WORKSHOPS OF MANCHESTER, ENGLAND.

BY MR. JAMES G. FLETCHER.

Forty-five years ago, at the commencement of the writer's career as a mechanic, tools were of a very rude and primitive description, the lathe and drill being about the only ones then in general use; slide lathes were possessed only by a few persons, being made with great labor and expense, and very inferior in point of workmanship.

The introduction of the planing machine, however, and its subsequent development, effected an entire change in the manufacture of tools and machinery of every class, giving the means of carrying out with facility many works which had been left unattempted previously as too expensive or impracticable, and opening the way for improvements and invention generally; and in a short time these machines became indispensable in every workshop. The slide lathe became then comparatively easy of manufacture, and, in conjunction with the planing machine and self-acting drill, formed a most important feature in the advancement of engineering work. Still, much remained to be effected; a large proportion of work was done by hand, especially the smaller portions of machinery, untill slotting and shaping machines were brought into use, and special tools adapted for all parts where quantity of work was required to be produced. By the gradual introduction and perfecting of the regulator screw, the wheel cutting engine, standard gages, large surface plates, long straight edges, and scraped surfaces, combined with the improved tools, not only was the amount of manual labor considerably diminished, but the work was done more expeditiously, and a much greater degree of accuracy was attained, whereby the workmanship in all classes of machinery was remarkably improved, and at a great reduction in cost.

Another important feature in connection with improved tools, is the direct application of steam power to individual machines, especially those for the purpose of punching or shearing plates or cutting bars, etc., by the combination of a small steam engine with each machine, thus rendereng the machines portable entirely self-contained, and independent of other sources of driving power, and thereby saving, in many instances, the necessity of running a large engine and quantity of shafting to drive only one or two machines when pressed for the work upon which they are engaged, and entirely dispensing with shafting and the usual attendant expenses. By this means, and by the use of an under-ground steam pipe with branches at convenient points, either in workshops or along the sides of docks, these machines may be moved about to any part required, and thus obviate the inconvenience and loss of time in carrying work to and from the machines. Steam pipes of great length are now being used, and are found very satisfactory for purposes of this description; and this plan makes a much more convenient and less costly arrangement than shafting, which requires constant attention.

In the earlier construction of the lathe, the slide rest was the first great step toward the principle of the slide lathe, and no doubt led to that invention, which was considered impracticable before planing machines were made of sufficient magnitude to plane a lathe bed of even small dimension. A few slide lathes had indeed been made, the bed of which were composed of a timber framing, covered with iron plates on the upper side to preserve the surface, similar to those which were previously used for the ordinary hand lathes, with the exception that the outer edges of the iron plates were made of suitable shape to form the Vs for the carriage to slide upon. It was not, however, until some time after the introduction of the planing machine that (the cost of workmanship being considerably lessened) slide lathes came into general use, and their utility was fully acknowledged, and attention directed to their improvement.

The application of a screw to the slide lathe, so as to render it capable of both sliding and screw-cutting, was the next important improvement; and a great amount of time, perseverance, and capital was expended by a few persons in endeavoring to perfect this portion of the lathe. A short screw was first made, as accurately as possible with the rude means then possessed, from which one was cut double the length, by changing the turned bar end for end in the lathe after cutting one-half. Subsequently, by following out this principle, screws were capable of being made of any length required.

After this, the surfacing motion was introduced, and also the use of a shaft at the back of the lathe, in addition to the regular screw, for driving the sliding motion by rack and pinion, instead of both the motions of sliding and screw cutting being worked by the screw alone; for it was found that the threads of that portion of the screw nearest the fast head stock, being most in use, were worn thinner than the other parts; and, in consequence, the lathe did not cut a long screw with the degree of accuracy which it otherwise would have done.

Thus, step by step, improvements were gradually brought forward; the fore jaw and universal chucks and other important appliances were added, so as to render the lathe applicable to a great variety of work, even cutting spiral grooves in shafts, scrolls in a face-plate, skew wheels, and also turning articles of oval, spherical, or other forms. The duplex lathe, with one tool acting in front and the other behind the work, is also found to be a very useful arrangement for turning long shafts, cast-iron rollers, cylinders, and a great variety of work, where a quantity of the same kind and dimensions has to be turned.

The planing machine is one of the most important tools in use, and has done more toward the advancement and success of engineering work than any other invention, with the exception of the lathe, and has passed through a great number of changes since its first introduction down to the present time. In the first planing machines the table was moved by a chain winding on a drum, as in the old hand machines; this mode was found to be very objectionable, the cut was unsteady, and, when the tool was suddenly relieved at the end of its cut, the table had a tendency to spring forward; it was also driven at the same speed both forward and backward, and thus a great loss of time was occasioned. This was much improved upon by the use of a rack and pinion. arranged to give a quick return motion, and also afterward by the screw arrangement.

In some of the earliest planing machines the Vs were made inverted, evidently with the idea of preventing any cuttings that fell upon the wearing surfaces from remaining upon them. They proved, however, to possess no advantage even in this particular, as the finer portions of the cuttings still adhered; and in addition it was found that, from the motion of the table, the oil, by its own gravity, would not remain upon the surfaces, and thus caused them to cut and wear away quickly.

The writer has in use a planing machine, with a bed 54 feet long, the Vs of which have two inches of surface on each side, and are planed to an angle of 85 degrees. This machine has been working upward of twenty years, and for the last six years both night and day. It has been employed during the whole of that time upon very heavy work, ranging from 5 to 20 tuns. The Vs are still in good condition, apparently very little worn, and the work the machine does is at the present time perfectly true. The bed is in three parts jointed and bolted together, and the table in two parts, since, at the time it was made, there was no machine capable of planing a very long piece, and this was considered to be one of the largest then in existence.

The planing machines were further improved by the use of two tool-boxes on the cross-slide, and by the application of slide rests or tool-boxes fixed upon the uprights, self-acting vertically, for planing articles at right angles to the tools on the cross-slide. The reversing tool-box is a very ingenious and useful contrivance for planing flat surfaces; but that plan is not so well adapted for general purposes. Planing machines have, like other tools, been specially adapted to a great variety of work, and the writer has made them with different numbers of tools, up to as many as sixteen, all of which were in operation at once.

The great changes which have lately taken place in the manufacture of wrought-iron and steel ordnance, and the revolution they have caused in the construction of vessels of war, have called into requisition a great many alterations and adaptations of the present machines, as well as many entirely new ones. The planing machine especially has been called upon to do work of a very curious and intricate character, namely, that of planing the edges of armor plates to different curves, shapes, or angles. In most cases this has been accomplished by a pattern bar of iron or steel, placed on edge in a small chuck fixed upon the surface of the table, adjustable by set screws, and shaped to the form to which it is required to plane the edge of the plate; as the table travels, this bar, which runs between two circular rollers attached to the under side of the cross-slide, moves the tool sideways, according to the amount of curve in the shaper or guide bar, the tool-box being disconnected for this purpose from the screw in the cross slide.

A duplex planing machine, made by the writer, is arranged with double beds and double tables, each table having a separate set of gearing, with starting, stopping, and feed motion. There are two tool boxes on the cross-slide, each of which is independently self-acting, so as to work with its own table. Thus the two tables may be used separately as two smaller machines working independently of each other, and capable of planing different lengths of work at the same time; or when planing a large article, the two tables, gearing and motion, may be coupled, so as to form one large machine, an arrangement rendering the machine capable of doing a variety of work. Also one table may be fixed stationary as a bed-plate to bolt awkwardly-shaped or long pieces of work upon, while they are planed by a slide rest fixed upon the other table. When used as one machine, both sets of straps and gearing are in operation, and are reversed by the stops of one table only, so as to insure the straps moving at the same time.

This machine is capable of planing articles 10 feet wide and 10 feet high. The racks on the under side of the tables are 3 inches pitch, with stepped teeth; the wheel working into the rack is 3 feet 9 inches diameter at the pitch line, and is driven by a smaller pinion. By this arrangement a steadier motion is obtained; and also the pulleys and driving gear can be placed entirely behind the face of the uprights, so as to leave the front of the machine perfectly clear, that the straps may not be in the way when taking the work off and on. The pulleys being below the ground line, may be driven by a horizontal underground shaft at the back of the machine, and no straps will then be visible. The writer has made machines of this description with beds 40 feet long, to plane work up to 14 feet in width.—*Newton's London Journal.*

ENGINE-ROOM SKYLIGHTS.

In the autumn and winter of 1862 and 1863, when so many Baltic steamers were lost, we pointed out, from the facts reported bearing on each disaster, that most of them foundered from the seas breaking through the engine-room skylights, putting out the fires, and thus stopping the machinery. As the engines work the bilge pumps the ships cannot be kept free, for the water taken in-board is so great that is impossible for the deck pumps, worked by hand, to keep it under. We stated our opinion then that no steamer ought to be sent to sea without having means at command to secure the deck openings, and we see no reason to alter our views. The *London* might have been pursuing her course in safety across the ocean at this moment, could the water which rolled over her bulwarks have been kept out of the engine department. It was, no doubt, thought that in so large a ship the waves falling in-board would never create such havoc, and that the fastenings of the skylight were sufficient for a vessel of her size. Events have proved that the weight of water tumbling on a ship's deck will smash stout glass and comparatively light frames, even though there is a covering of tarpaulin. The skylight of the *London* was 12 feet 6 inches by 9 feet 6 inches. The frame or sash was of teak wood, over three inches thick, and it was glazed with half-inch glass, each plate 12 inches by 9 inches. To protect the sashes from damage, there were round iron rod bars, forming a grating in the manner so commonly to be met with. This skylight slid in a rabbit of one and a-half inch, and the combing was of teak, rising sixteen inches from the deck, and five inches in substance. Such a skylight was sufficient for fine or moderate weather, but not adopted to withstand the force of such seas as were dashed by the wind against it. Waves in bad weather sweep ships' decks, and carry away boats, cooking-houses, and deck spars; but so long as a vessel keeps tight, and the water is carried off through the washboards and scuppers, there is no danger to the hull. The mischief arises when the water from above falls below in quantities that cannot be pumped out fast enough to keep the ship buoyant, as in the case of the *London*. Mr. Greenhill, her second engineer, states that, when the sea broke aboard, some of the glass and teak fell into the engine-room, which affords strong evidence of the power of a body of water, when projected violently against an object, to sweep all before it. It may be argued that the skylight of this ship was weak; but, if we compare it with other vessels of greater tunnage, we shall find that is above the average strength. The *London* might possibly have made many voyages, and even been worn out in the service, without her engine hatchway being put to such a severe test. But where a ship is caught in a hurricane at sea, she is sure to be well battered with the waves, and there is no provision that can be made to prevent the seas from breaking against her and falling over the rail. Everything on deck, therefore, that acts as coverings to keep the water from the hold, should be firmly fixed. The cargo hatches are always covered and battened down, and, not rising many inches above the flooring of the deck, there is very little leverage for the rolling water to act upon. It is different, however, with lofty saddle skylights. They are struck from the sides, and the seas at times fall perpendicularly from a great hight.

Mr. G. J. Gladstone, sen., Surveyor to the Port of London, when questioned, said that he considered the bars of the skylight and the tarpaulin a sufficient protection, and that it did not occur to him to have slides or hatches. Mr. Maxwell, the foreman of Messrs. Humphrey & Tenant, the makers of the ship's engines, in reply to a question, said that hatches flush with the deck could not have been used in the *London*, without interfering with the action of the piston rod; and Captain Harris read an extract from a letter of a gentleman connected with a shipping establishment, in which it was stated that there was nothing superior to the tarpaulin, for there had never been an instance of any of the skylights of the Company's ships being injured by a sea. The Surveyor, Engineer, and Superintendent are representatives of their classes. One did not look to engine-room fastenings for hatches; the second tells us of the piston rod being in the way; and the third belongs to a fortunate company who have never lost a ship from the fires being put out, and reasoning therefrom, cannot bring himself to believe they ever will. Perhaps Mr. Gladstone is now of opinion that some security of the character here alluded to is demanded. As for the piston rod preventing slides from being drawn flush with the deck, such an objection is frivolous. The *London* had pumps sufficient to throw out 4,000 gallons per minute. If an aperture had been left open to admit of the head of the rod and crank working through, the engine power would have freed the ship faster than it could have flowed down such an opening. But a box frame over the piston rod would have shut out the water taken in that way. There may be a difference as to the way protection should be given to skylights, but there is no insuperable difficulty in the way. It were better to put out the fires and trust to canvas, where there is plenty of sea room, than to lose a ship and all on board, because the air is excluded on an emergency from the engine room. But there are methods of obtaining artificial drafts of wind by mechanical aid, if the furnaces cannot be kept alight when the skylight is closed. On board the American iron-clad monitors, fans are used for this purpose, and likewise "blowers." Sufficient air can be generated to get an up draft, enough to supply combustion in the furnaces by a light iron rod, with a wheel for carrying a coupling band and a few vanes. In a strong gale of wind, however, a couple of iron pipes, with mouths like a wind-sail, would convey sufficient air down into the engine room to create a current to the fires. Those who have been on board the *Great Eastern* will remember that her engine-room skylight is a space of enormous extent, with nothing but glazed sashes. When this ship was under construction she was to have defied the elements; but this monster can roll, in a beam sea, and there may be occasion for a covering to her skylights. But managers will say, "The seas don't break the skylights of our ships," and therefore, steamers will now and then go down and create a panic. True economy lies in giving security at sea to those who have to travel by ships. A trifling outlay will make all the difference between a safe and an unsafe vessel.—*Mitchell's Steam-Shipping Journal.*

NOTES ON NEW DISCOVERIES AND NEW APPLICATIONS OF SCIENCE.

PEROXIDE OF HYDROGEN.

Peroxide of hydrogen is a compound of hydrogen and oxygen and containing just twice the proportion of the latter element that water contains. As it is a very unstable compound, readily giving off its second equivalent of oxygen, it would be of considerable use in some of the arts, as an oxygenant, if it could be obtained tolerably cheaply. Hitherto it has been produced only by the aid of peroxide of barium, and the process of producing it has been at once costly and exceedingly tedious, When peroxide of barium is added to a dilute solution of hydrochloric acid, kept cool by the vessels containing it being surrounded by a freezing mixture, the barium of the peroxide unites with the chlorine of the hydrochloric acid to form chloride of barium, one of its two equivalents of oxygen combines with the hydrogen of the hydrochloric acid to form water, and the other equivalent of oxygen combines either with the water thus formed or with an equivalent of the water originally present, forming therewith peroxide of hydrogen. To obtain by means of peroxide of barium, however, an at all strong solution of peroxide of hydrogen, after neutralizing with peroxide of barium a dilute solution of hydrochloric acid, the barium must be precipitated from the resulting chloride of barium by means of sulphuric acid, added drop by drop until slightly in excess; the precipitate of sulphate of barium must be separated by filtration, more peroxide of barium must then be added to the filtrate, the barium of the fresh portion of chloride of barium thereupon formed must be precipitated and separated as before, and these successive operations must be repeated very many times—the hydrochloric acid used being finally separated by means of sulphate of silver, and the sulphuric acid by means of caustic baryta. Hofmann has just found that a strong solution of peroxide of hydrogen may be obtained by a much simpler method than this, if peroxide of potassium be used instead of peroxide of barium. This method, indeed, involves only a single operation, consisting simply in adding peroxide of potassium—formed by directing a current of air, by means of a bellows, on to metallic potassium in a state of fusion—to a somewhat concentrated solution of fluosilicic acid. Silicofluoride of potassium, which precipitates, and a strong solution of peroxide of hydrogen, are the results. This process is very simple, but unfortunately, its involving the use of metallic potassium cannot but prevent it from yielding peroxide of hydrogen cheaply enough for use in the arts.

THE SPECIFIC GRAVITY OF ALCOHOL.

A Russian chemist, M. Mendelejeff, has just published the results of a series of very laborious researches with respect to the specific gravety of absolute alcohol, and of the various compounds of alcohol with water. Curiously enough, these results go to show that of all previous determinations of the specific gravity of alcohol and its hydrates, the oldest being those made by Gilpin, in 1794, are the most accurate.

M. Mendelejeff's experiments far transcend in accuracy all previous ones upon the same subject, their author having taken into account every possible source of error, and having bestowed the utmost pains upon ascertaining the magnitude of each. They show that at the zero of the Centigrade scale the specific gravity of absolute alcohol is 0·80625 at 5 deg. 0·8027, at 10 deg. 0·79788, at 15 deg. 0·79367, at 20 deg. 0·78945, at 25 deg. 0·78322, and at 30 deg. 0·78096.

TESTING MINERAL OILS.

The mineral oils used for illuminating purposes are usually tested, either by directly measuring their inflammability or by determining their density. Both these methods are inconvenient, and MM. Salleron and Urbain propose to substitute for them the measurement of the tension of the vapor of the oils—the tension of the vapor of any oil being of course proportional to its volatility, and therefore to its inflammability. In a recent communication to the Academy of Sciences of Paris, these gentlemen describe an apparatus by which the tension of the vapor of a mineral oil may be very readily determined, and they accompany this description with "a table of the elastic forces of one and the same oil taken as a type, so that knowing, on the one hand, the tension of the oil to be tested corresponding to a given temperature, and, on the other, the tension at this temperature of the typical oil, by comparing these numbers the value of the specimens examined can be deduced." This method is simple and convenient, and at the same time much more delicate than the methods previously in use.

FOREIGN INTELLIGENCE.

The *Spectator* insists that to secure house-room for the working class, their dwellings in great cities must be built into the air. The cost of the site must be distributed among many floors. Inside corridors can be superseded by broad, continuous outside balconies. Each tenant would thus possess a separate house, and the sense of living in a barrack, which workmen so much dislike, would be obviated. Such balcony streets, moreover, would be thoroughfares, and allow of supervision much more easily than corridors, while they would also allow the hard-working poor to open little shops above the ground floor—an impossibility with existing architecture.

Tripod Masts.—A model of Captain Coles' tripod masts has been shown at Lloyd's. It does away with shrouds and stays, as the mast is supported by two smaller ones. The advantages claimed are as follows:—Saving of wear and tear of ropes, improved ventilation of ship, increased speed. Quicker voyages may be made in consequence of a vessel fitted with these masts being able to sail closer to the wind. The masts may be as readily cut away as wooden masts.

Considerable difficulty is encountered in procuring suitable timber in South Australia for durable telegraph poles, and it is recommended that the lines which require repairs should be re-poled with Swan River mahogany, as the local timber will not last, on an average, more than six or seven years in the ground. Contracts have been accepted for this purpose, at 17s. 10d. per pole 23 feet long.

The consumption of oil as a lubricator is immense. There are some railroad companies whose annual expenses are more than $25,000 for lubricators alone. A single manufacturer in England (Young) testified in court to having manufactured and sold over 400,000 gallons of lubricating oil in one year, at about one dollar per gallon. This oil was distilled from coal.

Experiments have been made at the Hythe School of Musketry on gun cotton as applied to rifle practice. Excellent diagrams have been made at a range of 1,000 yards, hardly inferior to those obtained with the small-bore rifles of the day. The charge used, was 25 grains, and ten consecutive shots fired at 1,000 yards gave a mean radial deviation of 1·65 feet.

The *Journal Du Havre* states that during the violent hurricane of the 11th, 200 enormous blocks of stone, placed in front of the breakwater at Cherbourg to protect it from the action of the sea, were lifted by the waves and thrown over the wall into the harbor. Forty cannon planted on the pier were thrown into the sea. Such a storm had never before been experienced in that place.

The following is a good method of bronzing tin castings:—When clean wash them with a mixture of one part each of sulphate of copper and sulphate of iron in twenty parts of water; dry and wash again with distilled vinegar eleven parts. When dry polish with colcothar.

Iron Church at Crewe.—The directors of the London and North-Western Railway Company have just completed the erection of an iron church, to accommodate 300 persons.

Chlorate of potash is now extensively used in dyeing as an oxidizing agent, in brightening what are technically termed "steam colors."