz.)

The North of Scotland College of Agriculture: County Extension Department. Bulletin No. 28: Reports on Field Experiments with Oats, Turnips and Potatoes carried out on Farms in the College Area during the Years 1919, 1920, 1921. Pp. 76. (Aberdeen.)

The North of Scotland College of Agriculture. Bulletin No. 29: An Experiment on the Control of Finger-and-Toe by Liming. By Prof. James Hendrick. Pp. 15. (Aberdeen.)

Queensland Department of Mines: Geological Survey of Queensland. Publication No. 272: Geology of the Walloon-Rosewood Coalfield. By J. H. Reid. Pp. 69+2 maps. (Brisbane: A. J. Cumming.)

Department of the Interior: Bureau of Education. Bulletin, 1923, No. 20: Recent Advances in Instruction in Music. By Will Earhart and Charles N. Boyd. Pp. 21. Bulletin, 1923, No. 21: Specimen Junior High School Programs of Study. Compiled by W. S. Deffenbaugh. Pp. 28. Bulletin, 1923, No. 28: Vocational Education. By William T. Bawdon. Pp. 26. Bulletin, 1923, No. 34: Higher Education 1920–1922. By George F. Zook. Pp. 33. (Washington: Government Printing Office.) 5 cents each.

Department of the Interior: United States Geological Survey. Bulletin 717: Sodium Sulphate; its Sources and Uses. By Roger C. Wells. Pp. iv+43. 5 cents. Bulletin 718: Geology and Ore Deposits of the Creede District, Colorado. By William H. Emmons and Esper S. Larson. Pp. ix+198+12 plates. 40 cents. Bulletin 738: The Commercial Granites of New England. By T. Nelson Dale. Pp. xv+488+34 plates. 50 cents. Bulletin 745: The Kotsina-Kuskulana District, Alaska. By Fred H. Moffit and J. B. Mertie, Jr. Pp. ix+149+19 plates. 40 cents. Bulletin 750-A: Ilsemannite at Ouray, Utah. By Frank L. Hess. Pp. 16+2 plates. (Washington: Government Printing Office.)

Department of the Interior: United States Geological Survey. Water-Supply Paper 469: Surface Waters of Wyoming and their Utilization. By Robert Follansbee. Pp. x+331. 40 cents. Water-Supply Paper 495: Geology and Ground-Water Resources of Sacramento Valley, California. By Kirk Bryan. Pp. xi+285+19 plates. 60 cents. Water-Supply Paper 496: The Industrial Utility of Public Water Supplies in the United States. By W. D. Collins. Pp. iv+59. 10 cents. (Washington: Government Printing Office.)

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 32: The Cotton Plant in relation to Temperature and Rainfall. By C. B. Williams. Pp. vi+2 charts. (Cairo: Government Publications Office.) P.T. 2.

Report of the Government Chemist upon the Work of the Government Laboratory for the Year ending 31st March 1923. With Appendices. Pp. 34. (London: H.M. Stationery Office.) 1s. 6d. net.

Bulletin of the National Research Council. Vol. 6, Part 2, No. 33: On the Formulation of Methods of Experimentation in Animal Production. By E. B. Forbes and H. S. Grindley. Pp. 54. 1 dollar. Vol. 6, Part 3, No. 34: Causes of Geographical Variations in the Influenza Epidemic of 1918 in the Cities of the United States. By Ellsworth Huntington. Pp. 36. 75 cents. Vol. 6, Part 4, No. 35: Apparatus used in Highway Research Projects in the United States. By C. A. Hogentogler. Pp. 91. 1.50 dollars. (Washington: National Academy of Sciences.)

Year Book of the Michigan College of Mines, 1922–1923, Houghton, Mich. Announcement of Courses, 1923–1924. Pp. 125. (Houghton, Mich.)

Imperial Department of Agriculture for the West Indies. Report on the Agricultural Department, St. Kitts-Nevis, 1921–1922. Pp. iv+44. (Barbados.) 6d.

The East London College (University of London). Calendar, Session 1923–1924. Pp. 164. (London: Mile End Road.)

Diary of Societies.

MONDAY, OCTOBER 1.

SOCIETY OF ENGINEERS (at Geological Society), at 5.30.—A. Ferguson, Improved Method for Mass Production of Tank Glass Bottles, Jars, etc.

WEDNESDAY, OCTOBER 3.

SOCIETY OF PUBLIC ANALYSTS (at Chemical Society), at 8.—J. H. Coste, E. R. Andrews, and W. E. F. Powney: The Sampling of Coal; the General Problem and some Experiments.—H. G. Stocks: A New Test for distinguishing Castor Oil.—A. E. Etheridge: The Volumetric Estimation of Vanadium in Steel.—C. L. Hinton and T. Macara: The Iodimetric Determination of Sugars.

THURSDAY, OCTOBER 4.

CHILD-STUDY SOCIETY (at the Royal Sanitary Institute), at 6.—Discussion opened by Miss Norah March: The Report of the Commission in relation to the Teaching of Biology in Schools.

CHEMICAL SOCIETY, at 8.—E. B. R. Prideaux and A. T. Ward: A Revision of the Dissociation Constants of Weak Inorganic Acids. Part I. Boric Acid. Part II. Phosphoric Acid.—C. N. Hinshelwood and C. R. Prichard: Two Heterogeneous Gas Reactions.—C. N. Hinshelwood and C. R. Prichard: A Homogeneous Gas Reaction. The Thermal Decomposition of Chlorine Monoxide. Part I.—R. G. W. Norrish and E. K. Rideal: The Direct Union of Oxygen and Sulphur.—W. R. Ormandy and E. C. Craven: Note on Aqueous Formaldehyde Solution.—H. Hawley and H. J. S. Sand: The Interaction of Potassium Tetroxide with Ice and with Dilute Sulphuric Acid.

PUBLIC LECTURES.

THURSDAY, OCTOBER 4.

UNIVERSITY COLLEGE, at 2.30.—Sir Flinders Petrie: Religious Life in Egypt (Introductory Lecture).

LONDON SCHOOL OF ECONOMICS, at 5.—Sir Arthur Newsholme: Measurement of Progress in Public Health (William Farr Lecture).

UNIVERSITY COLLEGE, at 5.15.—Dr. T. G. Pinches: The New Babylonian Creation and Flood Stories. (Succeeding Lectures on October 11 and 18.

KING'S COLLEGE, at 5.30.—Prof. R. J. S. McDowall: The Position of Physiology in Science and Medicine.

FRIDAY, OCTOBER 5.

UNIVERSITY COLLEGE, at 5.—Miss Margaret A. Murray: Primitive Religion.