deposited, and the remainder froze as a eutectic in which these crystals were encased. The phosphide crystals showed sharp geometrical outlines, in marked contrast to the outlines of the crystals of solution, because the phosphide was deposited as a definite constituent in which the other constituent (iron) was not soluble.

To explain the zebra markings characteristic of eutectics, Dr. Ewing briefly referred to the phenomenon of surfusion, and gave it as his opinion that the formation of a eutectic occurred by alternate surfusion or supersaturation of each constituent in the other. A eutectic in the fluid state and about to freeze might be defined as a saturated solution of A in B which was at the same time a saturated solution of B in A. On the temperature falling, an alternating condition of instability results. By surfusion, A is at first supersaturated with B, until some of B is thrown down, leaving, in the liquid that remains, B supersaturated with A. Consequently, some of A is in turn thrown down, and so on alternately. In the appearance of a eutectic alloy there was much that was suggestive of alternate deposit of the two constituents, and it was in some such way as this that Dr. Ewing conceived the alternation to take place.

Eutectics in which the constituents were not of the same crystalline system appeared to be mechanically weak. A very small quantity of bismuth added to copper or silver or lead was shown by Arnold to produce great brittleness, owing to the weakness of the cement which the eutectic formed in the joints between the grains, although the individual grains themselves preserved their original malleability. In other eutectics no such weakness, as a rule, was found, and the intergranular cement was as strong as the grains themselves—often, indeed, it was distinctly stronger.

From the engineering point of view, by far the most important alloys were those in which the chief constituents were iron and carbon, or rather iron and carbide of iron. By help of Roozeboom's diagram, the lecturer explained briefly the characteristics of high and low carbon steels, and the transformations which occur in the process of cooling at temperatures far below that at which the metal becomes wholly solid, which had formed the subject of much study by Osmond, Roberts-Austen, and others. By the process of quenching these changes might be to some extent arrested, and the mechanical properties secured which characterise hardened steels. The evolution of heat in the transformation was illustrated by means of cooling curves, and by experiments in which steel wire was allowed to cool after being electrically heated above the transformation points. While passing through the region in which transformation occurs, the steel is specially plastic; this was illustrated in the cooling from bright redness of a steel wire coiled into the form of a spring and carrying a light weight. The spring extended in a conspicuous way while the process of re-crystallisation associated with "recalescence" was going on. The phenomenon of recalescence was further illustrated in an automatic record obtained during the lecture with a Callendar recorder which was exhibited by the Cambridge Instrument Company. The recent results of Carpenter and Keeling, in their research at the National Physical Laboratory, were referred to as giving in most particulars a general confirmation of Roozeboom's views. Other examples of transformation occurring in the solid state were illustrated by photographs selected from Neville and Heycock's series for the copper-tin alloys.

The gradual changes of structure which go on even at atmospheric temperatures in lead and other metals after the structure has been broken up by severe straining were next described, photographs by Rosenhain and the lecturer being exhibited to demonstrate the progressive character of these changes, and the manner in which they would be accelerated by elevating the temperature.

In conclusion, the lecturer referred to the analogous case of glacier ice. It had for long been known to possess a granular structure, and each grain was a crystal just as in the case of metals. Photographs by Principal Skinner, illustrating this granular structure, were shown. In the upper névé the grains were vague and comparatively small; as the glacier slowly travelled down the grains became consolidated and large, and their outlines became well defined. It was clear that a slow process of crystal growth was going on, and in the lecturer's opinion it was to this very process of growth that the plasticity of the glacier as a whole was to be ascribed. How ice came to be plastic in large masses was a question to which physicists had suggested more than one answer. But the plasticity was intelligible enough when one realised that the whole mass was in the act of structural change. Just as the spiral spring in the experiment with steel showed during its transformation a special plasticity, so the glacier showed a general plasticity throughout its course, inasmuch as it was undergoing a slow and probably continuous structural change in the crystallisation of its individual grains. Alike in the metal and the ice, nature was apparently following one structural process, and the consequences as to plasticity were alike in both. In neither case was any constancy to be found save the constancy of change. Nothing was more striking to a worker in this field than the evidence he found that those substances on which we were most accustomed to rely as constant were undergoing, sometimes comparatively fast and sometimes very slowly, a process of internal flux. A monument more enduring than brass might be a lofty ideal, but it was seen at least to be an ideal easy of conception when one realised how far from constant the inner structure of brass and other metals was apt to be.

THE GAS SUPPLY OF THE METROPOLIS.

A committee was appointed by the Board of Trade in January last to inquire and report as to the statutory requirements relating to the illuminating power and purity of the gas supplied by the metropolitan gas companies, and as to the methods now adopted for testing. The report of this committee has now been presented, after hearing evidence from the metropolitan gas referees, from representatives of the London County Council, the Corporation of the City of London, and each of the three gas companies concerned.

The supply of gas in the metropolis being a monopoly, provision is made in the private Acts of the various companies for securing the maintenance of certain standards of purity and illuminating power. Three gas referees are appointed by the Board of Trade, with power to prescribe and certify the situation and number of testing places to be provided, and to lay down the conditions under which the testings are to be made. By the insertion of clauses in recent Acts obtained by the gas companies bearing on the mode of testing, these powers have been somewhat curtailed. The testing places are usually fitted up in houses owned or leased by the gas companies, the tests being made by officials appointed by the controlling authority, either the London County Council or the Corporation of the City of London. A comparison of the tests made at the official stations with tests made with a portable photometer in the neighbourhood of those stations having shown considerable discrepancies, attempts have been made by the controlling authority to legalise the portable photometer, but these attempts have been successfully resisted by the gas companies before Parliament, and the present committee in the report is not prepared to recommend the adoption of such tests. As, however, these results have given rise to doubt as to whether the gas supplied to the testing stations really represents the gas supplied to the public, the gas referees have laid down a requirement that the gas to be tested is to be brought direct from the main to the testing place by a single service pipe, without tap or branch or provision for connection of any kind outside the testing place. This has been strenuously resisted by one of the companies, and has led to the curious result that, although the referees have powers to prescribe testing places, they have no powers to enforce their prescription, and owing to the deadlock thus created two testing places have remained closed for some years.

The committee is of opinion that this requirement is a reasonable one, and that it might with advantage be made a statutory requirement not dependent on the prescription of the gas referees.

In the case of any deficiencies being found by the official examiners, action is taken by the controlling authority before a magistrate, with a view to the recovery of the forfeitures specified in the Acts. If any technical objection is raised by the gas companies, the question is referred to

the chief gas examiner (Lord Rayleigh), and unless the appeal is sustained the case is referred back to the magistrate for the assessment of the amount to be paid. The gas companies have always strongly objected to these police court proceedings, and the committee recommends a modification of the existing provisions whereby, in future, police court proceedings will not be required when the chief gas examiner shall certify that the default is not substantial, or that it is not due to careless conduct at the works, the forfeitures in all such cases being left for assessment to the chief gas examiner. The committee also recommends that in the case of any disputes arising between the gas referees and the gas companies, they should be referred to the chief gas examiner, and that his decision should be conclusive and binding on both parties.

Important concessions to the companies are recommended by the committee with regard to the amount of sulphur impurity allowed. In addition to a relaxation of the stringency of the tests to be applied for the detection of sulphuretted hydrogen, it is suggested that the standards for the amount of sulphur present in the gas, other than sulphuretted hydrogen, should be abolished. The committee has been influenced in this decision by the consideration of the nuisance created near the works by the use of lime purification, and the danger to the men employed in connection with the process. At the same time, however, it is proposed that the official tests should continue to be made, and that the amount of impurity in each form contained in the gas should be ascertained and recorded.

In view of the increasing amount of gas used in incandescent burners and for heating and power purposes, it is considered desirable that the calorific value of the gas should be determined and recorded, but no standards are proposed, and photometrical data with flat flame burners, in addition to those already made with the standard Argand, are also suggested as desirable.

The report has been issued within five months of the date of appointment of the committee, and it is to be hoped in the interests of the public that the legislative action necessary to carry these suggestions into effect may be made with equal promptness.

SEISMOLOGICAL NOTES.

IN the *Bollettino della Società Sismologica Italiana*, vol. ix., No. 7, Dr. A. Ricco gives an interesting paper on the relative values of gravity in the vicinity of Etna, Sicily, the Æolian Islands, and southern Italy. The results are shown in two sketch maps, on which a series of lines having the appearance of isomagnetics pass through places at which the difference between the expected and the observed values for g are equal. The smallest values for the anomaly or $g-\gamma$. are found round the summit of Etna, whilst maxima occur in the proximity of deep water about 80 km. to the south-south-west and 150 km. at Stromboli to the north. A similar but not so marked gradient is found in the vicinity of the Bay of Naples. Along the Apennines and in central Sicily the anomaly is small, and the gradient is gentle. These observations are discussed in relation to volcanic and seismic activity, orographic and geotectonic conditions. An obituary notice of Dr. Mosé Contarini, who died at the early age of twenty-eight, at the commencement of a promising career, and a catalogue of disturbances for July, 1902, complete the number.

In vol. ix., No. 8, of the same publication, Dr. A. Cancani describes and analyses five seismograms relating to earthquakes with known origins. The peculiarity of these seismograms, copies of which are given, is that they were obtained on a high speed (72 to 97 mm. per minute) smoked paper record receiving surface.

The diagrams are therefore sufficiently open to read periods of half a second, which periods refer to the preliminary tremors. From the interval in time between the commencement of these first movements and the commencement of the large waves, the distances of origins from Dr. Cancani's station in Rome are calculated. The accuracy of the results obtained therefore depend upon the accuracy with which these two phases of motion can be identified upon the seismograms. In the first earthquake considered these identifications are clear, but if the figures for the remainder are exact reproductions of the original seismograms, it seems extremely likely that very different results might be arrived at by different investigators. For writing pointers with a minimum of friction, Dr. Cancani uses the hanging aluminium indices of his colleague, Dr. Grablovitz. The cost per annum for the recording materials, which include 730 sheets of paper, gas or oil for smoking, and varnish for fixing the same, &c., is about 3*l*. 15*s*. At the end of the number the earthquake registers are brought up to the end of August 1902.

The Austrian Earthquake Commission publish in No. 22 (new series) observations made by Dr. W. Láska in 1902 in Lemberg. They refer to records obtained from Reubeur-Ehlert horizontal pendulums.

In the *Mémoires* of the Geological Committee of St. Petersburg, No. 9 (new series), Dr. V. Weber gives a detailed account of the earthquake which on January 31, 1902, destroyed Chemaka. The epifocal area appears to lie along the major axis of a series of elliptical isoseists, and a map on which these are shown also indicates the different degrees of destruction in various villages within the disturbed district.

The phenomena observed are similar to those noted with many large earthquakes.

Another publication received from Russia is the *Bulletin* de la Commission Centrale Sismique Permanante. It refers to records obtained in the months April, May, and June at Tiflis, Taschkent, Irkutsk, Dorpat, and Krasnoiarsk, at each of which stations there are one or more seismographs.

The contributions to seismological knowledge received from Japan are as usual both varied and interesting.

Following in the footsteps of Dr. C. G. Knott, Mr. A. Imamura, in the reports of the Physico-Mathematical Society of Tokyo, vol. ii., No. 8, discusses certain earthquake registers, with the result that he finds that seismic disturbances have not only been most frequent at the times of conjunction and opposition of the sun and moon, but also at the times of quadrature. The extent to which barometrical pressure may effect seismic frequency is to be found in the same journal, the author being Dr. F. Ōmori. Another note by the same writer describes a horizontal pendulum controlled by an inverted pendulum. The former is 1 m. in height, and has a boom 1 m. in length which carries 50 kg. With its control a period of one minute is obtained without difficulty.

Dr. Ōmori's most important work is contained in No. 15 of the *Publications* of the Earthquake Investigation Committee. It relates to the measurement of the vibrations of railway carriages as recorded by seismographs. For years past the balancing of locomotives and the state of the permanent way have in Japan been determined by means of these instruments, and the practical advantages leading to the saving of fuel and the detection of faults which have accrued are generally known. Here we have an elaborate extension of previous work which railway engineers may read with advantage.

At the end of this number an index is given to the contents of the sixty-three profusely illustrated series of volumes and parts which, since 1893, have been issued by the Tokyo Earthquake Investigation Committee. Unfortunately for European readers, forty-seven of these publications are in Chinese idiographs. Amongst the latter we find reports upon seismographs, observations made in deep bore holes, notes upon magnetic disturbances which have preceded certain large earthquakes, many observations made for the purpose of determining the transit velocity of earthquake motion, observations relating to subterranean sound phenomena, observations upon sea waves, investigations relating to seismic frequency, reports upon faults, landslips and volcanoes, and a mass of material, all the result of patient investigation, which is of great importance to modern science. Many of the papers are of immediate value to those who have to construct in earthquake countries. Not only has the Japanese Government encouraged its engineers to study the effects of earthquakes upon structures within its own territory, but lengthy reports upon the damage which took place in Assam in June, 1897, indicate that it was considered advisable to derive lessons from misfortunes in foreign countries, and for this reason missions of