"Weary toiler, I bring thee a breath
From the Ocean of Life. Lo! the Shadow of Death
Is blown to the winds like a broken cloud.
Hark to my waves! they laugh aloud
With merry ripple and jubilant roar,
As they rush to efface thy cares once more.

"Rest! rest! rest!
Fling thyself down on thy mother's breast;
Touch the earth, like the Titan of old,
And arise with strength renewed and bold;
Draw a deep breath of my pure sweet air
And thy heart shall expand to do and dare—
Yes—to do and dare thy highest and best
Till the calmer ocean brings perfect rest."

W. A. Gibbs.

MY WORKSHOP AT HOME.

BY A PRACTICAL MAN.

IT is hardly possible to imagine a house which at some time or other has not to suffer from an incursion more or less prolonged of the much-detested workman, and often when only little jobs have to be done, which with but a few tools and slight practice might be accomplished by the master or one of the sons, to the great saving of expense, inconvenience and temper.

As far back as I can remember, indeed almost before I had budded into youth, I had surrounded myself with a collection of tools and instruments, together with sundry dry and useless-looking bits of iron, wood, or brass, sufficient in my small imagination to dignify my retreat with the name of workshop.

How from very small beginnings, and with comparatively slender means, I collected around me a really complete assortment—enough, that is, for ordinary requirements—is little to the purpose of this brief article, but I might just presage that possibly the very difficulties in acquiring expensive tools, and the passive opposition of my friends to my purchasing, from a pocket none too long, things which to them seemed useless luxuries, rather stimulated than hindered me in their pursuit.

I mention this because I have often seen workshops very completely fitted up by rich and fond parents for sons, which after short periods of great devotion have ceased to attract, and soon have become mere receptacles for rubbish, and a prey to the all-devouring cobweb.

To parents I should say, if any of your sons show any leaning towards mechanical pursuits, by all means encourage it, judiciously giving gradually increased facilities with growing skill, rather than at first having things so complete that the charm of novelty and the new spirit infused by each fresh tool will be lost. Supposing, however, the reader desires to equip himself for dispensing with the services of the mechanic, I will briefly describe his prime necessities. First, a room should be set aside for the purpose, if at all possible, and the best place for it is unquestionably the basement, or, as one of my youthful kingdoms was, away above a stable, because some mess and noise is absolutely unavoidable, and perhaps no inconsiderable part of the enjoyment. A room 12 feet by 14 is a fair size, but if a smaller one only is available, it may be made to do with compactness and care in arrangement. It is well, however, not to be too restricted as to space.

The first and most important article in a workshop is unquestionably a good bench, and it would not be at all a bad start for an amateur to commence by putting one up for himself. It may occupy one side of the room, with a good light over it, and should be 27 inches wide by 30 high, firmly supported on bearers and legs, so that there shall be no yield or spring in the planks of the top, which ought to be at least 2 inches thick; if 3 inches, and of hard wood, so much the better. In the section adjoined (Fig. 1), A is the frame, which should be 3-inch by 4 stuff for the legs, with 3-inch by 3 cross-bars morticed into the legs, and firmly pegged or wedged up; B shows the top planks, which should be tongued and glued together and planed up true; C is a curtain or front board firmly screwed to the front legs, and exactly flush with the front edge of the top. Into C the bench-vice D is fitted, the box or nut being attached inside. When screwed up, the board D should fit tight and true to the top edge of the bench. A little attention to this will be well worth the trouble. Some bench-vices have two screws, some one and a locking nut, which is perhaps as good. It is as well to make our bench a fixture, and if it can stand with its head up to the wall no difficulty should arise in assuring rigidity. See that the top is a dead level—your spirit level will tell you this.

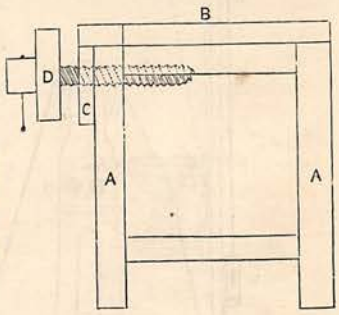

FIG. 1.

A small selection of proper-sized tools will have been first obtained, having regard to the ambition of the worker. Let me advise you to beware of combination tools, because all tools are, or ought to be, constructed on scientific principles, which must of necessity be often ignored where they attempt to sail under several aliases, and consequently bad work and annoyance are very likely to arise from their use. I have a vision—I had almost written a nightmare—of

one which essayed to be at once a rule, a screwdriver, pincers, hammer, and nail-puller, but I don't wish to see it again. Above all things, have your tools arranged properly, so that they can be found without trouble. I know nothing so vexatious as to work with tools all in confusion, and find on the whole it is more convenient to have them hung round the walls than arranged in drawers or boxes—that is to say, if the room is given up altogether to the purpose. A good large cupboard with sliding doors is arranged over my bench, so supported by brackets that it is out of use it for all sorts of holding purposes which the professional carpenter would consider foreign to its proper duty.

No amateur worthy of the name considers his room a workshop until he has in it a fair lathe, and from the immense service mine has been in every operation at some part or other, I should urge you to get one of some sort as soon as possible. My first was a cheap bar lathe, which I bought for £2 6s. at a dealer's, and fitted up myself on a wooden bench, and for light work in wood and ivory it did

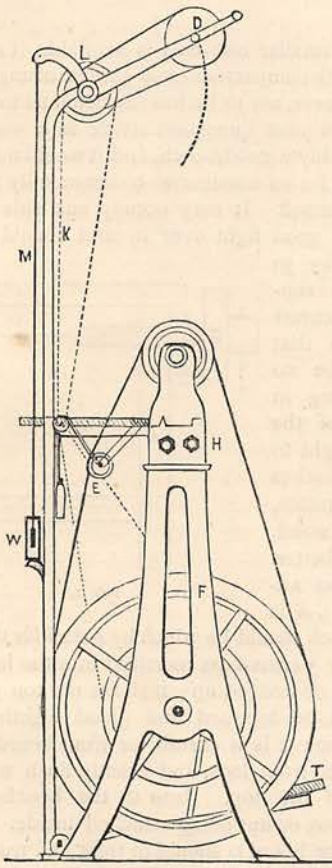

FIG. 2.

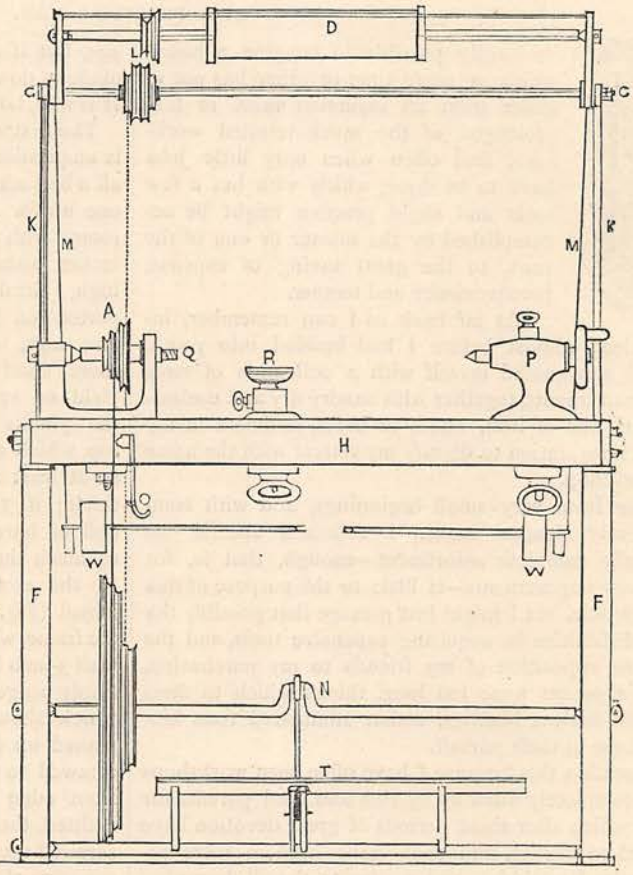

FIG. 3.

the way of planing operations, and it is invaluable for storage of the many bottles and jars in which I keep my numerous materials, such as paint, varnish, &c. The gas also should be arranged so as to throw a light well over the bench, and may with advantage be fitted with long joints up and down, as well as sideways. I have also a branch tap, to which is attached an india-rubber pipe, which by turns feeds a boiling stand for glue-heating, &c., and also supplies a blow-pipe, which is indispensable for soldering operations. I have a small second bench, to which is mounted a heavy iron vice for filing or chipping, for iron and brass work; and, at the risk of being called unworkmanlike, I admit that sometimes I very well, but it was soon necessary to my ambition to have a heavier one, with which I could attempt all sorts of metal-turning and drilling. I did not, however, buy an elaborate one, but a plain five-inch centre lathe, with a slide-rest, which I think cost about £11; and to this I have added from time to time, until now it is sufficiently effective to do almost all the usual combination of work expected of expensive ornamental lathes. To enumerate: it does all kinds of plain turning in wood and metal, all kinds of drilling in the same, and by the help of the overhead apparatus it will do the exquisite eccentric cutting so admirable when well done, and also fluting in even steel with slight adaptation. Perhaps the best way will be to

describe my lathe minutely with the help of the figure, as in principle it is practically the same as most, and any minor differences will not affect the general plan of working.

Fig. 2 is a side elevation, and Fig. 3 a front elevation of my lathe, and the letters refer to the same parts in each; H is a bed of iron, planed true on its top edges, the front being flat, and the back edge a Λ, into which the headstocks, hereafter to be described, are fitted, in order to preserve their truth to the line of centres. The bed H is strongly supported by the standards F F, to which it is bolted; these standards may be of wood or iron, and are in turn strongly braced together at the back of the foot; N is the crank shaft, on which is keyed the driving or fly-wheel, a heavy wheel with two series of grooves for a gut band, the outer series being for fast motion, for wood, brass, and ivory turning, and the smaller pair for iron or heavy work, a different length of gut being of course requisite for the two speeds. It will be seen that there are three grooves in the larger wheel, corresponding to three grooves in the pulley above, which give a variation of speed with same tension of gut, by shifting same from the largest below working smallest above to the smallest below to largest above, and so on, the object gained being a considerable variety in the speeds. In theory the lengths of gut for each separate combination ought to be exactly the same; but in practice, except in very good lathes, the gut will be found too tight on one speed and too loose on another, and in addition to this slight inaccuracy the band is affected by changes in temperature, the certain result being, at some time or other, that the hook or eye uniting the gut draws off, and much vexation ensues. To obviate this, I many years ago designed the simple contrivance shown in the figure, since which I have never had any recurrence of the difficulty. E is a grooved pulley sliding loose on a steel rod working on an arm. This pulley is kept up to the gut by means of a weight (about 3 lbs.) by a cord from the arm over a pulley in the gut gap, as shown in the sketch. It will be seen that the effect of this pressure, which is exerted on the *slack* of the band, is to keep the same well in the groove of the mandril pulley; and in practice I find it never slips, while at the same time the friction is greatly reduced. Another advantage is that the speeds may be more varied, as by arranging the band the right length it may be run from any groove below to any above. The before-mentioned crank-shaft is supported between centres screwing through the frames F, and prevented from shifting by lock-nuts; and it is actuated by means of a connecting-rod acted upon by a treadle, T, pivoting at the back of the frame.

Fitted to the bed H we find the mandril poppit A, the hand-rest R, and the back poppit P. The first consists of a steel mandril (on which is fitted a turned pulley, described above) working in a steel collar at its nose or screwed end, and with an adjustable centre at the other. The pulley should have a brass or gun-metal dividing plate on its face, which should have at least two circles of holes drilled at geometric distances. The most convenient numbers for two sets I find to be 96 in one row and 180 in the other, as with those graduations it is possible to divide any given circumference into 2, 3, 4, 5, 6, 8, 9, 10, 12, 15, 16, 18, and 20, and so on. The spring centre-point O is needed when the plate is in use, and turns up so that the point will fall into any dividing hole. It should be explained that for ornamental or eccentric cutting the work is held in the chuck upon the mandril by this point, and that the work does not revolve, but is cut by a revolving cutter actuated by the overhead drum, presently to be described. The mandril poppit or head is of course firmly bolted to the bed. The rest R is too simple to require description, and is necessary as a guide or rest for hand-tools used for any cutting operations; it can be shifted to any required position on the bed. The back poppit P can also be fixed at any place on the bed, and is a firm rest, holding exactly on the line of centres a point or "back centre," which by a wheel at the right can be made to advance or recede, or be set firmly into its place, when adjusted, by a set screw above. Its use is to support, with the help of one of the chucks, any cylinder or similar form under operation, usually by the help of a driver or wing chuck and a carrier. I shall tell you more about chucks further on, as they are as important almost as the lathe itself. A most valuable adjunct to a lathe, if anything more than plain wood or ivory turning is contemplated, is a slide-rest; indeed, I consider it essential. It is a rest fitting into the bed like the hand-rest, and has two slides, one parallel and the other at right angles to the bed, by means of which a tool placed in its holder can be made to traverse a right line in either direction, or at an angle, by altering the adjustment of the slide-rest at its quadrant. It should be understood that a cylinder—the first outcome of the turner's art—is only the combination of the circle (produced by the lathe's revolution) and a right line (produced by the tool's traverse); and, paradoxical as it may seem, it is even possible to turn a perfect cube in a lathe. I have no doubt it would be considered unworkmanlike to turn wood with a slide-rest, but I must admit that I have often done it, and claim that for work needing great accuracy it is admissible.

The above description completes our examination of the lathe proper, and possibly many will not care to carry it further; but for those to whom eccentric cutting and general ornamental work are attractive, I should say by all means make an overhead apparatus. I made the whole of mine myself, with the help only of the blacksmith to forge the iron standards and frame, all the fitting being done by the help of my lathe, just as complete as the above. In our overhead motion, K K are two iron frames screwed down to the floor and also to the lathe-bed by means of the cross-pieces showing just under the backboard, Fig. 2. These standards are drilled out at C above, and hold a centre rod, which is bolted right through the frames, so as to admit of the upper frame working easily on its axis at C. The frame is riveted on a pipe working on the centre C, and kept rigid by the rod shown at front; at

D in the section, Fig. 2, is the drum, mounted on a spindle revolving freely on centres, and driven by a V wheel, which in its turn is driven from the double V wheel L, in centre pipe. The object of this arrangement will be obvious. The wheel L is driven from the fly-wheel below by a long gut passed over

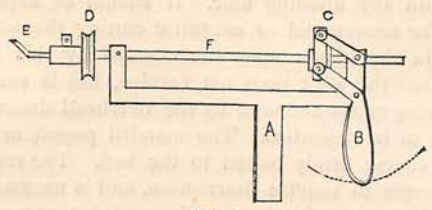

FIG. 4.

pulleys, as shown by the dotted line, and transmits its motion by another gut to the drum D. The drum is kept up to its place by counter-weights, W, and the wires M, but is free to move forwards and downwards without interference with its revolution.

Fig. 4 is the eccentric cutter, which is fitted in the slide-rest perfectly square to the surface to be ornamented, by the socket. It consists of a frame, A, carrying a spindle, F, which, by means of the handle B and bar C, working in a boss on the spindle, may be advanced or withdrawn a given distance at each cut. A gut from the overhead drum D (Fig. 3) drives this spindle with great rapidity by means of the pulley-wheel D (Fig. 4). It follows, then, that any drill or cranked cutting-point placed on the socket, as E, will describe a circle on the face to be ornamented; and by rotating the work given distances by means of the dividing plate before described, these circles can be arranged geometrically, overlapping each other, and resulting in very lovely patterns. The greater the ingenuity displayed in arranging and varying the patterns, the more beautiful the results. I am aware that the Fig. 4 cutter is not a usual form, as I contrived it myself; but as I have found it most effective, I venture to make a drawing of it.

A word or two about the necessary chucks, and I have done. A chuck may be defined as a means of holding work in the lathe, and only a few of the many varieties need be mentioned here. First, the driver-chuck screws on the mandril-nose, as all chucks do, and has a centre-point and a projecting bar catching a driver which screws on the rod to be turned. This rod is centred and a hole drilled at each end, so that the two centres (chuck centre and back poppit centre) may catch and hold it tight. Wedge-chucks are cups of iron or metal of various sizes, into which blocks are driven after being roughly turned to fit very tightly. They have the advantage of holding a block without the aid of the back centre, and are indispensable for work to be hollowed out. A face-plate is a true flat plate to which any surface may be attached by bolts. A very useful but somewhat expensive addition is a self-centring chuck for drills, and a similar but larger one for circular work; but it will be better to leave these more elaborate developments to the amateur's own investigation.

THE THREE ALPINE TUNNELS.

I.—THE MONT CÉNIS.

IT may not be generally known that the great Mont Cénis tunnel is not cut through Mont Cénis itself. It actually passes through Mont Vallon, a smaller mountain, and extends from Modane, Savoy, to Bardonnèche in the valley of the Dora, Piedmont. Of the hundreds of English travellers who annually pass through this wonderful tunnel, very few care to inquire how it was made. But let it be our task to set before our readers—pleasantly, we hope—the almost romantic and altogether wonderful history of this mighty work; the pioneer of the St. Gotthard and the Simplon, the father of the Alpine tunnels of Europe.

More than twenty-five years ago, the first suggestion respecting the construction of such a tunnel was made to Count Cavour; but even then the idea was no new one in the minds of the sturdy Piedmontese. Yet it is very doubtful whether the enterprise would have finally succeeded, had not a curious combination of circumstances tended to bring it about. Just previously to the suggestion being made to the Government, three young Piedmontese had come over to England to learn engineering and mechanics. They had been taken through the various workshops, and finally had been enabled to inspect our atmospheric railways, which naturally riveted their attention. For did they not hope to carry a railroad across their mountain boundaries, and what method more fit for the purpose than the traction of a train by atmospheric air? They returned home to apply the invention, if it were possible, to Mont Cénis. Curiously enough,