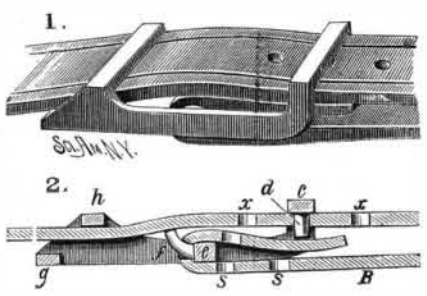
BUCKLE.

The buckle and fastener may he made complete in one solid piece, and consist of a frame composed of side bars united at one end by a raised cross bar, *c*, having a straight tongue, *d*, projecting from its inner side, an intermediate depressed cross bar, *e*, having a curved tongue, *f*, projecting in an outward and opposite direction relatively to the tongue, *d*, and an inner cross bar, *g*, and outer cross bar, *h*, at the opposite ends of the sides. To apply the buckle to a breeching strap, one end of the strap is looped over the bar, *e*, and a hole in it engages with the tongue, *f*; the end portion of the strap is then passed back under the cross bar, *c*, from whence it is passed through a ring and is then run to and under the bar, *c*, and engaged by a hole with the tongue, *d*, and from thence it is passed over the bar, *e*, and between the bars, *h g*. The construction and arrangement will be readily understood from the engraving, Fig. 1 being a perspective view, and Fig. 2 a longitudinal section. The buc-



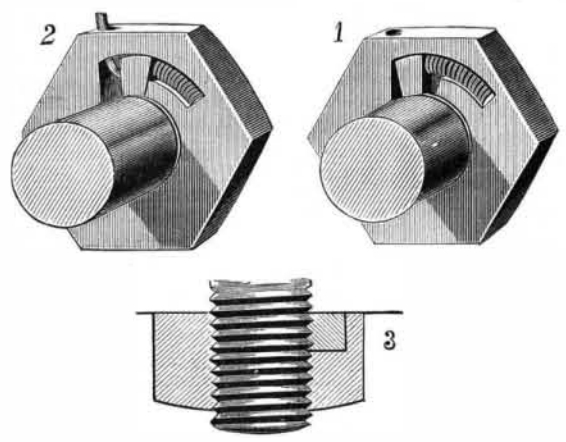
MITCHELL'S IMPROVED BUCKLE.

kle forms a very perfect self-fastener which may be cast in one piece without joint or tongue, and which, applied to a breeching strap, precludes all possibility of the horse's tail catching in it.

This invention has been patented by Mr. William F. Mitchell, of Williams, Ind.

LOCKING NUT.

The locking dog or block is fitted in a recess at the under side of the nut, the recess opening into the central aperture of the nut, and being formed on its outer face curved or inclined eccentric to the central aperture, so that the dog has two bearings—one against the surface of the bolt and the other upon the inclined side of the recess. The recess is extended at one side in a backward direction to receive a spring (shown in Figs. 1 and 2) that bears upon the dog so as to retain it in place and assist the locking movement. The dog, as represented in the engravings, is of angular form, the inner end being formed with thread sections to fit the thread of the bolt, so as to avoid injury to the thread and locks by a rocking movement. For the purpose of releasing the dog the nut is formed with a hole entering the recess at one side through which a key, as shown in Fig. 2, can be entered, and the dog pressed back into the wider part of the recess, when the nut can be turned backward. Fig.



SAMPSON'S LOCKING NUT.

3 is a section longitudinally through the bolt and nut. As will readily be seen, the dog holds the nut from any backward movement, but does not prevent its being turned forward for tightening or taking up wear.

This invention has been patented by Mr. General W. Sampson, of Springfield, Iowa.

The U. S. Railway Mail Service.

A recent report to the Postmaster-General reviews work in this department from 1842 to the close of last year. In 1842 the miles of railway mail service were 3,000, and the cost $400,000; last year the mileage was 110,000, and the cost $13,800,000; while at the present rate of growth, in the year 1900 it is estimated the mileage will amount to 200,000, at a cost of $25,000,000. The ratio of cost to mileage has been nearly constant, but the speed has been greatly increased, it requiring 16 hours to take the mails from New York to Washington 40 years ago against 6 hours now. In 1839 the service was divided into three classes: first class, $300 per mile per year; second class, $100; third class, $50, with an extra allowance of 25 per cent in all cases if one-half the service was performed at night. In 1867, when the railway mails were subjected to the process of weighing, astonishing inequalities were discovered. On fifteen routes where the pay was $200 per mile, the greatest weight per day carried by any one road was 19,183 pounds, and the least weight per day by any one road was 367 pounds, for which exactly the same compensation was received.

The first railway post office forced itself into use nineteen years ago. The previous system of distributing offices did not meet the necessities of the service. Experiments with railway or traveling post offices were therefore begun, and its economy has fully justified the new system. Taking the expenses of last year on the old basis, the cost of maintaining the distributing offices would have been $8,000,000, or $3,100,000 more than the new system, which is of immeasurably greater convenience, and avoids the delays of the old one. Forty years ago the mails sent out of New York in seven days weighed in the aggregate 19,000 pounds; now 19,000 pounds of mail matter on the average are sent out of that city by railroads every two hours, or about 150 pounds per minute.

Japanese Lacquer (Urushi).

HIKOROKURO YOSHIDA.

Urushi is the milky secretion of *Rhus vernicifera*, and is the material for the well-known Japanese lacquer varnish. The tree is cultivated in many parts of the country, throughout almost all latitudes, *e. g.*, at Dewa, Aizu, Hiroshima, and in many places about Tokio; the best urushi, however, is obtained at Yoshino. The tree is very similar in aspect to the ordinary wax-tree, and attains the height of 9 to 12 feet; trees about fifteen years old yield the largest amount of the juice. Two sorts of the juice are generally obtained from a tree, and by different processes; they are distinguished as ordinary "ki-urushi" and "seshime-urushi."

Ki-urushi (or raw lacquer) is the better of the two, and is collected best in June by making shallow cuttings in the stem of the tree, when it exudes as drops from between the outer and inner barks. A single tree yields on an average about 2½ grammes of this kind of juice. Branches and twigs of the tree, some of which are usually cut down each year, when steeped in water for some months and afterward warmed in the fire, give out an inferior kind of juice; this is seshime-urushi, which is used as under varnish after being mixed with some drying oil.

The juice is never sent to market in the form in which it comes from the tree, but is usually mixed with more or less of what is called "mokuyiki" (literally wood-juice), *e. g.*, what is ordinarily called Yoshino. Urushi consists of 60 per cent of the genuine juice with 40 per cent of mokuyiki, while the inferior quality contains as much as 70 per cent of the latter substance. Further, in the hands of varnish makers, some quantity of linseed oil is generally added to the already mixed juice, which, if excess is avoided, does not much impair the drying power of urushi.

Different colors are imparted to urushi by the addition of body pigments, such as lamp-black, vermilion, indigo, orpiment, etc.; thus red lacquer is prepared with 20 parts of linseed oil, 70 parts of urushi juice, and about 10 parts of vermilion, etc. Such is a rough yet general account of the extraction and preparation of urushi juice for varnish-making. The pure and unaltered urushi is a thick grayish fluid of dextrinous consistence, which under the microscope is found to consist of minute globules, some of darker, the others of lighter color, mixed with small particles of opaque brownish matter, the whole being held mixed in the form of intimate emulsion. It has a characteristic sweetish odor, and specific gravity 1·0020 (20° C.); some specimens, such as that obtained from Hachioji, contained a good deal of bark dust and other impurities, which raise its specific gravity as high as 1·038. If the juice be exposed to moist air in a thin layer at about 20°, it rapidly darkens in color and *dries up to a lustrous translucent varnish.* It contains a small quantity of volatile poison, which acts terribly on some persons, producing very disagreeable itching.

A peculiar acid, which I now call *urushic acid*, is the main constituent of the original juice, as well as of the portion soluble in alcohol. The juice also contains a very small quantity of a volatile poisonous body, which also passes into alcoholic solution, being almost completely driven out during the drying of the acid at 105° to 110°. It is a pasty substance of somewhat dark color, having the characteristic smell of the original juice, readily soluble in benzene, ether, carbon bisulphide, less easily in fusel oil and petroleum of high-boiling point, completely insoluble in water. Its specific gravity taken at 23° is 0·9851; it remains unchanged at 160°, and above 200° decomposes slowly with carbonization. Exposed to the air, it *neither dries up*, nor *shows any sign of change as the original juice does*, and in other respects it is a very stable body. From the alcoholic solution of the acid many metallic salts can be produced, most of which are slightly soluble in alcohol, but almost insoluble in water.

Gum is another normal constituent of urushi, and forms 3 to 8 per cent of the original juice.

As gum is insoluble in alcohol it is conveniently separated by treating that portion of the original juice insoluble in alcohol with boiling water, filtering, and finally evaporating the aqueous solution of gum over the water-bath till the weight of the substance remains constant. In this way a friable light colored substance is obtained, tasteless and inodorous; this is the anhydrous gum.

A mixture of gum and urushic acid (and with water) in the proportion in which they exist in the juice, does not undergo any change whatever, even when exposed to the condition most favorable for the drying of the lacquer. Moreover, part of the gum can be extracted in an unchanged state from the once perfectly dried lacquer; and since it exists in the original juice in the form of aqueous solution, it probably serves to keep the constituents of the juice in a state of uniform distribution and intimate emulsion. It may also act as a binding material, and assist the adhering power of the lacquer when laid upon any surface.

The results, so far arrived at, may be summed up in the following statement:

Urushi juice (lacquer) consists essentially of four substances, viz., urushic acid, gum, water, and a peculiar diastatic matter; and the phenomenon of its drying is due to the oxidation of urushic acid, $C_{14}H_{18}O_2$, into oxyurushic acid, $C_{14}H_{18}O_3$, which takes place by the aid of diastase in the presence of oxygen and moisture.

Action of Dilute Hydrochloric Acid upon Starch.

BY DR. F. ALLIHN.

Starch cannot be entirely and completely converted into sugar by dilute sulphuric acid, but this can be easily accomplished, as Sachsse has shown, by dilute hydrochloric acid; and, besides, the latter does not decompose the grape sugar so easily as sulphuric acid. The author has recently made a series of investigations upon the saccharification of starch with hydrochloric acid to ascertain the conditions under which the largest quantity of starch should be most rapidly and completely converted into sugar with the least quantity of acid. In all these experiments twelve grms. of starch and 100 c. c. of dilute acid were employed, the acid containing from 1⅓ to 10 per cent of real acid. The reactions were made at the boiling point of each liquid over an open flame, with a return cooler. When the action was stopped the solutions were diluted and a solution of caustic soda added until it was but faintly acid. It was then made up to two liters, and 25 c. c. were taken out and the sugar estimated in this. The process of analysis was that devised and previously described by Allihn (*Chemiker Zeitung*, vii., 1193), namely, by using an alkaline solution of copper in excess, then filtering out the reduced cuprous oxide and reducing it to metal with hydrogen and weighing, then calculating it into sugar.

In his experiments the author employed potato starch, which contained 98·6 per cent of pure starch, 0·9 of ash, and 0·3 of insoluble residue. The results are given in the following table:

No.	Starch used.	Time.	Sugar formed.	Strength of acid.
1	12 grms.	2 min.	92·55 per cent.	10 per cent.
2	"	5 "	92·14 "	" "
3	"	15 "	91·74 "	" "
4	"	30 "	89·55 "	" "
5	"	50 "	87·37 "	" "
6	"	10 "	96·60 "	5 "
7	"	30 "	94·33 "	" "
8	"	50 "	93·27 "	" "
9	"	30 "	93·27 "	3⅓ "
10	"	60 "	94·65 "	" "
11	"	90 "	94·49 "	2 "
12	"	30 "	84·94 "	" "
13	"	60 "	93·68 "	" "
14	"	90 "	95·05 "	" "
15	"	105 "	94·89 "	" "
16	"	1 hr.	87·85 "	1⅔ "
17	"	1½ "	92·87 "	" "
18	"	2 "	93·84 "	" "
19	"	2½ "	94·65 "	" "

These results show that when the ten per cent acid is employed the percentage of sugar obtained decreased with the time, as the acid decomposes the sugar to a considerable extent on long boiling. Similar phenomena were observed with five per cent acid when the boiling exceeds half an hour. With three and one-third per cent acid the maximum quantity of sugar is obtained at the end of one hour, and with two per cent acid in one and a half hours, while one and one-third per cent acid takes two and a half hours, and no decrease is noticed then.

The best results were obtained with two per cent acid, which produces 95·02 per cent of sugar in an hour and a half.

Although hydrochloric acid, in spite of its great saccharifying power, may be for commercial purposes too expensive to get rid of after the sugar is made, this acid is very suitable for the preparation of pure glucose on a small scale in the laboratory, as the acid is easily removed by means of caustic soda or sodic carbonate. The crude grape sugar may be purified by recrystallization from methyl alcohol having a specific gravity of 0·810.—*Chem. Zeitung.*

Hunyadi Janos.

H. Fresenius analyzed the Hunyadi Janos water and found it to contain the following salts:

Sodium sulphate	19·662123
Magnesium sulphate	18·449451
Calcium sulphate	1·321953
Potassium sulphate	0·132943
Sodium chloride	1·421068
Magnesium carbonate	0·731347
Iron carbonate	0·002059
Silica	0·011218
Carbonic acid (semi-combined)	0·383868
" " free	0·012683
Lithium	Traces.
Strontium	"
Nitric acid	"
Boracic acid	"
Bromine and iodine	"
Nitrogen	"
Phosphoric acid	"

The carbonates are calculated as simple monocarbonates, and all the salts are anhydrous, *i. e.*, without water of crystallization. The cathartic properties are due to the salts of magnesia and sulphate of soda.