ple, when in solution is not of a purple but a dull violet shade, and in the solid state is a nearly black crystalline powder. The moment, however, mauveine is brought in contact with an acid so as to form a salt, its solution changes to a purple color. This takes place even with that feeble acid carbonic. I have here a dilute solution of mauveine; you will observe the dull violet color it possesses; but if my assistant only breathes through it a few moments, the carbonic acid of his breath will combine with it, and it will acquire the ordinary color of aniline purple.

Mauveine is a most powerful chemical body, and will easily decompose ammoniacal salts. This may be readily seen if some mauveine be heated with chloride of ammonium and a little water, when an abundance of ammonia gas will be evolved, which can be distinguished not only by its odor, but by the white fumes it produces with hydrochloric acid.

The salts of mauveine are beautifully crystalline, and possess a splendid green metallic lustre. The crystallized commercial product consists of the acetate. Mauveine possesses one of the peculiar properties of indigo. Indigo, when treated with reducing agents, such as a mixture of sulphate of iron and lime, is rendered nearly colorless and soluble, but this colorless indigo, when subjected to the oxidizing influence of the atmosphere, rapidly becomes blue again. I here refer to the indigo vat so much used by dyers. Mauveine, when treated in a similar manner, is also nearly decolorized, changing to a pale brownish-yellow fluid, but the moment this is exposed to the air it assumes its original color far more quickly than indigo. This remarkable fact may be strikingly illustrated by boiling an alcoholic solution of salt of mauveine with a few strips of zinc in a sealed tube, from which the air has been previously removed. The dark purple solution will gradually lose its color, and change to a very pale yellowish-brown shade.

I have a tube containing some aniline purple decolorized in this manner, and now, if I open it, the air rushes in and the solution instantly assumes the ordinary purple color.

Ordinary indigo is quite insoluble in water, and, therefore, its property of becoming soluble, as well as colorless, when treated with reducing agents, is of great practical value, as the dyer, by immersing his goods in this solution of indigo, and then exposing them to the oxidizing influence of the air gets the coloring matter firmly fixed in the fibre of his materials. But as the mauve is always soluble in water, this property has not been found of any practical value.

Aniline purple, when introduced as a dye, being the first color of its kind, had to encounter many prejudices, and, on account of its peculiar nature, required the adoption of new or modified processes for its application. These difficulties, however, once overcome, its progress was very rapid. At first it was principally employed by the silk dyer and printer, its application to silk being comparatively easy, but it was not used by the calico-printer till a few years afterwards.

I distinctly remember, the first time I induced a calico-printer to make trials of this color, that the only report I obtained was that it was too dear, and it was not until nearly two years afterwards, when French printers put aniline purple into their patterns, that it began to interest British printers.

It will be seen that to introduce a new coal-tar color after the mauve was a comparatively simple matter. The difficulty in the manufacture of all the raw materials had been overcome, as well as the obstacles in the way of the practical applications of an aniline color to the arts.

We will now turn our attention to a coloring matter which has often been confounded with aniline purple. I have designated it as "Runge's blue," as it was first observed by Runge. I have mentioned that Runge, when he first obtained aniline, termed it "kyanol," or blue oil, on account of the blue-colored solution it gave with chloride of lime.

After discovering the mauve, I naturally made experiments with this colored product of Runge's, to see if it contained aniline purple, but my experiments answered the inquiry in the negative. A few years afterwards, however, I was puzzled by finding that French manufacturers were beginning to produce aniline purple by the agency of chloride of lime and salt of aniline; being much occupied at that time, I was unable to look carefully into the matter; and it was not until investigating these apparently opposite results a short time since that I was able to understand them. I will perform Runge's experiments, and for that purpose will take a solution of hydrochlorate of aniline, and add to it a very dilute solution of chloride of lime (taking care not to add too much). The solution is now changing, and getting slightly opaque; by daylight it has an appearance like indigo, but if I render it clear by the addition of alcohol, and place it before the magnesium lamp, it is seen to be of a brilliant color, and nearly pure blue, quite unlike aniline purple.

I have lately succeeded in obtaining this blue product in the solid condition by treating a solution of hydrochlorate of aniline with a dilute solution of chloride of lime, and precipitating the resulting coloring matter with common salt; it is thus obtained in an impure condition, and may be collected upon a filter; by treatment with cold ether or benzol, a large quantity of brown impurities are separated, the coloring matter being left in the solid condition. This substance dissolves in alcohol, forming a nearly pure blue solution, and is capable of dyeing silk a blue or blue-violet color.

An alcoholic solution of Runge's blue behaves with caustic potash quite differently to aniline purple, forming a brownish-red colored solution instead of a violet. Therefore, there can no longer be any reason for confounding this body with aniline purple, it being entirely different both in color and chemical properties. But as this coloring matter is produced by oxidizing hydrochlorate of aniline with chloride of lime, how is it that manufacturers have succeeded in preparing aniline purple with the same reagents? This question I find is very easy to answer: the manufacturer has gone a step further and boiled his product. Now if I take a piece of silk dyed with Runge's blue, and, instead of boiling it, which would wet it, and make it difficult to manipulate, do that which is equivalent—steam it—a very remarkable change takes place—Runge's blue being changed into the mauve. So, here we have cleared up the mystery, and find that by the action of chloride of lime on hydrochlorate of aniline, we first get Runge's blue, and then, by heating this blue, we change it into mauve. Runge's blue is a very unstable body, and of no practical value, as alcoholic solution changing into mauve in a day or two. This change takes place directly by boiling.

We must now pass on to another coloring matter, in name well known to all of you, I mean magenta, also called roseine, fuchsine, aniline red, and various other names. The discovery of this body and its manufacture were strangely dependent upon the source which had been selected for the preparation of aniline for the mauve. Had the aniline contained in coal-tar, or the aniline obtained from indigo, been employed for the preparation of the mauve, instead of that prepared from commercial benzol, magenta and its train of colored derivatives would, in all probability, have remained unknown to this present day, from the simple fact that magenta cannot be produced from pure aniline, a second body being also required.

You will observe, by reference to the table of coal-tar products, that next to benzol there is a substance named toluol, a substance having a boiling point not very much above that of benzol. On this account toluol is always contained in commercial benzol, and possesses most of its properties. With nitric acid it forms nitrotoluol, very similar to nitrobenzol; with iron and acetic acid it is converted into a base toluidine, very similar to aniline, except that it is solid, instead of liquid, when pure. Therefore aniline prepared from commercial benzol always contains a little toluidine, and this is the second body requisite for the formation of magenta.

An apparatus for the fractional distillation of coal-tar naphtha has been devised, so that its constituents may be almost completely separated from each other, and thus pure benzol or pure toluol may be obtained.* Having obtained these hydrocarbons, pure aniline and pure toluidine may be prepared and then mixed in the most suitable proportions for manufacturing magenta. This process is not very generally employed, however, but the quality of the mixture of aniline and toluidine is determined by distillation, noting the quantities which come over at different temperatures. The necessity of toluidine as well as aniline for the production of magenta was discovered by Dr. Hofmann, who found that it could not be produced by perfectly pure aniline, nor perfectly pure toluidine, but that a mixture of these two bases yielded it in quantity. Magenta was apparently first observed by Natanson, in 1856, when examining the action of chloride of ethylene on aniline, and afterwards by Dr. Hofmann, in 1858, when studying the action of tetrachloride of carbon on aniline, but industrially the discovery of magenta was made by M. Virguin, of Lyons, in 1859, three years after the mauve. M. Virguin's process consisted in treating commercial aniline with a fuming liquid, called tetrachloride of tin, and was first carried out by Messrs. Renard Bros., of Lyons. Since 1869, patents have been taken out for the production of this coloring matter with aniline, and almost all chemicals known, whether capable or incapable of forming magenta. I may mention one process which was extensively employed, and is still used to some extent in Germany, and that is the method of making magenta with commercial aniline and nitrate of mercury. With care this process works very well, and the coloring matter produced is of good quality. When first introduced, magenta prepared by this method was not purified, but sent into the market in a crude form, so that

*See "Clarke's Specification," June 5th, 1863, No. 1405.