the temple was destroyed by earthquakes, since whole ranges of columns have been overthrown together. These have been preserved from spoliation and decay by being covered with sand and clay; and the sanguine explorers almost think that the materials exist for rebuilding the façades. The bases of most of the columns, and frusta of some, remain *in situ*, as do also a portion of the pedestal of the statue of Zeus, some portions of the walls, and the bases of two altars in the aisles. The mosaic pavement, discovered by the French in 1829, has been re-examined, and covered again with sand to preserve it till work is resumed in the fall, when careful drawings will be made of it. Only the nave (so called) of the temple was paved with marble, the aisles being floored with stucco. A raised platform of about thirty by forty-five feet has been discovered in front of the eastern facade. It is encumbered by fallen columns, and has not been thoroughly examined. The statements of Pausanias concerning the dimensions of the temple agree with the measurement of the explorers, which prove that his were taken at the base of the lowest step on which the building stands. Two sculptured metopes have been found, one very well preserved and the other very ill. The Greek government, which takes great interest in the explorations, has stationed a detachment of troops at Olympia, and put the magazines under seal till the work shall be resumed.—*American Architect & Building News.*

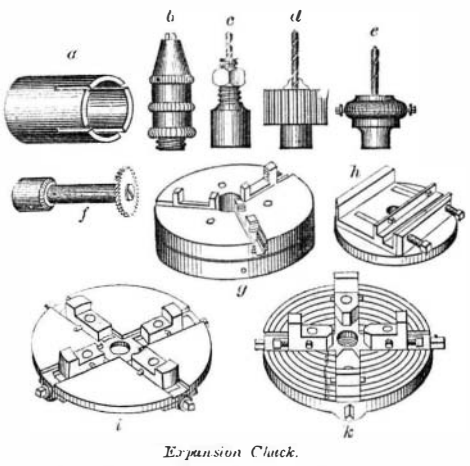
CHUCKS, FORMS OF IRON, AND LUBRICATORS.

Our extract from Knight's "New Mechanical Dictionary,"* for this week, includes an interesting series of illustrations of useful devices and forms of metal. The latter embody a very large number of sections of girders, beams, and other objects of iron, and the engravings will doubtless be found of utility for reference, in determining the selection of any especial shape desired for a particular purpose. Of

CHUCKS,

several improved forms are represented in Figs. 1 and 2. An expansion or elastic chuck, *a*, having a certain range of capacity, may be formed by giving a quadrifid cleft to the end of a cylindrical tube, whose other end screws on to the

Fig. 1.

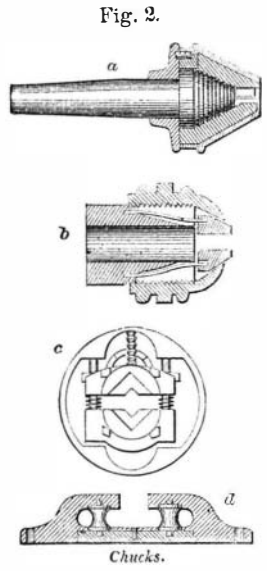


Expansion Chuck.

threaded mandrel of the lathe head. The object to be turned is thrust into the chuck, expanding the quadripartite socket. *b* is Beach's patent drill chuck. *c*, center drill chuck. *d*, Warwick chuck. *e*, Morse's adjustable chuck. A circular saw of small diameter may be mounted on a lathe chuck, *f*, which has an axial tenon to fit the hole in the saw, and a central screw or nut to fix the same. *g* is a scroll chuck with three radially adjustable dogs. *h* is a planer chuck. *i* is a screw chuck. *k* is an independent jaw chuck.

Fig. 2 shows three forms of lathe chucks having jaws to grasp the tool or the work, as the case may be. In *a* the stock of the chuck terminates in a conical, threaded head, which opens or closes the jaws, which are threaded, and slide in grooves in the conical shell. The nut in *b* has a conical opening in the end which operates against the inclined backs of the jaws, to clamp them upon the drill; when relieved they are expanded by springs. The chuck, *c*, belongs to that class which is constructed with screws for the purpose of operating the jaws. It is provided with a double screw, the pitch of one being just half that of the other, to operate the jaws simultaneously in opposite directions, so that they will approach or recede from the center at equal speed, thereby forming a self-centering mechanism. *d* is an entirely different device though having a similar name. It is a warping chuck, in which hawsers or ropes run. Friction rollers prevent the wearing of the rope. It is used on the rail or other portion of a ship's side.

Fig. 2.

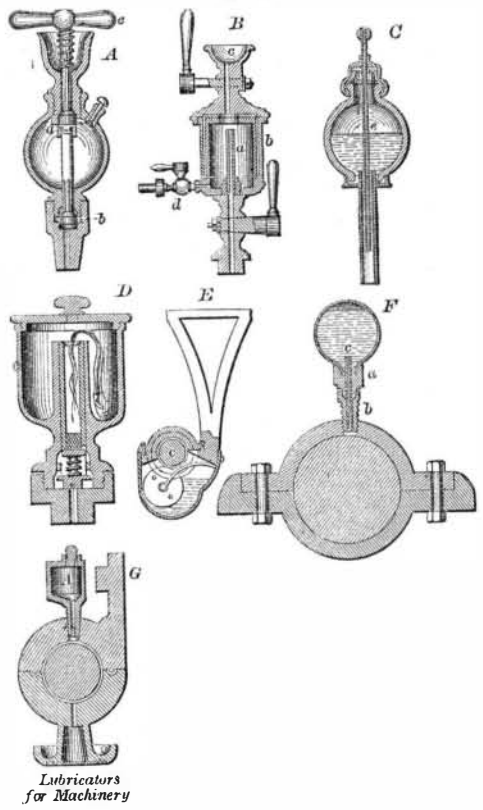


Chucks.

LUBRICATORS,

designed for supplying oil or grease to rubbing surfaces in order to diminish friction, are represented in Figs. 3 and 4. In A, Fig. 3, the two valves, *a b*, are connected by a rod. By turning the handle, *e*, in one direction, the valve, *a*, is depressed by means of a pin working on an inclined plane, and admits oil to the reservoir. A reverse motion opens the valve, *b*, furnished with a similar contrivance, permitting the oil to flow from the reservoir. The valve, *a*, is kept to its seat by a spiral spring on the rod. In B, steam is admitted through the pipe, *a*, to the oil chamber, *b*, forcing out the lubricating material through an opening to the desired point. The supply of oil from the cup, *c*, is regulated by a cock, and a cock, *d*, at the side of the oil chamber permits accumulating water of condensation to be drawn off. In C, the central tube, *e*, is open, and, when the oil sinks below its lower end, air is admitted through it and the annular passage

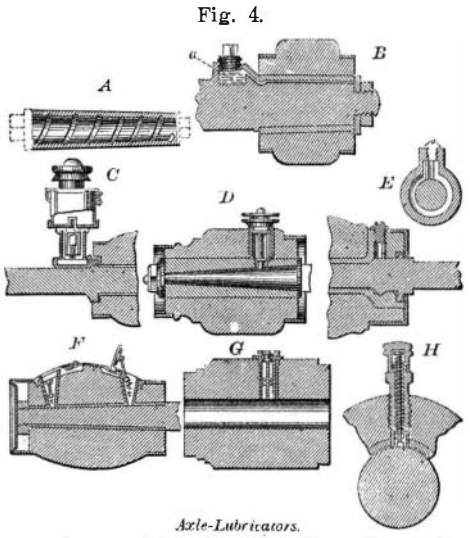
Fig. 3.



Lubricators for Machinery

to the reservoir above, and allows an equivalent amount of oil to descend. The vertical adjustment of the tube regulates the flow by determining the hight of the column of oil resting upon the journal. In D the oil is conducted from the annular reservoir by a wick of fibrous material into the tubular valve stem. This stem has radial holes at its lower end for the discharge of oil, and wire gauze to arrest impurities. Between the upper and lower valve is a spiral spring. When the engine is running, the valves are closed by steam and spring pressure; when stopped, the upper valve is closed by the spring, and when running without steam both valves are sucked open and the oil flows. E is designed for shafting. A pivoted disk in a cup below the lower journal box is revolved by contact with the under side of the shaft, *c*, and carries up oil to lubricate the latter. F has a transparent reservoir with metallic socket, *a*, screwing into the seat, *b*, fitted to the cap of the journal box. Between this and the journal is a slight vacuity, from which air is admitted through the tube, *c*, allowing a greater or less quantity of oil to flow in proportion as the journal turns more or less rapidly. When at rest the flow ceases. The flow of oil from the cup, A, in G, is regulated by an adjustable screw plug. The bearing has ducts for conveying surplus oil from the upper part of the shaft toward the center, and at its lower part is a closed chamber forming a drip cup. In Diller's (A, Fig. 4), a spiral groove is formed around the inner surface of the box, and leads the grease to all parts of the spindle, while the integrity of the bearing surface of the box is not materially interfered with. The reservoir, *a*, in B, is closed

Fig. 4.



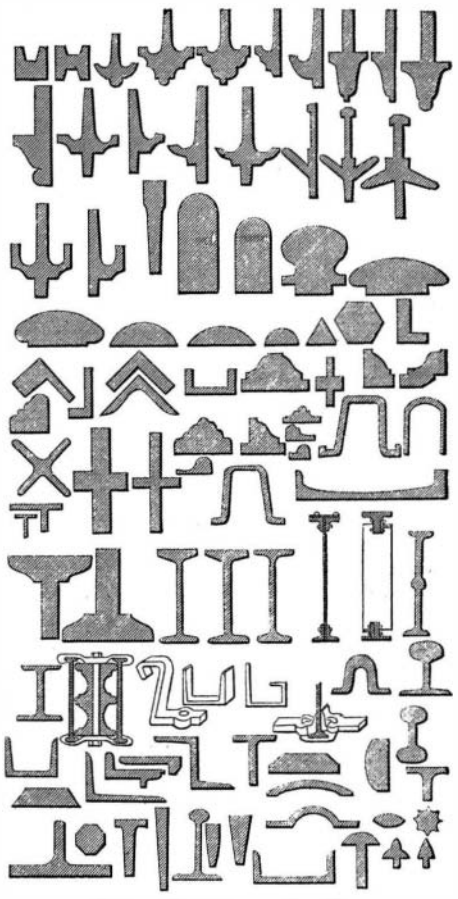
Axle-Lubricators.

by a screw plug, which is turned to force the oil through a duct leading to a groove in the upper part of the spindle. The groove tapers toward the outer end, so as to distribute the oil equally. In C a lantern is attached to the axle of the carriage just inside of the butting ring. The oil reservoir, besides furnishing supply to the wick of the lantern, also supplies oil through a duct to the bearing surfaces. In D a tube passes radially through the hub, its lower end opening into the interior space of the box. The oil reservoir is covered by a screw cap. The inner end of the tube is closed by a valve whose stem is attached to the cap. By turning the screw cap the valve is opened or closed, and the oil is allowed to flow, or is cut off. E has an oil chamber made in the box, which communicates with the bearing surfaces. The reservoir is closed by a screw plug, and the oil passes gradually to the spindle without special attention. In F there are one or more conical openings in the hub, each closed by a spring lid to which a rod and sponge are attached, extending to the axle. The sponge is charged with oil on opening the lid. This is kept shut by the spring when the wheel is in motion. G has an oil cylinder, having a piston on a screw rod which works through the cylinder cap, inserted in the hub. Turning the head of the rod pushes the piston down, forcing the lubricant upon the axle spindle. The piston is kept from rotating with the screw cap by a groove in its edge, into which a feather on the inside of the chamber fits. In H the depression of the spring valve allows oil to flow from the chamber to the spindle of the axle.

THE FORMS OF IRON

are simply sections, as already stated, and are illustrated in

Fig 5.



Angle, Bar, Girder, and Rail Irons

Fig. 6.

Angle, Bar, Girder, and Rail Irons.

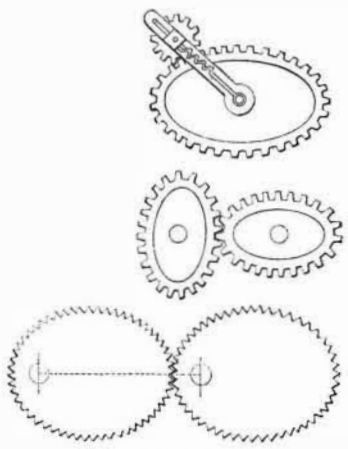
Figs. 5 and 6. The shapes are already shown and need no explanation.

*Published in numbers by Messrs. Hurd & Houghton, New York city.

In Fig. 7

ELLIPTICAL WHEELS

are represented. These are used where motion of varying speed is required, and the variation is determined by the relation between the lengths of the major and minor axles of the ellipses. In the upper figure variable rotary motion is produced by uniform rotary motion. The small spur pinion works in a slot cut in the bar, which turns loosely upon the shaft of the elliptical gear. The pinion is kept to its engagement by a spring on the shaft. The slot in the bar allows for the variation of length of radius of the gear.



Elliptical Wheels.

THE INDUSTRIES AND RESOURCES OF JAPAN.

Japanese manufactures are of great interest to foreigners, primarily in consequence of the raw materials (often unknown in other countries) of which they are made, and secondly on account of the various processes used in their production, processes invented in the long course of patient manual labor, which left to each artisan a free field for his exertions to simplify his work or to produce some new and original object.

With reference to the social condition of industry, it should be stated that there are but very few workshops, of any size or importance, giving employment to more than 30 or 40 persons, and that in most places the manufacturing is done on a small scale. Heavy machinery, with the exception of water wheels, is not used; but the hand tools are in general very well adapted for their purposes; and in several branches of industry, such as, for instance, in fan making, in the manufacture of porcelain, etc., the division of labor is carried on to a great extent. Of later years not only the government, but also the private people, have made great efforts to create larger industrial establishments. Several paper mills have been erected in Tokio, Kiyoto, and Osaka; cotton mills, silk-reeling establishments, with steam or water power, are to be found in different places; a glass furnace has been built in Tokio; sulphuric acid works in Osaka; soap manufactories are at work in Tokio and other places. The streets of Yokohama and of a great part of Tokio are lighted by gas made of the coal mined in Milike, province of Chikuzen; several machine shops and gun manufactories have been established by the government in Tokio, Osaka, Nagasaki, and the arsenal of Yokoska is very completely organized for the purpose of shipbuilding. At the same time, more liberty has been conceded to trade in general, and the old restrictions have been abolished without producing any of those perturbations which have so frequently taken place in Europe in consequence of reforms effected in connection with the social condition of industry.

To these remarks of general character we now extract some special notes concerning the various industries of the country, from the official Japanese Centennial catalogue, limiting our observations either to some characteristic features of a technical kind, or else only pointing out the peculiar nature of the raw materials used in the manufacture of the articles exhibited.

CHEMICALS.

Salt is used in large quantities for the ordinary food, and the preservation of fish and vegetables. It is exclusively produced from sea water by solar evaporation in large salt gardens, composed of a series of fields, the soil of which has been hardened and afterwards covered with a layer of sand. The clean sea water, flowing in through a perfect network of small ditches, is sprinkled over the fields by the workmen, the operation being repeated three times at intervals of a few hours. The sand is then raked together and carried for lixiviation to the filters, which consist of small square wood tanks, 4 by 4 inches, having a bottom of bamboo, covered with straw and mattings. The concentrated lye running out from these filters is first stored in covered wells, and then brought to the evaporating pans through wooden pipes. These pans are not always of the same construction. In some places they consist of low vaults, built of large pieces of slate, covered with gravel and mud, so as to fill up the interstices, and to form the bottom of the pan, which is surrounded by a low mud wall. This vault has an opening on one side for the insertion of fuel, and another on the other side leading into the flue

In other places, a very curious kind of a pan is used, which is constructed in the following manner: A low wall is built, enclosing a space of 13 by 9 inches, the bottom forming a kind of prismatical depression, 3 inches deep in the center. An ash pit, 3 feet deep, is then excavated, starting from the front wall, and extending about 4 inches into this depression at its deepest place; it communicates with the outside by means of a channel, sloping upwards, and passing underneath the front wall. The ash pit is covered by a clay vault, with holes in its sides, so as to establish a communication between the ash pit and the hollow space under the pan. This vault is used as a grate, the fuel (brown coal and small wood) being inserted through a door in the front wall. The air draft necessary for burning the fuel enters partly by the fire door, partly through the ash pit, and the openings left in the vaulted grate. Through these same openings the ashes and cinders are from time to time pushed down into ash pit, for which purpose small openings are left in the side wall of the furnace, through which the rakes may be introduced. A passage in the back wall, supporting the pan, leads off the results of combustion and the hot air into a flue gradually sloping upwards, and ending in a short vertical chimney. At the lower part, some iron kettles are placed in the flue for the purpose of heating lye before it is ladled into the evaporating pans. With reference to the pan, it is made in a way which requires a great deal of skill and practice. In the first place beams, reaching from one side to the other, are laid upon the top of the furnace walls, and are covered with wooden boards, forming a temporary floor. Two or three feet above this floor a strong horizontal network of wooden poles sustain a number of straw ropes, with iron hooks hanging down, and of such length that the hooks nearly touch the wooden floor. The floor is thereupon covered with a mixture of clay and small stones, 4 to 5 inches thick, the workmen being careful to incrustate the iron hooks into this material. It is allowed to dry gradually; and when considered sufficiently hardened, the wooden beams and flooring are removed with the necessary precautions. The bottom of the pan remains suspended by the ropes. The open spaces left all around, between the bottom and the top of the furnace walls, are then filled up, and the border of the pan, 9 or 10 inches high, is made of a similar mixture. It is said that this extraordinary construction lasts 40 to 56 days when well made, and that it can be filled 16 times in 24 hours, with an average of 500 quarts of concentrated lye at each filling. The salt, when removed from the pan, is placed in baskets, so as to allow the adhering lye and part of the deliquescent impurities to drip off; afterwards it is spread out with a layer of sand underneath, in order to dry. The purity of the salt, which differs in quality, depends upon this last treatment.

OILS, SOAPS, ETC.

The oil ordinarily used in Japanese households is the rapeseed oil, produced from the seeds by heating, crushing, and finally pressing them with a kind of roughly made wedge press; in short, it is prepared by a series of operations similar in principle to the European processes. The lamps are merely flat saucers, and the wicks consist of two or three pieces of the white and soft pith of the *juncus effusus*, which are laid into the saucer, and lighted by the end projecting above the edge of the vessel.

But the most important article for illuminating purposes is the candle made of vegetable wax, which is mostly composed of palmitine. It is produced from the fruit of several trees belonging to the genus *rhus*, among which the *rhus succedanea* is the most important, and is grown among vegetables, more or less extensively, almost everywhere in Japan, especially in the western provinces, from the south northwards to the 35th degree. The lacquer tree-*rhus vernicifera*, also yields wax, and differs in appearance but little from the wax tree; its geographical limit extends further northwards, being at the 38th degree. Finally the *rhus sylvestris*, or wild wax tree, should be mentioned. The cultivated wax tree was originally imported from the Loo-choo islands; but the growers of the tree now distinguish seven different varieties. The berries, of the size of a small pea, and united in bunches, contain the wax between the kernel and the outer skin; they are crushed, winnowed, steamed, placed in hemp cloth bags, steamed again, and afterwards pressed in a wooden wedge press, all by hand. In order to facilitate the flow of the wax, a small percentage of *pe no abura* (oil from *perilla ocimoides*) is added. The raw product, of a greenish color, is made into square cakes, and reduced to small scraps by means of a kind of planing tool, then washed and bleached by the sun and air, whereupon it assumes a pure white color. In ordinary candlemaking the unbleached wax is used, and the manufacturing is done by repeated dipping and rolling on the flat of the hand, in order to smooth and harden the successive coatings. The wicks are made by rolling a narrow strip of Japanese paper in a spiral line around the upper part of a pointed stick, and twisting it at the upper end, so as to prevent its getting loose. Two or three strings of the pith of *juncus effusus* are then rolled around this paper, in close spiral lines, and fastened with a few fibers of silk waste, so that the wicks can be taken off from the stick, and sold in bundles to the candle maker. The latter places the wicks again on sticks, takes half a dozen of them in his right hand, dips the wicks into the melted wax, and rolls them upon the palm of the left hand, repeating these operations till the candles have grown to the proper size For the outside coating, occasionally white wax is used. These candles are made of all dimensions; for ceremonies and similar occasions candles of bleached wax are used, of a fanciful shape and painted with bright colors. The art of candle making is said to have been introduced from Loo Choo, towards the end of the 16th century. Before this time pieces of resinous wood or paper dipped in oil were used.

Another tree yielding a kind of vegetable tallow is the *cinnamomum pecundulatum*. This, however, is seldom cultivated, as, in consequence of its being an evergreen plant, it would cast too much shadow on the other plants cultivated underneath.

An insect, producing a kind of wax very much like or perhaps identical with the Chinese *pela*, lives upon the *ligustrum Ibota*. The insects, in clustering round the thin branches, form by their secretions lumps of a slightly transparent white wax, of a crystalline construction and a very high melting point

A very fine oil is extracted from the seeds of a certain species of camelia, and, either flavored or unflavored, is used for the hair or for pomades, which consist of a mixture of camelia oil and vegetable wax.

PAINTS, PIGMENTS, VARNISHES, ETC.

The most interesting product appertaining to this class is undoubtedly the Japanese lacquer (*urushi*), celebrated all over the world for its excellent quality and great beauty This valuable article is almost entirely a product of Nature and requires but a few mechanical operations to be ready for use. It consists merely of the sap of the *rhus vernicifera*, which is cultivated especially for the production of lacquer, chiefly between the 33° and 37° of N. latitude. The trees when 5 years old are regularly tapped from the end of May until the end of October, incisions being made in the bark, extending about one quarter of the trunk's circumference, and just deep enough to reach the wood. On the incision being made, clear sap flows out, mingled with a very white milky substance, which darkens very soon when exposed to the air, and gradually assumes a dark brown and almost black color. At first these incisions are made at about 14·04 inches distance one from another, on alternate sides of the trunk, and the lacquer is taken off with an iron spatula as soon as it has filled the incisions. After an interval of three or four days new incisions are made, close above and below the former cuttings. Proceeding in this manner until the end of the season, the whole tree becomes covered with incisions, and has to be cut down. The branches are lopped off, soaked in water, and also tapped, by means of incisions made in a spiral line. The lacquer taken from the branches becomes very hard, and is therefore mostly used for priming; its name is *seshime urushi*. In the more northerly part of Japan, where the lacquer tree is cultivated with the additional view of producing wax, the tapping is done on a small scale only, so that the tree need not be cut down, but may yield lacquer and wax for a number of years.

The quality of the crude lacquer (*ki-no-urushi*) depends upon the season in which it has been tapped, and also upon the circumstances of climate and soil, as well as on the care bestowed on the cultivation of the tree. The raw produce is a viscous liquid of a dirty gray color, always covered with a dark brown skin where it comes into contact with the air, and mixed with particles of the bark of the tree and other accidental impurities. Having been placed in small wooden tubs lined with paper, it is allowed to settle gradually; the produce separates into a thinner and finer quality in the upper half, and a thicker and less good quality which settles in the lower half, of the tub. Both are separated by decanting, and are strained through cotton cloth. The superior quality of lacquer is stirred in the open air in order to allow a certain excess of water to evaporate, after which process it assumes a brilliant dark brown or nearly black color; in thin layers it appears transparent, with a brown color similar to that of shellac. The further operations which the lacquer undergoes before being ready for use are generally effected by the workman himself before using it; they consist of mixing it with powdered snbstances, with a view of either hardening or coloring it, and of straining the pure lacquer, or the mixture, through a peculiar long-fibered paper called *yashino-gami*, made for this purpose. The *shunkei urushi*, a kind of lacquer which has to undergo no grinding or polishing, and which is supposed to acquire sufficient brilliancy by mere hardening, is made by mixing the pure lacquer with a small quantity of the *ye-no abura* mentioned above. This lacquer is used in a manner similar to the foreign shellac or copal varnishes for furniture, upon which it forms a brilliant transparent coating of a yellowish tint, through which the veins of the wood remain visible.

A most interesting operation is that by which the celebrated black laquer (*roiro-urushi*) is produced. This is effected without the addition of any solid particles, such as lampblack or similar substances, but merely by stirring the crude lacquer for one or two days in the open air, whereupon it assumes a very dark brown color. Towards the end of the operation a small quantity of water, which has been allowed to stand for a few days mingled with iron filings, or a gall nut infusion darkened by the addition of iron is added, and the whole stirred again until part of the water has evaporated, whereupon the lacquer acquires a proper consistence and color. The addition of this water is said to be absolutely necessary for producing the highest brilliancy and darkness of the lacquer. The operation as described above is indispensable; but there are a few unimportant modifications, since the manufacturers sometimes add a solution of gamboge or a decoction of the yellow fruits of *gardenia florida*, or other liquid dyestuffs, for the purpose of improving or modifying the color of the varnish.

Among the peculiar properties of lacquer it may be mentioned that it is rather poisonous, and often produces eruptions on the skin, or swollen faces, or headaches, etc.; however, the effects are not the same upon all persons; most people get accustomed to it, others are not affected at all by it. The manipulations of coating and painting with lacquer will be described in another article.

Japanese writing inks are very much like Chinese, and manufactured in a similar, though perhaps not quite identical, way. The body of the ink is soot, obtained from pinewood or rosin, and lampblack from sesasum oil for the finest sort. This is mixed with liquid glue made of oxskin. This operation is effected in a large round copper bowl, formed by two spherical calottes placed one inch apart, so that the space between can be filled up with hot water to prevent the glue from hardening during the time it is mixed by hand