

all sorts of physical laboratory methods for comparing the temperatures of the two platinum helices, for example, Wheatstone bridge, etc., were considered. Liveing elected to adopt the more simple photometric device of a sliding white angle block placed between the two sources of light. When the two sides appeared equally bright the position of the block read against a scale indicated the proportion of fire-damp. This was an operation which a fireman could perform quite as quickly and easily as the usual one with a 'cap.'

Not long after the development of this instrument, I went at the instance of Mr. Fletcher, of Bolton, to investigate fire-damp in his own and in some neighbouring fiery pits. Its practical utility was such that, at any place selected, about a quarter of a minute was sufficient to turn the handle, slide the block, and read the proportion from $\frac{1}{4}$ per cent., the lower limit, up to about 2 per cent. While I was in Bolton there was a minor explosion of fire-damp in a neighbouring pit, and Mr. Fletcher and I went there immediately. On reaching the place where the gas had fired the safety lamp filled with flame. On collecting gas from the roof I found it to be practically pure fire-damp, for, like hydrogen, it quenched the wire exposed to it in consequence of its greater mobility. If instead of writing "practical utility" the author had used the expression "general adoption," he would have been right. At this time the really practical man had much influence. He suspected instruments which he did not understand, and he did not want to have fire-damp found even in minute quantities where none could be detected by the usual means, and where therefore no danger existed.

C. V. BOYS.

IN my note I had no intention of disparaging the very ingenious invention of Mr. E. H. Liveing; on the contrary, I wished, while commenting on a new application of the same principle, to recall the fact that the credit of utilising the increased glow of a heated wire over which a methane-air mixture is drawn, as a measure of the methane present, is due to Mr. Liveing. Like Prof. Boys, I tested the apparatus both near working faces and in the return airways of mines which gave off fire-damp. Although I cannot claim to approach Prof. Boys's unique experience in photometric work, I had had several years' practice in comparing the illuminating power of lights—and especially of lights of different tints—and I found it possible to make concordant readings with the instrument. But my companions—men of great mining experience—did not agree with my readings, or with each other's. The impression formed by me was that the indicator was not adopted because the mine-managers thought (rightly or wrongly) the instrument allowed too much margin to the 'personal equation.'

THE WRITER OF THE NOTE.

The Imaginary Roots of Equations.

IN discussing the stability of an oscillating system, it is often necessary to know whether the period-equation has any root the real part of which is positive. We proceed to show how to find out the number of such roots. Let the equation $f(z) = 0$ be of degree n and let $f(iz) = u + iv$ where u and v are real. If v is of higher degree than u put $f_1(y) = -v$, $f_2(y) = u$, otherwise put $f_1(y) = u$, $f_2(y) = v$. Go through the operation of finding the G.C.M. of f_1 and f_2 with the difference that the sign of each remainder is changed before it is recorded or used as a dividend (just as in getting Sturm's Functions), and let the remainders (with changed signs) be $f_3(y), \dots, f_m(y)$. Let the

number of changes of sign in the sequence f_1, \dots, f_m be χ when $y = \infty$ and χ' when $y = -\infty$. Then the number of roots of $f(z)$ having their real parts positive, less the number having their real parts negative, is $\chi' - \chi$. If now there are r real roots of the common divisor $f_m(y)$ of f_1 and f_2 , then $f(z)$ has $(\chi' - \chi + n - r)/2$ roots with the real part positive, $(\chi - \chi' + n - r)/2$ with the real part negative, and r purely imaginary roots.

For proof we divide f_1 and f_2 by $f_m(y)$ and $f(z)$ by the corresponding factor $f_m(-iz)$, and then find the increase in argument of $f(z)/f_m(-iz)$ on going round the positive half plane by considering its passages through $n\pi$ in the first case or $\pi/2 + n\pi$ in the second. The number for the infinite semicircle is the degree of $f(z)/f_m(-iz)$, and that for the axis of y is found by reasoning very similar to that used for Sturm's Functions to be $\chi' - \chi$.

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Spatial and Time Relations in Dreams.

THE letter with regard to so-called 'mind-pictures,' printed on page 372 in NATURE of September 11, has greatly interested me because such non-volitional pictures have been very familiar to me from my childhood up. I used frequently to amuse myself by observing them, especially when in bed, just before I went to sleep, but I can bring them on by closing my eyes at almost any time. They are non-volitional in the sense that I do not knowingly control their content. So far as my consciousness is concerned, I am simply in the position of an observer. The pictures are of moving events and include landscapes with persons and animals, buildings, trees, vehicles, etc. I am totally ignorant at any one moment with regard to what may appear on the scene at the next, and the whole thing is as interesting and amusing as if I were observing an actual scene. The fact that I do not amuse myself with these pictures in my adult age as I used to do as a child, I attribute to the fact that they are mentally tiring. Their production must involve some expenditure of energy in the brain in a way of which I am ignorant.

ARTHUR E. BOSTWICK,
Librarian.

St. Louis Public Library,
St. Louis, Mo., September 30.

The Influence of General Electron Displacement on the Reactivity of Conjugated Systems in the Molecules of Carbon Compounds.

IN the September issue of the *Journal of the Chemical Society*, Baker and Ingold state that the nitration of benzoic esters is being investigated at Leeds. A similar study is in progress in these laboratories, and preliminary results show, for example, that the proportion of the *m*-nitrobenzoic acid derivative obtained on nitration rises in the series $\text{Ph} \cdot \text{CO}_2 \leftarrow \text{CR}_3$ ($R = \text{alkyl}$), $\text{Ph} \cdot \text{CO}_2 \cdot \text{CH}_3$, $\text{Ph} \cdot \text{CO}_2 \rightarrow \text{CH}_2 \rightarrow \text{C}_6\text{H}_4\text{NO}_2$. This is in accordance with the writer's theoretical views (*Chemistry and Industry*, 1925, 44, 118, 563; Allan, Oxford, Robinson, and Smith, *J. Chem. Soc.*, 129, 401, 1926; Ing and Robinson, *ibid.*, 1655), and it is anticipated that the nitration of benzoic esters (and of substituted benzamides) will afford a convenient auxiliary method for the estimation of the electron affinities of various groups. The arrows show the assumed direction of displacement of electrons, methyl benzoate being the standard of reference.

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October 10.