

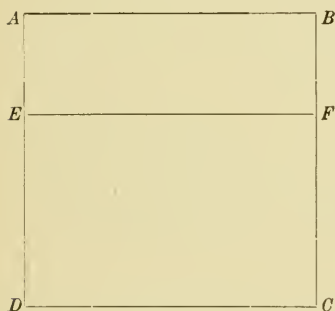
A PROBLEM IN GEOMETRY.

J. A. CRAGWALL.

TO CONSTRUCT A SQUARE THAT SHALL BE $\frac{M}{N}$ OF A GIVEN SQUARE.

The method given below can not be new, nor does it involve any new processes or discoveries; but in all the textbooks examined by the writer no mention has been made of such method.

It is here given because of its simplicity and directness, in the hope that some teacher will consent to lighten the work of the pupil in geometry to that extent. The construction is as follows:



Let ABCD be the given square. Lay off on one side of the square, as AD a distance DE equal to $\frac{M}{N}$ of AD. Then, CDEF is a rectangle with base equal to a side of the square and altitude $\frac{M}{N}$ of it. Then CDEF is $\frac{M}{N}$ of the square. Now construct a square equivalent to this rectangle and we have a square that is $\frac{M}{N}$ of the given square.

SOME INVESTIGATIONS IN THE ELECTRO-DEPOSITION OF PLATINUM.

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When the work for this paper was begun, it was with no intention of making any study of the deposition of platinum, but to obtain a foil that could be used to separate an electrolyte into two compartments and at the same time to set up no barriers to the passage of a current of electricity; it was thought that in this way some new light might be thrown on the subject of the migration of ions. Not being able to secure platinum leaf thin enough for the purpose, an effort was made to make it by depositing platinum electrolytically on some metal that could afterwards be dissolved and leave the platinum intact. The work proved of greater proportions than was anticipated, so that the limited amount of time would only permit a partial investigation into the action of the electrolyte and the character of deposit. The available literature on the subject was

very meager, the bibliography of the deposition of metals giving very little light.

Dr. William H. Wahl, of Philadelphia, has written a pamphlet which deals with the subject qualitatively and in a rather indefinite manner. In the investigation several problems presented themselves for solution, among them being the following:

- I. The metal that shall be used for the cathode;
- II. The solution of platinum to use for electrolyte;
- III. The current density that gives the best character of deposit at the most rapid rate;
- IV. The concentration of solution that gives best results;
- V. The temperature that gives highest efficiency and best character of deposit;
- VI. If the foil is porous or granular, the way to treat it so as to remedy the defect and get a dense, tough deposit;
- VII. The liquid that will dissolve the metal of the cathode and leave the platinum foil intact.

Most of these problems are very closely related, so that results for several were sometimes obtained from the same set of experiments.

I.

On account of the smooth surface it will take, the ease with which it may be dissolved, that it will take a deposit of another metal so readily, and that it can be rolled into thin sheets, copper seems the best metal for the cathode. The anode, of course, should be platinum, carbon or other substance that will not be acted on by the nascent gas set free in the reaction.

II AND III.

The salt of platinum used must be such that it is easily dissolved and will start up no harmful secondary action during the passage of the current. Platinic chloride will not serve on account of this last restriction. Platinic hydrate, however, is almost ideal and was used in all experiments.

At first an effort was made to use platinic hydrate dissolved in oxalic acid, forming oxalate of platinum, the proportions used being—

- 1 oz. platinic hydrate,
- 4 oz. oxalic acid,
- 4000 c.c. distilled water.

Experiments gave the highest current density that could be used without the appearance of platinum black, as being about .0001 amperes per square centimeter, and even then there was a slight appearance of gas at the cathode. The liquid was of a clear straw color when warm, becoming purple on cooling; but, after allowing the current to run for about 15 minutes, a dark cloudy appearance was noticed at the anode that gradually spread to the whole liquid. No chemical analysis was made to determine the composition of this, though it is very likely that it was platinum hydrate. The liquid was then tightly stoppered and left for about two months, when it was found that all the platinum had been reduced to the form of spongy platinum. This was due to the fact that oxalic acid is an active reducing agent.

Taken as a whole, the experiments with oxalate of platinum were very unsatisfactory, the current being low, the solution unstable and the deposit dark, as if some of the dark precipitate was occluded in the deposit.

Mention is made of these trials for the reason that the results are contrary to the statements of Dr. Wahl.

The next solution tried was made by dissolving platinum hydrate in caustic potash in the proportions—

- 1 oz. platinum hydrate,
- 4 oz. caustic potash,
- 2000 c.c. distilled water.

It was possible to use a current density of .003 amperes per square centimeter and get a bright smooth deposit, when the liquid was held at a temperature of 65 F. When the deposit was made comparatively thick, however, there was some appearance of crystallization. Trial showed a current density of .002 to be about as high as it was best to go with this particular solution at the above temperature.

IV.

Tests were now made to determine the effect of varying the concentrations of the liquid. As above noted, when the proportions were—

- 1 oz. platinum hydrate,
- 4 oz. caustic potash,
- 2000 c.c. distilled water,

the maximum current density that could be used and get a clear, bright deposit was .0035 amperes per square centimeter.

With a solution in the proportions of

- 2 oz. platinic hydrate,
- 4 oz. caustic potash,
- 2000 c.c. distilled water,

it was found possible to run the current density up to .006 amperes.

With another solution in which the proportions were

- 5 oz. platinic hydrate,
- 8 oz. caustic potash,
- 4000 c.c. distilled water,

the current reached .012 amperes before the appearance of platinum black.

Increasing the platinic hydrate in the above so as to have 6 oz. platinic hydrate, increased the current density to .015 amperes per square centimeter. The amount of caustic potash was increased so as to make a solution having the proportions—

- 2 oz. platinic hydrate,
- 1 oz. caustic potash,
- 4000 c.c. distilled water,

when it was found that .002 amperes was as high as the current density could be carried. Increasing the amount of caustic potash still further decreased the amount of current that could be used.

From the results given it may be concluded that the greater the per cent. of platinum in the solution, the higher the current density that can be used. Any increase in the amount of caustic potash lessens the maximum current density.

V.

In regard to the temperature that gives the best results, the experiments showed that any increase in the temperature raised the maximum current density that could be used. Thus, at 65 F. .0035 amperes per square centimeter was the maximum, while a temperature of 100 F. permitted the use of a current as high as .008 amperes per square centimeter, with corresponding changes for intermediate points.

VI.

Burnishing the foil with a smooth bent glass rod, or with a piece of hard wood, made the platinum denser. Lightly beating the foil between chamois skins was of some assistance, though for the purpose in view great care had to be exercised to prevent getting the deposit of unequal thickness over the foil.

VII.

There are many liquids that will dissolve the copper—notably, nitric acid, but, on account of the formation of gas during the reaction and the consequent tearing of the foil, it and several others had to be discarded. Ammonium chloride was found to be the best, though its action is very slow. The result may be hastened, however, by first making this foil of copper, the anode in a copper sulphate electrolyte and dissolving away a large part of the copper before putting the foil in the bath of ammonium chloride.

There is one serious difficulty that is met in dissolving the copper. After all the copper has been dissolved, it is extremely difficult to remove the foil from the liquid on account of the cohesion being sufficient to add enough weight of water to the foil to tear it as it is taken from the liquid or roll it up so that it is useless.

This can only be overcome by placing the foil where it is to go when completed, and then dissolve away the copper.

Although some very fair foils were made in these experiments, it is hardly fair to say that they were wholly successful. But the work opens up another avenue that may lead to something very useful—the electroplating with platinum of delicate surgical instruments, etc., to take the place of nickel. It is well known that many efforts have been made to use platinum for such purposes, but, as far as the writer knows, with very indifferent success on account of the great trouble and consequent cost of the work. Using an electrolyte of platinate of potassium, it is possible to keep it constantly saturated by simply keeping a bag of platinic hydrate hanging in the solution; the process is comparatively rapid and needs little attention after once started. The plated article will stand considerable amount of usage, and, of course, will not tarnish under any ordinary circumstances.