MECHANICAL DRAWING.

For an outfit, procure two drawing-boards 42 inches long and 30 inches wide, to receive double elephant paper. Have the boards plain, without cle ts or any ingenious devices for fastening the paper, and made from thoroughly seasoned timber at least 1¼ inches thick.

Two boards are required, so that one may be used for sketching and drawing details, which, if done on the same sheet with elevations, dirties the paper and is apt to lower the standard of the finished drawings by what I will term bad associations.

Details and sketches should, when made on a separate sheet, be to a larger scale than on the elevations. By changing from one scale to another, the mind is schooled in proportion, and the conception of sizes and dimensions is more apt to be based upon the finished work than the drawing itself.

In working to regular scales, such as a half, eighth, or sixteenth size, it is a good plan to use a common rule, instead of graduated scales. There is nothing more convenient for a mechanical draughtsman than to be able to resolve dimensions into various scales; and the use of a common rule for fractional scales trains the mind so that the computation come naturally and after a time almost without effort.

Use a plain T square, with a parallel blade fastened on the side of the head but not impeded into it. In this way, the set square can pass over the square head in working at the edges of the drawing. It is something strange that a draughting square should ever have been made in any other manner than this, and still more strange that people will use squares that do not allow the set squares to come near to the edge of the board.

A bevel square is often convenient but should be an independent one; a T square that has a movable blade is never fit for general use; combinations in drafting instruments, no matter what their character, should be avoided; such combinations, like those in machinery, are generally mistakes, and effect just the reverse of what is intended.

For set squares, or triangles, as they are sometimes called, no material is so good as ebonite; such squares are hard, smooth, impervious to moisture, and contrast with the paper in color; they will also wear longer than those of wood.

If wood squares are used, pear wood is best, because of its flexibility. A coat or two of shellac varnish improves such squares by making them smooth, and preventing their derangement by moisture.

For instruments, avoid everything of the elaborate or fancy kind; such sets are for amateurs, not engineers. It is best to procure at first only such instruments as are really required, of the best make, and then to add others as necessity may require; in this way experience will often suggest modifications.

One pair each of 3½-inch and 5-inch compasses, two ruling pens, two pair of spring dividers, for pen and pencils, a triangular box-wood scale, a common rule, and a hard pencil, are the essential instruments for machine drawing.

At the beginning, when "scratching out" will probably form an item in the work, it is best to use Whatman's paper, or the best roll paper, which, of the best manufacture, is quite as good as any other for drawings that are not water shaded.

In mounting sheets that are likely to be removed and replaced, for the purpose of modification, as working drawings generally are, they can be fastened very well by small copper tacks driven along the edges at intervals of 2 inches or less; the paper can be very slightly damped before fastening in this manner, and if the operation is carefully performed, the paper will be quite as smooth and convenient to work upon as though it were pasted down; the tacks can be driven down so as to be flush with, or below the surface of the paper, and will offer no obstruction to the squares.

If a drawing is to be elaborate, or is to remain long upon the board, the paper should be pasted down. To do this, first prepare the mucilage, and have it ready at hand with some slips of absorbent paper about 1 inch wide. Damp the sheet on both sides with a sponge, and then apply the mucilage along the edge, for a width of ½ inch; then set the edge of the board upon the floor, so that it will lean against the desk at steep angles. In this position the paper can be applied without assistance. Then, by placing the paper along the edge, and rubbing over them with some smooth, hard instrument, the edges are pasted firmly to the board, the paper slips taking up a part of the moisture from the edges which are longest in drying. If left in this condition, the center would dry first, and the paper be pulled loose at the edges by contraction before the paste had time to dry. It is therefore necessary to paste over the center of the sheet with a wet sponge at intervals, until the edges adhere firmly, when it can be left to dry, and will be tight and smooth. In this operation much depends upon the judgment of the learner and much will be learned by practice. One of the most common causes of trouble in mounting is not having the mucilage thick enough; when thin, it is absorbed by the wood or paper, and is too long in drying; it should be as thick as can be applied with a brush, and made from clean gum arabic or tragacanth; glue is not so good.

Thumb tacks are but of little use in mechanical drawing, except for the most temporary purposes, and can very well be dispensed with altogether: they injure the drafting boards, obstruct the squares, and disfigure the sheets.—*J. Richards* in *Engineering*.

THE GLORIES OF THE STARLIT HEAVENS.

BY R. A. PROCTOR.

If the eye could gain gradually in light-gathering power, until it attained something like the range of the great gauging telescopes of the Herschels, how utterly would what we see now seem lost in the inconceivable glories thus gradually unfolded. Even the revelations of the telescope, save as they appeal to the mind's eye, would be as nothing to the splendid scene revealed, when within the spaces which now show black between the familiar stars of our constellations, thousands of brilliant orbs would be revealed. The milky luminiosity of the Galaxy would be seen aglow with millions of suns, its richer portions blazing so resplendently that no eye could bear to gaze long upon the wondrous display. But with every increase of power more and more myriads of stars would break into view, until at last the scene would be unbearable in its splendor. The eye would seek for darkness as for rest. The mind would ask for a scene less oppressive in the magnificence of its inner meaning; for even as seen, wonderful though the display would be, the glorious scene would scarce express the millionth part of its real nature, as recognized by a mind concious that each point of light was a sun like ours, each sun the center of a scheme of worlds such as that globe on which we "live and move and have our being."

Who shall pretend to picture a scene so glorious? If the electric light could be applied to illumine fifty million lamps over the surface of a black domed vault, and those lamps were here gathered in rich clustering groups, there strewn more sparsely, after the way in which the stars are spread over the vault of heaven, something like the grandeur of the scene which we have imagined would be realized—but no human hands could ever produce such an exhibition of celestial imagery. As for maps, it is obviously impossible by any maps which could be drawn, no matter what their scale or plan, to present anything even approaching to a correct picture of the heavenly host. There is no way even of showing their numerical wealth in a single picture.

It is not till we have learned to look on all that the telescope reveals as in its turn *nothing* compared with the real universe, that we have rightly learned the lessons which the heavens teach, so far, at least, as it lies within our feeble powers to study the awful teaching of the stars. The range of the puny instruments man can fashion is no measure, we may be well assured, of the universe as it is. The domain of telescopically visible space, compared with which the whole range of the visible universe of stars seems but a point, can be in turn but as a point compared with those infinite realms of star-strewn space which lie on every side of our universe, beyond the range —millions of times further than the extremest scope—of the instruments by which man has extended the powers of visions given to him by the Almighty. The finite—for after all, infinite though it seems to us, the region of space through which we can extend our survey is but finite—can never bear any proportion to the infinite save that of infinite disproportion. All that we can see is as nothing compared with that which is: all we can know is as nothing; though our knowledge "grow from more to more," seemingly without limit. In fine we may say (as our gradually widening vision shows us the nothingness of what we have seen, of what we see, of what we can ever see), not, as Laplace said, *The Known is Little*, but THE KNOWN IS NOTHING; not *The Unknown is Immense*, but THE UNKNOWN IS INFINITE.—*Knowledge*.