lecturer put forward as a tentative hypothesis the theory that, underlying the gross and visible micro-structure of the steel, there existed a molecular structure, which in the present state of knowledge could not be detected, except in rare cases, by the microscope. It was suggested that this molecular structure was brought about by improper heat treatment developing in the ferrite from a series of centres well developed mineral cleavage. On the circumference of these centres existed areas in which the molecular cleavage was less perfectly developed, and beyond these were the areas of good steel in which the cleavage lines were extremely imperfect. It was then easy to conceive that the plane of dynamic fracture in a perfectly developed cleavage area might give the remarkably low record of having endured only 230 alternations, as in the table previously exhibited on the screen, whilst a test-piece in which the plane of fracture went through an area of good steel free from what might be called cleavage disease might readily endure 1290 alternations before breaking, and a third test-piece from the middle zone of somewhat developed cleavage might endure, say, 700 alternations. This theory, at any rate, was in accordance with the mechanical facts which had been presented. Another step towards the experimental verification of this hypothesis would be to prove that iron was a veritable mineral, as capable of exhibiting geometrical cleavage as was, say, fluor-spar or Carrara marble. Fortunately the lecturer

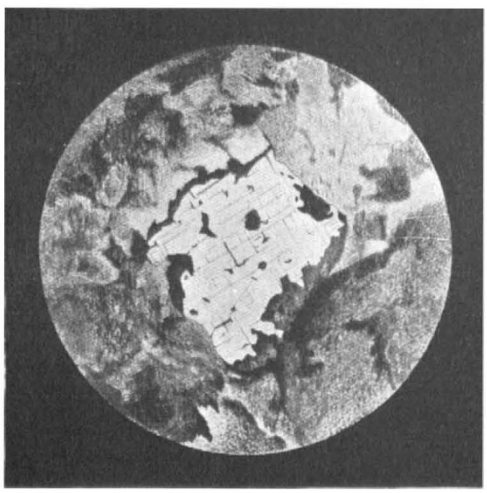

FIG. 3.

found himself in a position, by what might be called a million-to-one chance, clearly to prove that iron could possess absolutely perfect mineral cleavage parallel to the faces of the cube. This discovery came in no heroic form from the swift-moving machinery of a destroyer or in connection with metal forming the stupendous engines of a battleship, but in connection with a wrought-iron bolt, literally forming part of a common or garden gate-post. This fractured under the taps of a hand-hammer during repairs, and one of the crystals cleaved exactly at right angles to the axis of the bolt, and consequently when the fractured end was cut off in the lathe for examination, it was found at right angles to the axis of the microscope, exhibiting the wonderfully perfect cubic cleavage delineated in Fig. 3.

Metallurgists had now arrived at a deadlock. The microscope, after rendering great services, had in its turn broken down, mainly owing to the fact that optical examinations associated with transmitted light could not be applied to opaque objects, and in more senses than one the scientific metallurgist could not yet see through steel. Nevertheless, he must endeavour to tear down this mysterious veil or in some way get behind it, and in the lecturer's opinion the resources of science in connection with steel metallurgy were not yet exhausted.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

MR. A. C. SEWARD, F.R.S., has been appointed professor of botany in the University of Cambridge in succession to the late Prof. Marshall Ward.

WE learn from *Science* that Mr. J. A. Creighton, one of the founders of Creighton University, Omaha, Nebr., has presented to that institution two buildings worth about 100,000*l*.

AN interesting educational development in Manchester is recorded in the *Electrician*. The Corporation of that city has just decided to take approved students from the School of Technology into the electricity works for a three years' training, giving them a certain small but increasing salary during that time. This privilege is to be restricted to sons of Manchester ratepayers.

IT is announced in *Science* that Mr. A. C. Chapin has given Williams College an additional gift of 10,000*l*., to be used by the trustees without restriction, and that Mr. C. T. Barney has given 2000*l*. to the college. It is stated that the fund for Oberlin College, as completed, amounts to 100,300*l*. This includes the following funds:—25,000*l*. for a new library building given by Mr. Andrew Carnegie, 20,000*l*. for library endowment, 20,000*l*. from an anonymous donor in Boston for the increase of salaries of teachers in the college and seminary, and 30,000*l*. for miscellaneous purposes. The gift of the Boston donor enables the trustees to increase by 40*l*. the salaries of twenty-four full professors.

THE following announcement appears in the volume of Regulations (Cd. 3201) just issued by the Board of Education containing the prospectus of the Royal College of Science, London, with which is incorporated the Royal School of Mines (session 1906–7):—"It is probable that as a result of the investigation made by the departmental committee lately appointed by the President of the Board of Education, various changes will be made in the organisation and relations of the Royal College of Science, including the Royal School of Mines. The Board therefore give notice that the arrangements detailed in this prospectus are subject to such alterations as they may determine in respect of the classes for the college session, 1906–7, and of courses of study in future."

THE last report of the Scotch Education Department dealing with secondary education in Scotland directs attention to a new departure in the method of awarding leaving and intermediate certificates. The report states that last year the aid of the teacher was actively enlisted in determining the question of success or failure, and that much weight was attached to a pupil's school record, as properly attested by his teacher, in the allocation of school bursaries. The secretary puts it on record that events have completely justified the confidence of the Department. The teachers, as a body, have risen to the responsibility that was placed upon them. Of course there were cases of miscalculation by the teacher, but these were rare exceptions. The success which this Scottish experiment has met in the direction of humanising the methods of appraising knowledge and intellectual training, with the object of selecting the best pupils, should encourage those responsible for examinations south of the Tweed to increase their efforts to abolish the mechanical character of many of the current tests to which young students are subjected.

THE annual general meeting of the Association of Teachers in Technical Institutes was held on Saturday, October 27. Mr. W. J. Lineham, president, occupied the chair, and Mr. V. Mundella was elected president for the ensuing year. The following resolutions were adopted:—(1) That the association urges the desirability of attendance at evening continuation schools between the ages of fourteen and sixteen being made compulsory upon all not in attendance at elementary or secondary schools. (2) That in view of the generally inadequate provision made in the present scholarship schemes of local educational authorities for the needs of scientific, technological, and trade students, the local branches of the association be instructed to consider what amendments of local scholarship schemes

are necessary to meet the needs of such students, and to press such amendments upon the local education authority with the view of remedying the defects indicated. (3) That the attention of the technological branch of the Board of Education be directed to the desirability of recruiting the staff of inspectors from those with experience in technological teaching.

By the will of the late Mr. John Daglish, Armstrong College, University of Durham, will eventually receive about 45,000*l.* After the payment of claims on the estate and certain legacies, the whole of the testator's property is placed in the hands of trustees upon trust to pay the income to the testator's widow during her life. Subsequently 5000*l.* is to be paid to Armstrong College for the foundation and maintenance of a travelling fellowship in mining and the associated subjects to be called the "Daglish Fellowship." As certain annuities successively fall in, the income is to be paid to Armstrong College for its general purposes, among which three, in the order named, are to have precedence. The first of these is the augmentation of the principal's stipend to 1500*l.* a year, the second is the augmentation of the stipend of the professor of mining to 800*l.* a year, and the third the augmentation of the stipend of the professor of agriculture to a similar sum. When all the annuities have fallen in, the trustees are to hand over 30,000*l.* to the college to be invested for its general purposes. The income of the residue is to be paid to Armstrong College, to be applied as ordinary revenue, until the council of the college shall erect, as one scheme, further buildings costing not less than 20,000*l.*, and shall have received from legacies or subscriptions 10,000*l.* applicable to such buildings.

The new buildings of the King Edward VII. Grammar School, at King's Lynn, presented by Mr. (now Sir) W. J. Lancaster, were opened by the King and Queen on Monday. The Town Council of Lynn provided the site for the buildings, which with the foundations cost more than 43,000*l.*, and include chemical and physical laboratories and lecture-rooms. In the reply of the King to an address of welcome presented by the Mayor of Lynn, the words occur:—"The occasion of our presence here to-day shows that you are not content with the traditions of the past, however worthy of remembrance those may be; but through the liberality of an old pupil of the school which bears my name, the new buildings of which I am now about to open, are determined to keep abreast of the times, and are conscious that it is only by a thorough education that the younger generation can hope to prove successful in later life." An address was also presented by the governors of the school; and the King read a reply, in the course of which he said:—"You are aware of the deep interest which I have always taken in the public institutions of the county of Norfolk and in all schools established for the purpose of imparting higher education. It is not easy to overestimate the far-reaching benefits of the tuition obtained in such an institution as this. . . . You, as governors of the school, will, I feel sure, exercise the most solicitous care in the direction of the studies of your pupils, that they may be able to face the stress of life with an intellectual equipment such as will enable them to hold their own in the world and bear their part in its work and duties with efficiency and to the benefit of others; nor will, I feel confident, the higher teaching of morality, truth, and self-respect be neglected."

The annual report of the council of the City and Guilds of London Institute for 1906 has reached us. In the last report the council directed attention to the financial position in which the institute had been placed by the reduction of the contributions of the Corporation and the Mercers' and Fishmongers' Companies, but in the present report the council is able to state that the Corporation has reverted to its previous contribution of 500*l.*—the amount in 1904 having been reduced to 400*l.*—and has decided to contribute a similar sum for each of the following five years. The Mercers' Company has also reverted to its original contribution of 2000*l.* The Vintners' Company has increased its contribution, and the Saddlers' Company has withdrawn conditions previously attached to its subsidy. The Fishmongers' Company has yet to rescind its resolution to reduce its contribution from 4000*l.* to 2000*l.* The extracts printed in the volume from the examiner's reports should be carefully read by teachers and students. Apart from the value of the suggestions and criticisms they contain, they afford an instructive insight into the mental capacity of the artisans, who are training to become skilled operatives in many of the chief branches of industry. They show very clearly where the preliminary education of these students is at fault, and the errors into which they most frequently fall. The council remarks that from the reports furnished by the examiners it appears that, on the whole, there is a gradual but distinct improvement in the character of the students' work, and in the knowledge, intelligence, and skill which their answers and exercises display.

An address by Prof. George H. Mead, delivered before the Chicago Chapter Sigma Chi in March last, is reprinted in *Science* for September 28. Prof. Mead states that science in the colleges of Chicago and other American universities has not the importance and popularity that it should have. This is due, it is said, to the freedom of choice of studies in the preparatory schools; the scientific courses are not selected by the children at a period when the concrete subject-matter of science properly presented should be immensely more attractive than languages and abstract studies. The science courses in the high school are not, Prof. Mead affirms, popular at the present time, nor is the money spent on them, whether in equipment or teaching staff, comparable with their educational importance. The result is that the majority of American students leave the universities without a grasp of the important achievements in modern thought, and without being able to interpret what they see, hear, and feel, by means of the splendid generalisations now known to the world. Prof. Mead explains the unpopularity of science in schools and colleges by the statement that scientific problems are no longer within the immediate experience of the student, and not always to be expressed in terms of that experience. In addition, he says, the natural sciences are not interconnected in the minds of the students. Discussing the remedy for this misfortune, Prof. Mead thinks it lies with the schools, where children should be introduced to science in an intelligent manner. Until this is done the colleges, he maintains, should arrange introductory courses in science, in which the subject should be presented from the points of view of history and of a survey of the world of science as a whole. In this way, the address contends, the culture value of science would become clear and suitably esteemed.

A recent article by Mr. J. L. Bashford in the *Westminster Gazette* provides an interesting description of the Berlin High School of Trade, or Merchants' College, which was opened in the presence of the Crown Prince a few days ago. The college has been erected by the Corporation of the Merchants of Berlin at a cost of about 166,000*l.*, and will be maintained entirely by the same body. The State has in this instance made no grant, nor did the idea of the college originate with the Education Department. This Berlin school is the only institution of the kind in Germany, and is intended for merchants. The aim of the teachers will be to give the students knowledge and a theoretical training. Lectures will be delivered on all subjects connected with the usances of trade—exchange, banking, Stock Exchange, gold and silver standard, investment of capital; the history and technique of certain branches of industry—*e.g.* electricity, machines and the textile industry, book-keeping, arithmetic and insurance, trade politics, political economy, statistics, social questions, the requirements of workmen in factories, the money market and its organisation in Germany, England, France, and the United States of America; civil law, commercial law, and every other form of law connected with trade relations; commercial geography and commercial history. Philosophical and art studies also find a place in the programme, and knowledge of foreign languages as well as knowledge of foreign countries. The new college contains an aula, capable of holding about 600 persons, and nine lecture-rooms, some for forty and others for fifty, 100, and 150 students, as well as a laboratory for chemistry and one for physics.

FROM Continental contemporaries we note the following recent appointments:—Prof. H. Rubens, professor of physics at the Technical High School, Berlin, to be professor of physics at the University of Berlin and director of the Physical Institute; Prof. Arthur Wehnelt, professor of theoretical and applied physics of the University of Erlangen, to be a professor and departmental director in the University of Berlin; Dr. Joseph Grünwald, privatdocent at the University and the Technical High School of Vienna, to be extraordinary professor of mathematics in the University of Prague; Dr. H. Mache, privatdocent of the Vienna University, to be extraordinary professor of physics in the University of Innsbruck; Prof. Cæsar Pomeranz, extraordinary professor of chemistry in the Vienna University, to be professor of chemistry in the University of Czernowitz; Prof. Karl Zsigmondy, professor of mathematics in the Technical High School, Prague, to the chair of mathematics in the Technical High School, Vienna; Prof. Reissner, privatdocent in the Technical High School, Berlin, to be professor of mechanics in the Technical High School, Aachen; Prof. Zdenko Skraup, professor of chemistry in the University of Graz, to the chair of chemistry in the University of Vienna; Prof. Franz Streintz, privatdocent of the University of Graz, to be professor of physics of the Technical High School in Graz.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 31.—"The Viscosity of the Blood." By Dr. A. du Pré **Denning** and John H. **Watson.** Communicated by Prof. F. Gotch, F.R.S.

It is urged that the full import of a knowledge of the variations in the viscous resistance to be overcome by the blood in circulating through the capillaries and smaller vessels of the system, and the significance of such data to the more exact consideration of a large number of normal and pathological conditions, especially those of the circulatory system, have not been fully realised by either clinicians or physiologists. Experiments have been undertaken to observe the influence of the number of the corpuscles present upon the viscosity of the blood under varying conditions of pressure and temperature, the rate of flow through capillaries of different sizes under the same conditions, and the alterations caused by the additions of certain salts and other substances; one important result of the experiments was to show that the decrease in viscosity for each degree rise of temperature for a blood rich in corpuscles is considerably greater than for a blood poor in corpuscles, especially when the flow is through the finer capillaries, or, in other words, the flow of blood does not follow the fourth power of the radius as required by the Poiseuille formula. An attempt is made to indicate briefly the import of the results obtained in a consideration of the mechanism of the circulatory system. At the end of the paper an account is given of a clinical viscosimeter which the authors have devised for determinations of blood viscosities with but a few drops of blood; such viscosity determinations, it is claimed, are necessary supplements to hæmacytometer observations.

June 21.—"On the Behaviour of Certain Substances at their Critical Temperatures." By Dr. Morris W **Travers,** F.R.S., and Francis L. **Usher.**

Traube, de Heen, and others have recently suggested that the simple theories of Andrews and Van der Waals may be insufficient to account for the changes which take place in pure substances at their critical temperatures. Their evidence appears to show that in the case of such substances as ethyl alcohol and ether the Cagniard-Latour temperature is dependent on the relative volumes of the two phases, and to account for this they have suggested the existence in the system of complex molecules.

The authors have carried out investigations with ether and with sulphur dioxide, and have found that the Cagniard-Latour temperature is independent of the conditions under which the experiments are carried out. Particular precautions were taken to obtain the liquids pure and to maintain steady temperatures, the measurements of which were certainly accurate to within 0°·05.

The second part of the paper deals with the phenomenon of opalescence which is observed in pure liquids at their critical temperatures. If varying quantities of a pure liquid are heated in sealed glass tubes, provided that the liquid neither disappears nor completely fills the tube before the critical temperature is reached, the surface separating the two phases may sink and disappear near the bottom of the tube, or it may remain stationary about the middle of the tube, or, lastly, it may rise and vanish near the top. In all three cases, if the temperature is raised so slowly that equilibrium is attained without ebullition of the liquid phase, the contents of the tube become opalescent at a temperature slightly below that at which the surface vanishes, the effect being similar to that produced by the action of oxidising agents on a solution of sulphuretted hydrogen. When the surface is falling the opalescence appears in the space below it, and when the surface is rising, in the space above it. In either case the opalescence is confined to the space in which it first appeared by the moving surface, and its intensity is inversely proportional to the volume it occupies. Although it is fairly evenly distributed through the space it occupies, it is usually more intense very near to the surface, and when the latter disappears gradually becomes diffused through the whole tube.

In the case where the surface appears to remain stationary, the tube appears slightly and evenly opalescent throughout its whole length, and if, when this is the case, the volume of the space containing the substance is increased or decreased, opalescence appears below or above the surface itself, and its intensity is inversely proportional to the space it occupies. The effect persists over a finite range of temperature. In the case of sulphur dioxide it sets in at 0°·1 below that at which the surface vanishes, attains a maximum at about 0°·05 above it, and completely disappears at a temperature 0°·1 higher. In the case of ether the effect persists over about 2°.

The conditions necessary for the existence of complexes in a liquid-vapour one-component system in the neighbourhood of the critical temperature were given by Donnan at the British Association in 1904. He suggested that at the critical temperature the interfacial tension becomes zero for ordinary values of the radius of curvature, but remains positive for very small values, for which it does not become zero until the critical temperature is passed. Hence it may be assumed that at temperatures slightly below the critical the interfacial tension is greater for very small radii of curvature than for ordinary curvatures. If over a range of temperature, including the critical temperature, limited above by the temperature at which the interfacial tension for very small curvatures becomes zero, and below less sharply, small non-molecular aggregates can be formed, it follows that these will be differentiated from either the liquid or vapour phase, and will have a stable existence. To such aggregates is attributed the phenomenon of opalescence, and the range of temperature over which it is observed, and the manner of its appearance and disappearance, are in agreement with the assumptions.

PARIS.

Academy of Sciences, October 29.—M. H. Poincaré in the chair.—A new and rapid method for the determination of the errors of division of a meridian circle: M. **Lœwy.** A more detailed discussion of a method described in outline in an earlier paper.—The moth of the beetroot, *Lita ocellatella*: Alfred **Giard.** The author has recognised by a further study of this parasite that he was in error in identifying it as belonging to the species *Loxostege sticticalis* of American naturalists, or *Phlyctoenodes* or *Eurycreon sticticalis*, according to the European nomenclature. The author points out the remarkable facility with which the larvæ escape through small apertures, and the danger through this cause of sending live specimens through a district not subject to this pest.—Observations on the sun made at the Observatory of Lyons during the third quarter of 1906: J. **Guillaume.** The results are summarised in three tables, giving the surfaces of the sun-spots, their distribution in latitude, and the distribution of the faculæ in latitude.—The deformation of quadrics: Luigi **Bianchi.**—The transformations of some linear partial differential equations of the second order: