* * * * I know little or nothing of drawing, but I have given much attention to the subject of drawings. This may look like a narrow point of difference, but it is as broad as the difference between product and process. My attention has been given to machine shop drawings; not to the art of making them, but to the desirable points in them after they are made and before they are made.

* * * * The machine shop drawing is simply a memorandum, showing what is to be produced. It is essentially an illustrated memorandum, or it would be no drawing. To be perfect, it should answer all questions which a workman can reasonably ask in regard to the piece of work; it should be durable enough to form a record for future use; it should be small enough to be easily preserved in a safe place, and it should be as low in cost as possible.

* * * * A drawing should be complete, for a

drawing which requires explanation from a draughtsman is no drawing at all. Instead of being the workman's memorandum, such a drawing is simply a draughtsman's memorandum, and if he is not present, the drawing fails in its mission.

Drawings for use in the shop, right at the draughtsman's elbow, should be so complete and self-explaining that they could be sent a thousand miles away without a word of explanation, and enable properly-skilled men to execute the work as well as the man who can confer with the man that made the drawing. It requires no more artistic skill to make a self-explaining drawing than it does to make a drawing of which the draughtsman is an essential part.

* * * * The mechanics of the shop, such as have to do with the drawings, are pattern-makers, blacksmiths, boiler-makers, wood-workers, painters and packers. The drawing is the record of results to be accomplished by all these men, and properly-made drawings should tell all these men what the ultimate result is to be, and should not contain any blank hints that will lead you to ask questions till you find out what is wanted.

* * * * Drawings are destroyed by being torn, broken, defaced, faded, or lost. Durability is secured by making them so they can't be torn, broken, defaced, faded, and so forming them that they are not liable to get lost.

A paper drawing, as a record for continued future use, has no place in a machine shop. It gets defaced in a short time, gets torn in a short time, and, fragment by fragment, it gets lost. They do not last long enough to fade. They should never be used in machine shops, except on such work as permit the drawing to be destroyed as soon as the job is finished.

Tracing cloth is but little better than paper. It gets

soiled and broken, and requires a clumsy process of unfolding or unrolling before it can be consulted, and even then, it will not lie flat. These tracings are expensive because they imply a total unnecessary duplication of the draughtsman's work. They cannot be distinguished or designated when rolled, and time is lost in going through a cord of them to find the right one. If rolled, they will not store away in some accessible and compact shape, and if folded, they are constantly liable to be mislaid or lost.

The machine-shop drawing should always be flat, and it should be made a penitentiary offense to roll or fold it.

* * * * If a paper drawing is glued on a board, it ceases, as we are speaking of it, to be a paper drawing. It then becomes a wooden drawing, and it has many superior virtues. You can't roll it ; you can't fold it ; it lies flat ; it is always open : and some designating character, conspicuously placed upon it, will tell if it is the one wanted, and it is not liable to get lost. Numerous coats of hard varnish will secure durability of surface.

The objections to the wooden drawing are : It is thick, and a number of them composing a set will not pack closely ; if of any size, battens must be put on the back to prevent splitting, which makes them still bulkier, and prevents their being moved over each other in a search ; they are very heavy ; and are altogether so large and clumsy that no safe preservation can be given very many of them. They also cost too much money. The lumber, the building of the boards, the drawing paper, and the artistic gluing of the paper all count up.

* * * * As to size, little need be said. A draughtsman can't make a good drawing so small that a workman can't follow it. The scale of a draw-

ing is immaterial. No one is called upon to *measure* a good shop drawing; and a scale of five inches, or two and a quarter inches, or seven-eighths of an inch, or three-sixteenths of an inch, to the foot, is far better than full size, because the men will then keep their rules off.

Wooden drawings are generally about twenty by thirty inches. This size is entirely too large for convenience, and is not called for by any class of work. Such big boards cannot be handled in sets; they take up too much room; it takes too much time to make such big drawings; the boards are too large to use around the lathes, the vises, or anywhere; they get used for tool boards and dinner tables, and trays, and tend to destroy each other by bulky contact. Boards half as big, say ten by twelve inches, are much more convenient, and are large enough for bridge work, locomotive work, steamship work, boiler work, and every other kind of work.

* * * * Sackett uses drawings which seem to combine all the virtues. They are made on cards about an eighth of an inch thick. The cards are good tarboard, with a peculiar quality of drawing paper pasted on one side. The edges of the paper are brought over the edges of the tarboard and pasted to the back. They are very light and strong; in fact, they seem indestructible. They cost $80 a thousand, or eight cents each, and are made by William Mann, stationer, Philadelphia. The size is 10 x 13½ inches. These cards are nice. A set of detail drawings for a common slide valve engine (the size of the engine makes no difference in the drawings), requires about twenty-five of these cards. The whole set can be carried in one hand. They slide over each other like a eucre deck; they are light; they are of convenient size to handle around the shop; they store nicely in a safe, and they are cheap.

* * * * Sackett uses these card drawings, and his whole drawing system has many tip-top points in it.

A panel drawing board is used with these cards. The card drops into the panel, so that its surface is flush with the stiles. In the edges of the panel, wood screws, with their heads half cut away, are fixed. A half turn of the screws brings the sharp heads around into the edge of the card. Nothing projects above the surface of the card, and a card may be returned to the board and nicely trued up.

* * * * When Sackett gets up a new machine, he has temporary detail drawings made on brown detail paper. The machine is given some short symbol like *G* 6, which is used as the name of the machine. Patterns and drawings are marked with this symbol, and the time and cost books deal with this symbol. Of symbolism, more hereafter. After the first machine is made, corrections made, and the details all approved, the permanent drawings are made on these cards, and the temporary drawings are immediately destroyed. The drawings are made in detail, no two pieces being shown in contact; and the fewest possible number of lines are used in making the drawings. No dotted lines are used where not essential, and there is no hatch shading, shapes being brought out by pencil shading. Every confusing element is omitted, and everything is shown, past all misunderstanding. Then, before a figure is written on the drawing, it receives one coat of white shellac varnish. This is sand-papered, and on the hard surface thus presented all the figuring is done. A printed general instruction sheet is then pasted on the back of the card, together with a big symbol, so the drawing can be easily identified Three coats of white shellac varnish are then applied to the card, back and front. If errors should at any time be discovered in the figuring, it is only necessary to erase

through the external varnish, correct the figure, and re-varnish. Were the figures put on the paper surface, some ugly digging would have to be done in correcting an error. If subsequent changes are made, it is a trifling matter to make one of these little cards new.