scales were marked off with the slider firmly clamped in the null position, its left end being against the stop. Sharp graduation lines in the desired positions were cut with a razor blade. Carbon black was worked into the cuts to make the lines stand out clearly. The surface was then sanded clean, the numbers were written on with India ink, and the surface was varnished.

A little practice enables the more accurate scale for the problem at hand to be chosen quickly. With the slider in the null position, squares and square roots can be read from the rule directly. Square roots of numbers from 1 to 10, from 100 to 1,000, from 0.01 to 0.10, etc., would ordinarily be sought on the upper half of the rule, while square roots of numbers from 10 to 100, from 1,000 to 10,000, from 0.10 to 1.00, from 0.0010 to 0.0100, etc., would be sought on the lower half, keeping in mind any necessary shifts of decimal points.

Similarly, in problems involving sums of squares the upper half would be used for sums approaching 0.10, 10, 1,000, etc., and the lower half for sums approaching 0.01, 1, 100, 10,000, etc.

To solve for x in the problem: $x = (1.53^2 + 0.95^2 + 2.17^2)^{\frac{1}{2}}$, one can proceed as follows: With the slider in the null position (pushed against the stop), the cursor is set on 1.53 on the B scale. (The reading on the A scale is now 2.34.) The slider is then moved so that its 0.00 is under the hair line on the cursor. The cursor is then moved to 0.95 on the B scale. (The A scale reading, the sum of the two squares, is now 3.24.) Again the slider is moved so that its 0.00 is under the hair line. The cursor is next moved to 2.17 on the B scale. (The A scale reading, the sum of the three squares, is now 7.95.) Finally the slider is pushed back to the null position, and the reading on the B scale, the square root of the sum of the squares, is seen to be 2.82.

Except for the final push to the automatically set null position, the sequence of movements in the solution of this problem therefore is exactly analogous to the series of motions involved in solving the corresponding problem: $X = 1.53 \times 0.95 \times 2.17$ on an ordinary slide rule.

With this rule the final answer in problems of the type just discussed can be recorded to three significant figures, with the error seldom larger than one unit in the third figure. In the majority of cases there is no error in the third figure. In fact, on some portions of the rule (particularly the right-hand end of the B scale) the answer can be read to four significant figures with less error in the result than would occur, on the average, in rounding off four-figure calculating machine answers to three figures.

An ordinary slide rule adds logs. This one adds squares. Obviously, similar rules could be designed and constructed for the addition (and subtraction) of other functions, such as cubes, roots, trigonometric functions, etc., or even for combinations of these, merely by providing the desired scales on the slider. The width of the slider could be increased to allow for as many scales as one might want to place on it. If it were desired to have slide rules available for several types of problems, in some cases appropriate interchangeable sliders could be constructed for use in a single base. In many cases meter sticks could be used for the linear scales on home-made rules.

A simple experimental model of any rule can easily be made by marking off appropriate scales on pieces of paper or cardboard, which can be folded and fitted together to serve as slider and fixed part.

Thanks should be expressed to Dr. O. L. I. Brown, now of the United States Naval Academy, for suggestions which he made concerning the construction of the rule discussed above.

An Impurity in Some Commercial Penicillin Preparations Which Interferes With the Diazo Reaction in Determining Blood Phenols

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While determining the free phenol content of the blood of a uremic patient, using the method of Schmidt (*1*), the following was observed: After extracting 35 ml. of the Folin-Wu protein-free filtrate plus 1 ml. of 10 N sulfuric acid for 2 hours with absolute ether, the free phenol was determined in 3 ml. of the ether extract, to which had been added 5 ml. of 95-per cent ethyl alcohol, 2 ml. of water, 1 ml. of diazotized *p*-nitroaniline reagent, and 3 ml. of 5-per cent sodium carbonate. The normal reaction yields a clear, straw-yellow to orange color. However, on this particular determination the final color which developed was an olive green, which, of course, made a colorimetric comparison impossible. This result was obtained with each of two blood samples taken on consecutive days.

Upon investigation it was found that 48 hours previous to securing the first blood sample the patient had received intravenously 220 000 Oxford Units of the sodium salt of penicillin (Brand I). The patient was anuric (except for one catheterized specimen) up to the time the blood sample was taken. It was hypothesized that the penicillin in the blood might be the cause of the adverse reaction, bearing in mind that penicillin is normally excreted in from 2 to 4 hours.

In an effort to gain information as to the source of the green color the following procedure was carried out:

To 2 ml. of water containing 5 mg. of penicillin (Brand II) was added 5 ml. of 95-per cent ethyl alcohol, 3 ml. of absolute ether, 1 ml. of diazotized *p*-nitroaniline reagent, and 3 ml. of 5-per cent sodium carbonate. The resulting color was of the same olive green as was seen in the above determinations. Two drops of concentrated hydrochloric acid, when added to this mixture, caused the olive green to fade and a brownish-yellow to appear. Upon realkalinizing, the olive green reappeared. It was also found in the above procedure that the color (olive green) formation required the presence of the 95-per cent ethyl alcohol, but did not require the absolute ether. A water solution of penicillin (Brand II), treated without the alcohol, gave a yellow-orange color upon diazotization.

The foregoing procedure was carried out on several other standard commercial penicillin preparations used clinically. In all cases the results were the same. However, a sample of pure crystalline penicillin sodium G and of "pure" penicillin sodium[1] did not give the slightest adverse chromogenic reaction, but did give a yellowish color with the diazotized *p*-nitroaniline reagent.

It was observed that a few of the yellow crystals (pure penicillin is colorless) of the standard preparations, when shaken with absolute ether, failed to dissolve. However, when a 35-ml. water solution of penicillin (Brand II) plus 1 ml. of 10 N sulfuric acid was extracted for 2 hours in the usual manner as for the determination of phenols, the ether extract, when treated with the diazo reagent, alcoholized, and then alkalinized, gave the olive green color. The ether extract itself had a yellow tinge, while the extracted water solution, which had been pale yellow, had lost its color.

From the evidence presented we may conclude that (a) those commercial preparations of penicillin tested contain some substance (or substances) which gives an adverse chromogenic reaction in the alcoholized, alkalinized, diazotized medium used in determining free phenols according to Schmidt; (b) it is probable that the yellow color in the penicillin preparations is responsible; and (c) pure penicillin G (sodium salt), when alcoholized, alkalinized, and diazotized, does not give the adverse chromogenic reaction, but does give a yellow to orange diazo reaction.

Reference

1. SCHMIDT, E. G. *J. biol. Chem.*, **150**, 69–73.

[1] Kindly supplied by Merck & Company, Inc., Rahway, New Jersey.

A Method of Growing Dense Cultures of *Paramecium*

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The method described below will produce very dense cultures of *Paramecium* substantially free from other *Protozoa* other than minute forms which do not interfere with the use of the material for class purposes. Variations in the method have been tried, but none has given as good results.

Obtain a glass jar about 7 in. deep by a 4- or 5-in. internal diameter. Place in this a tripod made of glass rod or tubing, with its top about 1½ in. below the top of the jar. The tripod consists simply of a ring of tubing a little smaller than the jar, with three legs fused to it.

Pick off the grass blades from some hay, lay them parallel, and cut to length, so as to make a mattress of them, resting on the glass tripod. The mattress should be about ¾ in. thick when pressed down a little.

Fill the jar with tap water to such a depth that the grass mattress is just awash at the top, and then place the jar against the side of an embedding oven set to about 50° C. (The jar is outside the oven, in the room.) With normal room temperatures, this should result in a temperature gradient across the jar, varying from about 25° C. near the oven to about 23° C. away from the oven. Place a lid on the jar and leave for a few days until a thin, whitish scum commences to form on top. Inoculate with *Paramecium*, and leave for another 5 or 10 days, examining from time to time to see that the grass keeps just at or below the water surface. Add a little distilled water if necessary. At the end of this time, a heavy, whitish pellicle should have formed, with enormous numbers of *Paramecium* hiding just at the junction of pellicle and jar at some point at which the temperature suits them. Best results are obtained when the cool side of the jar faces the window, but is shaded from sunlight.

After a week or two, "lagoons" or clear spaces about ¼ in. in diameter will appear in the pellicle. If they do not do so, they should be made by cutting the pellicle from the glass all round. These lagoons are ringed with a whitish "fuzz" consisting of vast numbers of *Paramecium* in almost pure culture. The water below the tripod will be murky with bacteria and minute ciliates, which would seem to provide a reservoir of food for the *Paramecium*.

The culture will remain rich for some weeks and