iron pipes placed in the flue between the boilers and the chimney. The feed-water passes through the pipes on its way to the boilers, and takes up some of the heat from the waste furnace gases, which thus reach the base of the chimney at a temperature lower than would otherwise be the case. The exterior surfaces of the tubes are kept clean by scrapers, which travel automatically up and down the tubes. In 155 plants fitted with economisers the average efficiency of the appliance was 11.4 per cent. The possible practical efficiency is $17\frac{1}{2}$ per cent. to 20 per cent. Only 17 per cent. of the plants were saving 15 per cent. or more of the coal-bill, and more than 30 per cent. of the plants were saving less than 10 per cent. The fault does not lie with the economiser as an appliance, but is due to the fact that the economical generation of steam is not understood, and economisers are often not installed on correct lines. The authors estimate that a saving in this country of from 7,000,000 to 10,000,000 tons of coal per annum could be obtained by the use of economisers installed on correct scientific lines.

THE Decimal Association, 212 and 213 Finsbury Pavement House, Finsbury Pavement, London, E.C.2, has published in pamphlet form the article on "The Metric System and Decimal Coinage" contributed by Mr. Harry Allcock to the issue of NATURE for June 6, 1918. It will be remembered that the article was concerned with the attitude towards the metric system of weights and measures and decimal coinage taken by Lord Balfour of Burleigh's Committee on Commercial and Industrial Policy after the War, and it was shown that the decisions arrived at were open to serious criticism.

DR. L. L. FERMOR has pointed out to us, in connection with our notice of his recent paper on hollandite (NATURE, vol. ci., p. 392), that he used the term "bipyramidal" as a synonym for the older "pyramidal" in the paper itself. He also shows that the name "romanéchite" is correctly accented, according to French usage, although derived from the place-name Romanèche, a good analogy being the three words *cher*, *chère*, and *chéri*.

THE LIBRARY PRESS, LTD. (26 Portugal Street, W.C.2), will publish shortly a translation, by B. Miall, of Prof. J. Amar's "The Physiology of Industrial Organisation and the Re-employment of the Disabled." The book is being edited by Prof. A. F. Stanley Kent, who will supply to it an introduction and notes.

OUR ASTRONOMICAL COLUMN.

THE DARK-LINE SPECTRUM OF NOVA AQUILÆ.—Dr. J. Lunt has sent to NATURE some interesting details relating to the transient dark-line spectrum of Nova Aquilæ, as photographed at the Cape Observatory with the McClean spectrograph on June 10, 11, and 12. Apart from the bright and dark hydrogen spectrum which was in process of development, the spectrum was a continuous one crossed by a true absorption spectrum consisting principally of the enhanced lines of titanium, iron, chromium, strontium, calcium, magnesium, and helium. As shown by iron comparison spectra, the entire series of lines was displaced to the violet by an amount representing a radial velocity of 1500 km. per second (June 11 and 12). The violet edges of broad absorption lines, left partially uncovered by broad bright bands, do not appear to be in question, and the displacement is regarded as a true Doppler effect, due to the actual motion of a stellar body possessing an intensely heated atmosphere of metallic vapours. As in the case of other novæ,

the fine dark H and K lines appeared nearly in their normal positions, but Dr. Lunt thinks it erroneous to consider their small displacements as representing the velocity of the star; it seems to him more probable that these lines do not originate in the nova itself, but in a nebulous mass lying in the line of sight. The residual incandescent and disturbed nebulous matter left behind after the passage of a rapidly moving star into a nebula would seem to offer a sufficient explanation of the bright-line spectrum. To account for the supposed enormous velocity of the nova, Dr. Lunt suggests that our own system may have a velocity comparable with those found for spiral nebulae, and that the velocity may result, in part from this motion, and in part from the high velocity of a wandering star which has come from outside our system.

As in Nova Geminorum, there were two sets of dark hydrogen and helium lines during the earlier stages, the first of which showed the same displacement as the enhanced metallic lines. On June 15 the second set had become comparatively narrow and sharp, and showed a displacement equivalent to 2286 km. per second; except for the K line, these have no counterpart in the enhanced line spectrum, and their meaning remains obscure.

OBSERVATIONS OF MINOR PLANETS.—Shortly before the outbreak of war an important international scheme of work on these bodies had been arranged, to secure that all should be sufficiently observed without waste of labour through overlapping. Though the organisation was shattered by war, the observations continue. Marseilles Observatory undertook the circulation of ephemerides and information generally; the recently published *Journal des Observateurs* (vol. ii., No. 9) contains observations of sixty-six planets made during the past year by MM. Gonnessiat and Sy at Algiers Observatory. They include some positions of Juno and Vesta. It is a matter for regret that the Nautical Almanac has discontinued its ephemerides of the four principal asteroids. No predicted positions of them are now available except the approximate ones in the list published annually at Berlin.

A BRIGHT METEOR.—*Astr. Nach.* (No. 4961) contains an account of a bright meteor which fell near Treysa, in Hessen, $9^{\circ} 10' \text{ E. Gr.}$, $50^{\circ} 55' \text{ N.}$, on 1916 April 3, 2h. 25m. G.M.T., the sun's altitude being $30^{\circ} 50'$. It was seen over a circle of 135 km. radius, and heard over a circle of 50-60 km. radius, besides a few isolated points at 100 km. distance. The earth-point was calculated, and a prolonged search at length revealed the meteor in a wood. It had made a hole 1.60 metres deep, at an inclination of 60° to the horizon, in a direction from N. 15° W. to S. 15° E., agreeing well with the calculated values. It was composed of iron, and weighed 63 kg. A Wegener, whose calculations led to its discovery, estimated that its final velocity was in the neighbourhood of 1 or 2 km./sec. The position of the radiant inferred from the observations during flight is $357^{\circ} + 80^{\circ}$, and from the direction of the hole in the ground $20^{\circ} + 78^{\circ}$. The difference is only 5° in great circle.

THE HOT WORKING OF STEEL.

IT is generally held that, in order to obtain the best mechanical properties of which a steel is capable, it is necessary, after having cast it in the form of an ingot, to subject it to a large amount of deformation either by forging or rolling or pressing at a high temperature. Many official specifications, in fact, require a given reduction of the original section of the ingot. These requirements are expressed as "the coefficient

of working," which is equivalent to the ratio of the initial to the final section, or, what comes to the same thing, that of the final to the original length. The minimum values assigned to this coefficient are generally three or four, and sometimes higher. Doubts as to the necessity of this, however, have been raised. Prof. Howe, in his treatise "The Metallurgy of Steel," after weighing the evidence on the subject, wrote many years ago that "cumulatively the evidence raises a presumption in favour of the view that the supposed special effect of kneading and pressure, as such, does not exist or is relatively unimportant." Prof. Tchernoff, the eminent Russian metallurgist, has gone even further, and claims to have proved that the effects of forging can be produced by heat treatment alone. In view of the great practical importance of the question, it is somewhat surprising that it has not been made the subject of decisive experiments until quite recently.

Much experimental work is, of course, carried out in metallurgical works which is never published, and from the character of the discussion on M. Charpy's paper entitled "The Influence of Hot Deformation on the Qualities of Steel," presented at the autumn meeting of the Iron and Steel Institute, it would appear that a certain amount of information on this subject is already available. Nevertheless, M. Charpy is entitled to the credit of having been the first in recent years to attempt to obtain an answer to the question with the view of publishing his results and submitting them to discussion.

M. Charpy's experiments may be classified under two heads. In the first place, he attempted to trace the actual character of the deformation when steel ingots are worked either by hot forging or hot rolling. By ingenious methods he was able to show conclusively that in the former the deformation is very far from uniform, that extremely variable local deformations are produced, and that in a given instance, where the mean coefficient of working was 4.8, the extreme values were 2.37 and 7.30. This was one of the simplest cases possible, namely, the transformation of a cylinder into one of smaller diameter; and there can be no question that in a more complicated forging the local deformation would be even more diverse. In the latter case the deformations are very much more regular, and they may be considered as practically uniform. At any rate, lines originally parallel with the axis of rolling were shown to remain rectilinear and parallel during the course of deformation.

In the second place, the author describes certain experiments, designed with great care, to determine the influence of hot working on the properties of the steel. Test pieces prepared from rolled bars, in which the coefficients of working were 1.7, 3.2, and 6.1, were subjected to tensile tests, impact-bend tests, and impact tests on notched bars. The test bars were all cut from the same parts of the ingot, and were situated at one-third of the distance between the surface and the axis so as to avoid the influence of segregation and axial porosities. The bars were quenched and annealed under exactly similar conditions. It was found that the hot rolling of the steel does not appreciably affect the tenacity or elongation either longitudinally or transversely, but that it improves the reduction of area and resistance to impact longitudinally, and considerably diminishes these values transversely. The extent of the variation depends on the quality of the steel, and is more marked the lower its purity. This is a very important result to have established, for it shows that the effects of hot mechanical work must be considered as they affect the properties of the steel both longitudinally and

transversely. The author declares that the favourable influence attributed to hot working rests solely on the fact that, in the great majority of cases, only the results of longitudinal tests have been taken into consideration, and that the conclusions arrived at have been unwarrantably extended to materials where the main stress is transverse. His conclusion is that for pieces working under transverse stresses, such as guns, longitudinal extension by hot working has undoubtedly an injurious effect, and that, so far from specifying a minimum reduction of cross-section of the original ingot, it would be much better to reduce it as little as possible. H. C. H. CARPENTER.

EDUCATION AND LIFE.

AMONG the Acts which will make memorable the closing session of the present Parliament none will be held of more momentous import than the Education Act of 1918, limited in its scope to England and Wales; or the scarcely less important measure dealing with Scottish education, which passed its third reading in the House of Commons on October 17. Both measures will have a potent effect on the future education of the two kingdoms, and be fruitful of great results for the educational and physical well-being of the children of the nation. It is therefore to be regretted that Prof. Robert Wallace, professor of agriculture in the University of Edinburgh, should have thought it well to occupy the attention of his students, on the occasion of the opening of the University session on October 8, with a denunciation of the policy of both measures, and that he has now issued and circulated the lecture as a pamphlet (Edinburgh: Oliver and Boyd, price 6d.) to Members of Parliament and the Press. Prof. Wallace is apparently persuaded that children between the ages of eight and fourteen should, for their practical instruction, participate actively in agricultural and manufacturing industry on the ground that 85 per cent. of the children of the nation must earn their living by hand-labour, and he would therefore introduce them at a tender and immature age into close intimacy with adults in field, factory, and workshop.

That is not, in the estimation of most thoughtful persons, parents, teachers, and administrators, a desirable policy to pursue in the best and permanent interests of the children and of the nation. Both measures provide not only for a fairly adequate training in literature and in science, but also for effective, practical instruction for both eye and hand, as well as for the physical health and training of the child, and that at just the period of his life when he is most susceptible of treatment and of the permanent effect of such training. Few Acts have been subjected to so large a measure of public discussion as the Education Act of 1918, or have won so general an approval. Its chief purpose, whilst providing for the general well-being of the childhood of the nation, so vital a matter in present circumstances, is to give full opportunity for those who are naturally gifted to share in the highest educational advantages which the nation can offer. Despite Prof. Wallace's strictures, it is demonstrable that the Education Act of 1870 has had a marked effect on the moral health of the nation; for whilst in 1865 70 per 10,000 of the population were convicted of crime, fewer than 30 per 10,000 were so convicted in 1913. And there is abundant testimony, some of which was cited by Mr. Fisher on the introduction of his measure, to the wonderful initiative and intelligent grasp of the young men trained in the elementary schools who, in their scores of thousands, joined the national forces