Aluminium Plate Printing.

BY PALMER H. LANGDON.

Revolutions in the industrial arts are becoming more common in these days of comparative peace than revolutions political, and such an industrial revolution is now taking place in the branch of printing known as lithography. It is a change which has come with the discovery of a new printing material—aluminium—and which has in turn made it necessary to build entirely new types of printing presses and to change the methods and shop practice of lithographic plants. Before describing this remarkable industrial revolution, it is essential that the various classes of printing be mentioned.

Printing may be classed under three heads. One method is relief printing, in which the design to be printed is raised above the surface of the printing plate. This method includes all type printing, which means that all newspapers come under the head of relief printing.

A second method is intaglio printing, in which the design is cut into a metal plate, the lines, etc., lying below the surface. Steel-plate printing is the most common form of intaglio printing, and intaglio is also popularly known in the form of calling cards, which are printed from engraved copper plates. Intaglio printing is practically limited to hand work, and is consequently slow and expensive.

The third branch of the printer's art is designated as surface printing, in which the design is neither cut below the surface nor is raised above the surface, but lies on the surface. By this method are printed the theatrical and circus posters, fashion plates, insurance policies, portraits, and the great bulk of prints produced in colors, and which are termed color work. Surface printing is far the youngest branch of the printing industry, for it was but a little over a century ago that Alois Senefelder, at Munich, Germany, discovered that a certain quality of lime rock now known as lithographic stone had the property of absorbing sufficiently a design or drawing in ink, to make a reprint of the very drawing without raising or depressing any part of the stone surface.

A picture or design is drawn upon the stone in greasy ink; this the stone absorbs. By washing the surface with an acid solution and gum arabic, the greasy design is rendered insoluble in water, and at the same time those portions of the surface not occupied by the greasy design have attached to them a film of gum arabic, which has an affinity for water. Water and grease will not mix—they are mutually repellent. It is upon this principle that surface printing is based. When the design is ready to print, first a wet roller is passed over the surface—the water adheres to the surface everywhere except where the greasy design lies; there the grease rejects the water. Then the ink roller is passed over the same surface, and the water-covered portions reject the ink, which adheres only to the greasy design. The design being thus inked, the paper is pressed against it and receives an impression of the picture or design. But stone, fine as it is for surface printing, is a cumbersome, fragile material, and the supply is limited. If lithography was to grow like other branches of the printer's art, what was to take the place of stone, which was steadily increasing in price? Lithographers had many years ago experimented with the different metals, but none, with the exception of zinc, was found to possess the right texture and porosity essential for surface printing. Zinc, for which the lithographic trade had high hopes, proved to be of limited capabilities, and lithographers found again that they must rely on stone or find a more suitable material.

Some ten years ago aluminium began to be manufactured in a sufficient quantity to make it commercially useful, and it was soon discovered that this light, white metal could be treated in a way which would give it the property of printing like lithographic stone. The treatment of the metal differed slightly from the preparation of the slabs of the stone. Sheet aluminium was ground with pumice stone to give it an open grain, and then subjected to an acid treatment, which after a number of experiments was found necessary to give the plate the proper surface. The plates were then fastened on blocks, placed on the old flatbed presses, and it was but a short time before the experimenters were able to do creditable color work from aluminium plates. The new aluminium art had developed sufficiently to exhibit work at the centennial held in New York a few years ago to commemorate the discovery of surface printing.

However, the progressive minds were not content to print from aluminium plates in the old-fashioned way, but they must have a new style of machine to do the printing; and it is right here that the revolution is taking place in the complete change of surface printing machinery, which at the present time is going on in lithographic establishments all over the world. It is pleasing to record in passing that America has led in the revolution, and is supplying the revolutionary machinery—so to speak—to Europe, the Orient, and the Occident.

As long as stone was the only surface printing material, only one form of press, that known as the flatbed, was practical. This form of press has a heavy swinging bed, is of slow motion, and is noisy. With a metallic plate it was possible to bend the metal to a cylinder, thus applying the principle of revolution, and making it necessary to build a rotary press. When the press builders were convinced that printing from aluminium plates was no longer an experiment, they quickly put on the market a press especially built for metal plates, and by applying the rotary motion mentioned, were able to get twice as many impressions as from the slow-moving flatbed. With the rotary press it was simply passing the paper sheets between two cylinders, as clothes are passed through a laundry wringer.

When it had been demonstrated that the rotary press was a thoroughly practical machine, the builders decided to go a step further and build a press that would print two colors at one time—a two-color rotary. Never had it been commercially possible in lithography to print two colors from stone in one run through the old flatbed press. Inventors, lithographers, and press builders have striven for years to perfect a machine which would allow them to put on the various colors of a picture in one run through a press. Hundreds of thousands of dollars had been spent and years of time consumed toward this end, but without practical results. The application of surface printing remained the same as in Senefelder's day, viz., that each color is printed separately from the stone, and that if there were ten colors to form the complete picture, there must be ten separate prints made on the press, and each in perfect register with the others.

A perfect register is obtainable in a rotary press, and from the form of construction of the machine it was possible to put in a third cylinder and an additional set of rollers, and put two colors on the sheet of white paper before it had passed through the press. Great as this improvement is in surface-printing machinery, lithographers believe it is but a step to a three-color press, when by the wonderful finished effects which are obtainable with the combination of three colors, it would make three-color lithography, or more properly speaking three-color algraphy, a triumph in the graphic arts.

But it is not alone a gain in multicolor printing which has been brought about by the aluminium plate and the rotary press, but it is the great gain which is accomplished with the single-color rotary, and which at the present time is more widely used. The largest size stone generally used on a flatbed press measured 44 x 64 inches and weighed 1,200 pounds. The same size aluminium plate weighs but 12 pounds. It is possible to make 12,000 impressions a day from a rotary. With stone 5,000 prints is considered a good day's run. The motion of the rotary is continuous, while that of the flatbed is reciprocatory. The difference in motion of the two might aptly be compared with the difference in motion of the steam engine and the electric motor. With the introduction of the rotary there has been indeed a revolution in lithographic establishments, until some of the larger shops now print 90 per cent of their work from aluminium plates and rotary presses. As most of the lithographic plants are located in large cities where storage room is limited, the smaller space taken up by a plate is a particular advantage. A stone of the average size four inches in thickness requires thirty times the space of a one-sixteenth inch plate.

The revolution, however, is not taking place with the haste of the French revolution of history, but is a gradual change from the old method to the new. Stone and the flat bed are still used exclusively by the majority of the litho shops—though this majority is steadily diminishing—and particularly for the class of surface printing known as commercial work. Where there is no color work, stone is preferred. Commercial work borders on relief printing, and no method has as yet been devised whereby the aluminium can be etched high enough to print such fine lines as the stone. There is hope, however, that invention will give a process which will overcome this difficulty, and that even commercial work will be produced entirely from aluminium plates.

In the Zeitschrift of the German Engineers' Association, Mr. L. Austin describes experiments made at Charlottenburg on the co-efficient of thermal surface-conductivity across the surface of separation of a solid and a fluid, giving the following results: From metal to water at the boiling point the resistance is equivalent to a thickness of ½ centimeter to 2 centimeters of iron, but is reduced by stirring by an amount equivalent to about 0.75 centimeter of iron. The resistance increases as the temperature falls, reaching a maximum of 10 centimeters of iron, which is reduced by 1 centimeter by stirring. For flow of heat from water to metal, the resistance appears greater than for the reverse flow if the water is undisturbed, and about the same when the water is stirred.

Correspondence.

In Memoriam of Robert Henry Thurston.

To the Editor of the SCIENTIFIC AMERICAN:

The class of 1904, Sibley College, has requested that a copy of the following resolutions be sent to you, and we hope that you will favor us by publishing the same.

RESOLUTIONS.

Whereas, It has pleased the Almighty God, in His infinite wisdom, to call from among us our Head, Robert Henry Thurston, Director of Sibley College, Cornell University; be it therefore

Resolved, That we, the members of the Senior Class of Sibley College, individually and as a body, feel the loss sustained by this class and college to be unspeakable.

That we mourn him not only as our respected Teacher and Director, but as a true friend of every member of the class.

That we deeply appreciate the exceptional opportunities of having been under his instruction and of having enjoyed the advantages of personal contact with this ideal member of our future profession. Further be it

Resolved, That a copy of these resolutions be sent with our deepest sympathy to his bereaved family.

That a copy of these resolutions be published in the college papers and in the leading engineering journals of the scientific world; and

That a copy of these resolutions be duly engraved and placed in Sibley Hall.

CLASS OF 1904, SIBLEY COLLEGE, CORNELL UNIVERSITY.

Committee: HURD ALDRICH, R. W. ROGERS, W. S. FINLAY, JR.

Cornell University, Ithaca, N. Y., November 18, 1903.

The Ninety-Footers.

To the Editor of the SCIENTIFIC AMERICAN:

I have read with great interest your article on the subject, "Is Yacht Designing an Exact Science?"

The anomalies you refer to in the relative performances of "Reliance" and "Shamrock" in light and strong winds can, I think, be shown to be not real, but apparent only.

You say experts predicted that "Shamrock" would relatively do better in light winds because of her lesser wetted surface. But the question of wetted surface must be considered *in relation to sail area*. "Reliance" had close on 2,000 square feet more sail, an area equal to "Reliance's" biggest jack yard topsail. She carried 14 per cent more sail than "Shamrock" on a hull of the same length of waterline, and allowing for "Reliance's" greater wetted surface, it is probable that "Reliance" carried at least 10 per cent more sail *per square foot of wetted surface*.

I contend that the performance of "Reliance" in light winds fully accords with theory if her sail area per square foot of wetted surface exceeds that of "Shamrock," about which there can be no doubt.

In regard to the relatively better performance of "Shamrock" in strong winds reaching, which should in theory be "Reliance's" best point, I think the comparatively good performance of "Shamrock" in strong winds can be accounted for in three ways: First, a cutter of such immense rig as "Reliance" would be more difficult to manage in strong winds and the small sail plan of "Shamrock" would be more effective in proportion to its size. Secondly, "Shamrock's" area of cross-section may be very little larger than "Reliance's," and if this is correct, her relative fineness of hull will be very little fuller. Owing to her shallowness of hull and extreme overhangs, "Reliance's" buttock and diagonal lines will of course be much finer than "Shamrock's," but "Shamrock's" water lines, on the other hand, are much finer, and consequently it is probable there is not much difference in the relative fineness of the hulls of the two boats. If these assumptions are correct, it is in accord with theory that "Shamrock" should develop high speed in conditions favorable thereto. Thirdly, the finer waterlines and sweeter form of "Shamrock" would of necessity cause her to take more kindly to rough water.

It will be remembered that in the trial races on the Clyde, while "Valkyrie III." could sail rings round "Britannia" in light winds, "Britannia" beat "Valkyrie" in strong breezes. The differences in type between these two boats were more pronounced than in the case of the "Reliance" and "Shamrock," but otherwise I think the cases are analogous.

ARCH. BUCHANAN.

Auckland, N. Z., October 15, 1903.

The new leviathan "Baltic," for the White Star Line of the Morgan shipping combine, is rapidly approaching completion at the Belfast shipbuilding yard of Harland & Wolff. This steamship when launched will be the largest vessel afloat, exceeding the "Cedric" by 3,000 tons. The tonnage of the "Baltic" will approximate 24,000 tons.

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