alloy content of the copper and the comparative mildness of the cold working, it is not so high as to lend support to the view that the Egyptians possessed a method of hardening copper with which we are unacquainted. The hardness of the axe-head was produced partly by alloying and partly by cold working. By a suitable choice of alloying elements and more effective mechanical treatment, much greater hardness can be produced to-day.

One further conclusion may be drawn. This investigation has made it possible to answer the question whether hardening by cold work is permanent in an alloy of this type at the ordinary temperatures. According to Mr. Brunton's view, the axe-head is more than 3700 years old. When I discussed this question with him and the extent to which this date might be in doubt, he was willing to advance it 200 years but no more. Accepting this, its age is at least 3500 years. No one, of course, can say whether it has lost any of its original hardness, but it is quite clear that it has retained a considerable amount of work hardness throughout this long period.

I wish to acknowledge the assistance of two members of my staff, Mr. C. W. Dannatt and Dr. M. S. Fisher, in the above investigation.

H. C. H. CARPENTER.

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Constitution of Rhenium.

OWING to the kindness of Dr. Noddack, who provided me with a sample of the heptoxide of his recently discovered element rhenium, I have been able to obtain its mass spectrum. Re_2O_7 is a slightly volatile greenish crystalline solid. Its vapour was first admitted to the discharge like that of osmium tetroxide, but with no success. The solid was then introduced into the discharge tube and heated in the cathode ray beam, but although the volatilisation was ultimately such as to cause a visible dark layer on the surrounding walls, not the slightest sign of its mass spectrum could be obtained. The substance seemed hopeless, so I proceeded to my next investigation, which was an attempt to get the mass spectrum of gold by volatilising its chloride. This compound is unstable and, as the presence of halogens had on some previous occasions brought out the lines of other bodies in a remarkable way, it seemed just worth while to volatilise it in the discharge tube before the rhenium oxide deposit had been removed from the walls. This procedure was successful beyond all expectation. Although no lines of gold were visible, the doublet lines of rhenium appeared in great intensity and in addition were repeated 16, 32, and 48 units higher as ReO, ReO_2, and ReO_3, so giving unusually convincing evidence of its constitution.

Rhenium consists of two isotopes, 185, 187, as was expected from the general rule that complex elements of odd atomic number (above 9) consist of two odd mass numbers two units apart, but it is the first element analysed in which the heavier isotope is the more abundant. The ratio of this abundance was estimated photometrically by analogy with the mercury lines to be 1·62 : 1. The position of the line 203 due to $Re^{187}O$ in the mercury group was used to determine its packing fraction, which is -1 ± 2, the same as that of osmium. From these provisional values the atomic weight on the chemical scale works out at $186{\cdot}22 \pm 0{\cdot}07$, in good agreement with Hönigschmid's latest value of 186·31. The strongest isotope of rhenium is isobaric with the weakest of osmium.

F. W. ASTON.

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The Behaviour of Antiknocks.

IT is generally agreed that it is the metallic radicle of an organometallic antiknock compound that is mainly responsible for the delaying of the oxidation of a combustible mixture. That the metal atom is in an oxidised state before it becomes effective, was an inference made on the basis of many different experimental facts, for example, the behaviour of potassium vapour,[1] but it has not been proved directly. We have recently been able to show that a small quantity of lead tetraethyl vapour, when let into an evacuated vessel heated to 265° C. into which a charge of pentane vapour and oxygen is afterwards introduced, will not affect the course of the combustion to any great extent, and may even accelerate it, but that if some oxygen is let into the vessel before the lead tetraethyl vapour, and then this followed by the bulk of the charge, the combustion is invariably strongly inhibited. These experiments provide direct evidence that the lead must first be oxidised before it is effective as an inhibitor. It is possible that the accelerating effect is due to the C_2H_5 radicles which help to start reaction chains, but that has yet to be proven.

A. EGERTON.

L. M. PIDGEON.

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[1] See Egerton and Gates, *J. Inst. Petm. Tech.*, **13**, 244; 1927.

Pasteurised and Raw Milk.

IN NATURE of Mar. 21, p. 466, an abstract appears of a report issued by the Department of Health for Scotland on "Milk Tests in Lanarkshire Schools", by G. Leighton and P. L. McKinlay. In this experiment, nearly ten thousand school-children received a supplementary ration of three-quarters pint of milk daily for about four months. Two important tables from the report, showing the average increases in height and weight of the children, divided into 14 groups by age and sex, are reproduced.

The special point to which we wish to direct attention concerns the apparent contrast in the effects of pasteurised with that of raw milk. About half the children receiving milk consumed it raw, while the other half were supplied with milk from the same source which had been pasteurised. It is somewhat unfortunate, however, that the recipients in the same school were never so divided, the whole of the milk supplied to any one school being either raw or pasteurised. In the absence of the records from the separate schools, it is impossible altogether to eliminate the doubt which this choice of method introduces; nevertheless, the report concludes with the statement (p. 20):

"In so far as the conditions of this investigation are concerned the effects of raw and pasteurised milk on growth in weight and height are, so far as we can judge, equal."

The importance of such a conclusion, if well established, is manifest. It is, however, open to some question, for Table 12, printed on the same page, shows that of the 14 groups (by age and sex), pasteurised milk gave a greater increase in height in only 2 groups, the increases were equal in 1 group, while in 11 groups the raw milk gave the greater increase. If we may regard these as 14 independent experiments, the difference from expectation on the hypothesis that raw and pasteurised milk have the same effects, is such as would only occur once in about ninety trials, and it seems evident that the conclusion should have been that the *growth response in height to raw milk is significantly greater than that to pasteurised milk.*

In order to examine the magnitude of the difference,

we have calculated from Tables 6 and 7 of the Report the average increments in the control, raw milk and pasteurised milk groups, weighting the averages given according to the total numbers of boys and girls in each group. In this way we find an average increase in height and weight, standardised for age, for the whole group of children observed. From the average increase, the excess ascribable to milk feeding is obtained by subtraction, and the relative value of pasteurised as a percentage of the value of raw milk, as measured by increase in growth, is calculated from the two differences.

AVERAGE INCREASES IN WEIGHT IN OUNCES.

	Boys.		
	Control.	Raw Milk.	Pasteurised.
Increase . . .	10·041	13·780	12·507
Excess over control .	..	3·739	2·466
Value per cent . .	..	100·0	66·0

	Girls.		
	Control.	Raw Milk.	Pasteurised.
Increase . . .	9·755	14·315	13·907
Excess over control .	..	4·560	4·152
Value per cent . .	..	100·0	91·1

In weight the average increment ascribable to the consumption of about 10 gallons of milk is a little more than 4 ounces, being a little more for girls than for boys. In both sexes the pasteurised milk gives a lower return, the increment ratios being 66·0 per cent in the case of boys, and 91·1 per cent in the case of girls. In respect of growth in height the contrast is even more striking :

AVERAGE INCREASES IN HEIGHT IN INCHES.

	Boys.		
	Control.	Raw Milk.	Pasteurised.
Increase . . .	0·7274	0·8145	0·7707
Excess over control .	..	0·0871	0·0433
Value per cent . .	..	100·0	49·8

	Girls.		
	Control.	Raw Milk.	Pasteurised.
Increase . . .	0·7300	0·8140	0·7889
Excess over control .	..	0·0840	0·0589
Value per cent . .	..	100·0	70·1

Measured by its effect in increasing growth in height, pasteurised milk appears from these data to have only half the value of raw milk in the case of boys, and about 70 per cent of the value in the case of girls.

These results are put on record to avoid the danger that, from a superficial examination of the report, the conclusion should be drawn that this extensive experiment demonstrates the equivalence of pasteurised and raw milk. In reality the reverse is the case ; and the very marked difference in response to two materials, which in their gross nutritional contents are so closely equivalent, raises a problem of very great interest, which can probably only be cleared up by more deliberate experimentation. The contrast between the response to pasteurised milk and that to raw milk is of value also in interpreting the difference between the milk-fed and the control children, for it would evidently be extremely rash to draw from the experimental results the 'natural' conclusion, that the increases induced by milk feeding indicate that the Lanarkshire children are, in their normal diet, inadequately supplied with such nutrients as fat, protein, or sugar, which are contained equally by the raw and by the pasteurised milk.

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Capture of Electrons from Mercury Atoms by Positive Ions of Helium.

IN a recent paper [1] we gave an account of some experiments on the determination of the mobility of ions in helium gas at a pressure of 360 mm. of mercury. We found that the mobility of the positive ions decreased when small traces of other impurities were introduced into the apparatus, and we interpreted the results as due to an 'exchange' phenomenon similar to that observed by Kallmann and Rosen in the case of high-speed positive ions. On this view, when a helium ion 'collides' with an

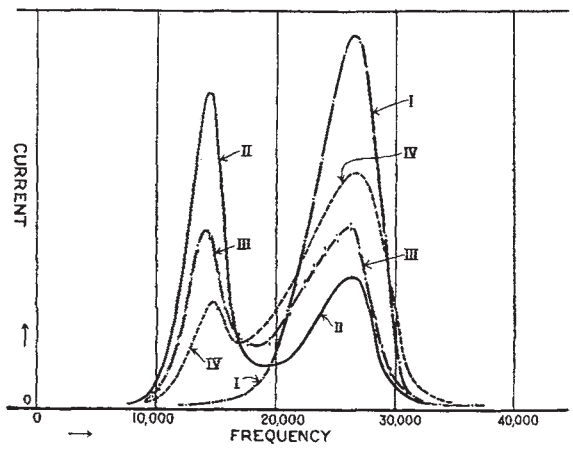

FIG. 1.

impurity molecule there is a certain probability that an electron will be captured from the impurity by the ion. The impurity ion so formed will not lose its charge in collisions with other helium atoms, because the ionisation potential of helium is greater than that of any impurity and the speed of the ions in our experiment is much too small to supply the energy required for the transition. For this reason, a very small concentration of impurity is sufficient to change completely the rate at which the positive charge is carried through the gas.

In our first experiments we had not sufficient control of the purity of the gas to identify the impurities which gave rise to ions of smaller mobility. We have now made experiments in a new apparatus in helium at 20 mm. pressure and have obtained a definite example of the exchange phenomenon from helium to mercury.

In our method of measuring the mobility of ions in gases, a peak is obtained in a current-frequency curve for each type of ion present (Fig. 1). Curve I shows the curve which we obtained for positive ions in pure helium in a baked-out apparatus, mercury vapour being excluded by liquid air traps. On