plane figure on a plane. Plan and elevation of a line which is inclined at given angles to the co-ordinate planes. The meaning of the terms "trace of a line," "trace of a plane."

The difference between a scalar quantity and a vector quantity. Addition and subtraction of vectors.

Slope of a line; slope of a curve at any point in it. Rate of increase of one quantity relatively to the increase of another quantity.

\( x \); the symbol for this rate of increase, namely, \( \frac{dy}{dx} \); how to determine \( \frac{dy}{dx} \) when the law connecting \( x \) and \( y \) is of the form

\( y = ax^n \). Easy exercises on this rule.

In setting out the above syllabus the items have been arranged under the various branches of the subject.

It will be obvious that it is not intended that these should be studied in the order in which they appear; the teacher will arrange a mixed course such as seems to him best for the class of students with whom he has to deal.

---

**ANALYTICAL PORTRAITURE.**

It seems well to put on record the principal results of experiments that I have recently made to isolate the particulars in which one portrait differs from another. There is no measure of success, but not enough to deserve illustration or lengthy description. The objects I had hoped to attain are important; namely, to define photographically the direction and degrees in which any individual differs from the race to which he belongs, the race being represented by a composite picture of many individuals belonging to it. Or, again, to define the particulars in which any variety of plant or animal differs from the type species. Or to define family features; or to isolate expressions, recollecting that these consist both of subtractions from, and additions to, the features as seen in repose.

My starting point was that the exact superimposition of a rather faint positive upon its rather faint negative produces an approximately uniform grey, when they are viewed as a single transparency. Thus, I photographed a rotating disc that had been faced with white paper and divided into concentric rings. The innermost disc was left white, the outermost ring was painted black, and the intermediate rings contained successively increasing proportions of the black to white. The photographic negative showed rings of graded tints, and from this I took a positive by contact. Subsequently applying the positive to the negative film, and viewing them as a transparency, a nearly uniform grey surface was produced. It was necessary to superimpose them with exactness; otherwise the edges of the rings were conspicuously dark in one part, and light in the opposite part. Another test experiment was to paste together thicknesses of tracing paper—two-fold, three-fold, &c., up to twelve-fold—to cut distinctively shaped snips out of these and to variously distribute them over the surface of a glass plate, which was then photographed, and a positive taken as well. On treating the positive and negative as above, all the tints between those of the three-fold and the nine-fold inclusive produced a uniform grey.

Let A and B be any two pictures whose respective negatives and positives will be called neg. \( a \), pos. \( a \), neg. \( b \), pos. \( b \). My object was to produce photographically a third picture \( X \) which should express the difference between \( A \) and \( B \); that is, should be equal to \( A - B \), or else a fourth picture \( Y \) which should represent \( B - A \).

It will, however, be simpler to treat the problem at first as an optical one, based on the following equations:

\[
\begin{align*}
(1.) & \ pos. \ a + neg. \ a = grey; \\
(II.) & \ pos. \ a + x = pos. \ b \\
& \text{if treated as a photographic problem, (II.) would be replaced by} \ pos. \ a + x = neg. \ b. \\
& \text{From these we obtain} \ pos. \ a + \{pos. \ b + neg. \ a\} = pos. \ b + grey \\
& \text{and} \ pos. \ b + \{pos. \ a + neg. \ b\} = pos. \ a + grey.
\end{align*}
\]

A RECOLLECTION OF KING UMBERTO.

How enthusiastically the late King of Italy could devote himself to the welfare of science and art, those of us who were at Como last September had an opportunity of seeing. One very hot day he arrived with the Queen and the Duke of Naples by train from their palace at Monza, near Milan. First they made an official inspection of the galleries and machinery in the Silk and Electricity Exhibition, then they visited the Exhibition of Sacred Art, and, after lunch, they opened