Action of Cutting Tools.

In the interesting letter which appeared in *NATURE* of August 26, p. 277, Mr. Mallock objects to the use of the word cutting as incorrect when applied to tools used for metal work, and it is surprising, therefore, to find that his own paper to which he refers in support of his contention is entitled "The Action of Cutting Tools," although it is almost entirely devoted to showing that the action of such tools is that of shearing.

In a further letter in *NATURE*, p. 603, of November 4, Mr. Mallock dismisses my paper as having no reference whatever to the action of cutting tools, apparently on the ground that it is entirely devoted to a consideration of elastic strains. So far as the tool itself is concerned, it is only useful so long as it does not become permanently deformed, and to the maker of tool steel, the stresses and strains produced within the elastic range are therefore matters of interest, so that an attempt was made in this paper to show the distribution of stress in the tool itself under these conditions.

In another section an account is given of the stress effects in the work when the tool is removing material therefrom, which are quantitative within the range for which the laws of photo-elasticity are known, and qualitative in the plastic region, as present knowledge is not sufficient to interpret fully the interference effects observed. Mr. Mallock ignores these latter effects, although they are undoubtedly of importance. They show, for example, that the action is sometimes discontinuous, and under other conditions is not so, although Mr. Mallock states quite definitely that it is always discontinuous and quasi-periodic. Mr. Mallock's letter also lays stress on the curling up of the shaving, but this does not always happen, as the discussion on my paper brought out the interesting fact that, as the speed increases, the curls of steel shavings increase in radius until at speeds of about two feet per second the shavings become practically straight and are often a danger to workmen. This effect has also been produced in nitro-cellulose at low speeds with a suitable tool, and it is then found that these straight shavings show permanent stress effects similar to those produced when a thin curved beam is flattened out.

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A New Worship?

"Therefore no man that uttereth unrighteous things shall be unseen;
Neither shall Justice, when it convicteth, pass him by.
For in the midst of his counsels the ungodly shall be searched out;
And the sound of his words shall come unto the Lord
To bring to conviction his lawless deeds:
Because there is an ear of jealousy that listeneth to all things,
And the noise of murmurings is not hid.
Beware then of unprofitable murmuring."

AFTER a period of 'ennobling worship in that greatest of our English Cathedrals, the Scafell massif, on my return to town I chanced to enter that strange building, Burlington House, wherein be installed many altars to the great god, Science. Visiting that which ranketh first, I found an impassive figure, seated in a chair, at the High Altar, with a brass bauble before him: he needed but the peculiar head-dress to be an Egyptian Priest-King. Moreover, the service was apparently Græco-Egyptian, if not Babylonian. The officiating young priest used many beautiful words clearly of Grecian origin,

though at times an American phrase was noticeable, as when he spoke of Arrhenius doing chores, as I understood, for the god Isos. Most remarkable, however, was the way in which, at intervals, turning towards the altar, he solemnly gave utterance to the incantation—"See, Oh, Too!" My impression was that *Too* was the great king in the chair. The priest apparently was in fear of impending disaster, for at the close of his address he spoke much of concentration of the Hydrogen Ikons and their attack and repulse, often repeating the phrase "See, Oh, Too"—but *Too* seemed not to notice.

Two young acolytes then cast pictures of writing upon the wall as difficult to interpret as was that message expounded by Daniel in days long ago.

Most marvellous was the closing sermon, in which an account was given of the confusion wrought among a strange people, called "Lysodeiktics," by adding tears, nasal secretion, animal stews, turnip juice—seemingly muck of any kind—to their food: and how some of them were not killed. To one of an old faith, it seemed a strangely degenerate worship; indeed, that such service could be held worthy of attention amazed me.

In the evening, it chanced that I was led to peruse an article, in *The Times Literary Supplement*, on "Tradition and the French Academy," wherein is given Matthew Arnold's quotation, in his well-known essay, from the Academy's statutes:—

"The Academy's principal function shall be to work with all the care and all the diligence possible at giving sure rules to our language and rendering it *pure, eloquent and capable of treating the arts and sciences.*"

The whole article is worth reading; at the end is a quotation from a work by the late Pierre Duhem, the closing words being—

"*le respect de la tradition est une condition essentielle du progrès scientifique.*"

It is scarcely necessary to point out the application of these quotations; yet shall I ever pray: See to it, Oh, see to it, great Oh, Too!

HENRY E. ARMSTRONG.

The Spectrum of Neutral Helium.

A MOST significant feature of the success of the quantum theory in explaining the sequence of radiation-frequencies forming the Balmer type of series in the spectra of hydrogen and ionised helium is that it also offers an intelligible explanation of the differences in the intensities of the successive lines in the sequence, and that its postulates are not inconsistent with the known facts regarding the sizes of the atoms in their normal states. The fundamental assumption in the theory is that the states of the atom represented by increasing quantum numbers depart more and more from the normal state, and the greater intensities of the earlier lines in a sequence are readily understood as due to the greater probability of transitions actually occurring between states represented by smaller quantum numbers.

Any attempt to build up a theory of spectra which ignores these fundamental considerations must be received with caution. The remark just made appears to be particularly applicable to Dr. Silberstein's attempt (*NATURE*, August 19) to explain the spectrum of neutral helium on the assumption of the independence of the electrons. Looking over the list of frequencies given in his letter, and comparing them with the maps and tables of the helium spectrum contained in Prof. Fowler's report, it is noticed at once that the well-known intense yellow line of helium at $\lambda 5876$, which is the first member of the diffuse series of doublets, is given by Dr. Silberstein the

formula $9/6.15/6$, while other lines which are of vanishingly small intensity in comparison with it are assigned formulae with much smaller quantum numbers. For example, the doublet at $\lambda 3652$, which is the seventh in the sharp series and so faint that it fails to appear in the photographic reproduction of the spectrum, is assigned the formula $6/4.9/5$. Similarly, the first diffuse singlet at $\lambda 6678$ gets the formula $9/6.24/7$, while the fifth in the same series is indicated by $7/5.19/5$, that is, by much smaller quantum numbers, while it is actually a far fainter line than the other.

These facts naturally lead one to question whether Dr. Silberstein's proposed new combination principle has any real physical basis or significance. To settle this point, I undertook a careful survey of the figures and carried out a series of computations with the aid of my research student Mr. A. S. Ganesan, and have come to the conclusion that the approximate agreements between the calculated and actual frequencies are merely fortuitous arithmetical coincidences. This is clear from the following facts brought out by a survey of the figures:

(1) The proposed combination formula with its freedom of choice of four numbers gives a very large number of lines out of which it is possible to pick out a few coinciding approximately with practically any arbitrary series of frequencies which may be proposed, the accuracy of fit increasing as the quantum numbers chosen are increased.

(2) The coincidences between the calculated and observed frequencies are most numerous and accurate precisely in the region where the density of either series of frequencies is greatest, which is what we should expect according to the laws of chance.

(3) It is not, in general, possible to get a good fit for the earlier members of a line-series except by using large quantum numbers. This is what we should expect if the coincidences were fortuitous, as the frequency-differences between successive lines are greatest in the beginning of a series.

(4) More than one combination of quantum numbers will fit a given line tolerably well. For example, the D_3 line of helium is also represented fairly well by $13.21/5.12$.

(5) The quantum numbers giving the best fit do not fall into any regular sequence when arranged either according to the frequencies of the lines or their intensities, nor do they show any characteristic differences for the singlet and doublet series.

Needless to say, the foregoing remarks apply with even greater force to the case of the lithium atom when a choice of six numbers is permitted.

Finally, it may be remarked that the Rydberg constant 109723 chosen by Dr. Silberstein is appropriate only to the case of the ionised helium atom in which only one electron is coupled to the nucleus. If both electrons exert reactions on the nucleus and move simultaneously, the value of the Rydberg constant cannot remain the same in general.

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210 Bowbazaar Street, Calcutta,
October 18, 1922.

Water Snails and Liver Flukes.

HAVING been attracted on several occasions by the presence of actively swimming cercariae of *Fasciola hepatica* in material collected for protozoan studies and searching for the intermediate host, I have come across several examples of *Limnaea peregra* harbouring perfectly developed cercariae of the same species. Prof. Graham Kerr has also had similar experiences.

May I claim the hospitality of your pages to ask of your readers for references to literature dealing with the subject of any intermediate host, other than *L. truncatula*, of the liver-rot parasite? Mr. Staig has kindly informed me that Prof. J. W. W. Stephens writes in "Animal Parasites of Man," by Fantham, Stephens and Theobald: "In the allied species of *L. peregra* the fluke will develop up to a certain stage but never completes all its various phases." Many text-books in zoology give one the impression that *L. truncatula* is the only intermediate host.

My experience in searching for *L. truncatula* is that the occurrence of the snail is very local in S.W. Scotland. It seems to be rare, or altogether absent in some districts. Yet in these districts the sheep are known to be infected with the liver-rot disease. It would seem, then, that *L. peregra* acts as the normal intermediate host in those districts, the *Fasciola* completing within its body in normal fashion the life cycle up to the stage when the cercaria becomes free.

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A Mutation of the Columbine.

LAST summer a remarkable mutation of the blue columbine (*Aquilegia caerulea* James) was discovered by Miss Madeline Gunn near the Smuggler Mine, in the vicinity of Ward, Colorado. Only a single plant was found, growing under a spruce tree. The flowers are of good size (about 63 mm. diameter), with the pale blue sepals deeply trifid apically, the divisions about 12 mm. long, broad basally, the outer ones overlapping the median one (Fig. 1). In one case the median division is bifid apically. The petals are white, the laminae and spurs shorter than usual.

FIG. 1.

The form may be called *mut. trifida*; it represents a striking new type which, if it can be propagated, will be a notable addition to horticulture. Were it received from some remote region, it would appear to be a very distinct new species, or some might even wish to separate it generically. The trifid structure is characteristic of the divisions of the leaves of *Aquilegia*, and no doubt we may say that a quality of the leaf has been transferred to the sepals. Numerous cases of phyllody of the calyx in various flowers have been described by Maxwell Masters and others, but in this case the sepals are not at all leaf-like, and if such flowers were common they would not strike any one as abnormal.

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