states that in 1884 he found a rather coarse sample to have a specific gravity of 0.965. When exposed to intense cold the oil becomes turbid, owing to the decomposition of solid matter at 20°. The precipitated solid matter is entirely redissolved on warming again. The bromine and iodine absorptions were: Bromine absorption, 66.50 per cent.; iodine absorption, 122.90 per cent. A thick, dark-colored sample was found by Mills, in 1881, to have a bromine absorption of 74.42 per cent. On saponification with alcoholic potash, the total KOH absorbed is 19.34 per cent., which gives a saponification equivalent of 290.07. The oil is readily saponified in the cold. An English contemporary states that the higher fatty acids present in corn oil seem to present no unusual features, but exact determinations as regards the proportion in which they are severally present have not been made. The volatile fatty acids, separated by Reichert's distillation process, for 100 parts of the oil required for their neutralization 0.56 part of KOH.

It should be noted that a tendency to oxidize or to gum is almost absent in this oil while in its natural state, and no decided siccative properties are communicated to it by simply boiling or by the addition of litharge to it. On passing a current of air through it for an hour at a temperature of about 150° C., the oil becomes slightly darker in color, and rather more viscous, but by no means to the same extent as cotton oil. If to the oil so treated a small quantity of borate of manganese is added, the oil acquires to a small extent siccative properties, and a thin film on the lead dried in from ten to twenty hours, but not completely, being tacky to the touch at the end of that time. Like cottonseed oil, the elaidin reaction gives rise to a mass having a pasty or buttery consistency. But it is claimed by parties at Buffalo, N. Y., that the problem of eliminating the non-drying ingredients has been

roughly by observing the time of flow of 5 c. c. of the oil through a burette, with a capillary point, and comparing the results with standard oils:

	Corn.	Olive.	Colza.	Mineral.
Specific gravity . . .	0.925	0.918	0.915	0.910
Time of flow	177.3"	244.5"	290.0"	13.52"
Viscosity	61.1	84.3	100	83.9
(Colza=100).				

From the foregoing it will be observed that corn oil possesses a striking individuality. In general, it may be said that in properties it is somewhat akin to cottonseed oil. At the same time, there are differences between them which are primary and radical.

The Drugs, Oils and Paints, of Philadelphia, says: The interest in corn oil as an alternative for linseed oil in paint manufacturing, when linseed oil is deterred by high, is great and widespread. The manufacturers of corn oil profess to know that some paint manufacturers are using it successfully, but the process of preparation and manipulation employed for making it dry satisfactorily are said to be trade secrets, zealously guarded by those who have discovered them.

One correspondent mentions a refined corn oil offered for his inspection which dried on glass nearly as rapidly as raw linseed oil, and this sample is now under examination. The probability is that the success obtained is usually more or less commensurate with the proportion of linseed oil with which the corn oil is mixed.

We have less chemical knowledge of corn oil than is desirable where attempts are making to convert it into available drying oil, and the manufacturers of the product might do themselves and the paint trade a good turn by setting their chemists at work to determine not only its properties and chemical constants, but its molecular constitution. We want to know the easiest

tion about its axis of symmetry, being therefore in perfect running balance; and the elliptical section is produced by an automatic cross-feed movement of the tool holder, which travels in and out upon the slide rest, while the latter is driven longitudinally by the lead screw as usual, so that an elliptical cylinder of any length can be turned as readily as a circular one, and with the same degree of accuracy. The manner in which this is accomplished will be understood by aid of the accompanying illustrations; which, it is to be kept in mind, are intended solely to exhibit the principles and mode of action, as no attempt is made to observe the proportions, or actual arrangement of details, of a working machine.

The fundamental "mechanical movement," or combination, from which the required motion of the cutting tool is derived, is shown in the diagram, Fig. 1. We have here a disk in whose face are two slots at right angles to each other, and a block sliding freely in each slot; to these blocks the bar PIH is pivoted at H and I . Holding the disk still, and moving the bar, this is at once recognized as the familiar elliptograph, the point P tracing the curve upon the disk. Now let the disk be pivoted at its center upon a fixed pin, and let the free end P of the bar be constrained by guides to travel along the horizontal center line. Then as the disk goes round, P will traverse, back and forth, the path ab , equal to IH , the difference between the semiaxes of the original ellipse. But the motion of P relatively to the disk is the same as before; and it follows from this that a pencil fixed at that point in the bar would trace the same ellipse as before upon a disk rotating in contact with it about the same center, in either direction, with the same angular velocity. For the rotating disk, substitute the piece mounted in a lathe, replace the pencil by a cutting tool, and the desired result will be accomplished.

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solved — accomplished during the present year — and that the oil thus manipulated is made to exhibit even greater siccative properties than linseed.

The rise in temperature when 5 c. c. of strong sulphuric acid are mixed with 15 grammes of the oil is 79° C. For a naturally non-drying oil this is a high figure, but it is in keeping with what may be called the "tenderness" of this oil in the presence of chemical reagents. The so-called qualitative tests for oil with sulphuric acid and nitric acid, etc., fail to give with corn oil reactions sufficiently characteristic to warrant their application in identifying or detecting this oil. Hence its bromine and iodine absorptions, its high Maumene figure, and the ease with which it saponifies in the cold, must be looked upon as the features by which the oil may best be recognized.

A soap expert in discussing the industry and its relation to corn oil states that the potash and soda soaps are of good quality, being light in color, and readily and completely soluble in water. The soda soap is distinctly the harder of the two, but the potash soap is harder than the average "soft soap." Soapmaking is a use to which the oil has up to date been most largely applied. The ease with which it saponifies also might make it useful to mix with other oils, to accelerate the saponification. But it must displace cottonseed oil, which gives a perfect saponification as against an 80 per cent. result with corn oil. So it is always a question (in corn oil) of economy, the price determining which oil shall be utilized. Of the production in the United States, about 18,000 barrels per month at the present time, German soapmakers take about 75 per cent.

As a lubricant, corn oil might, in certain cases, be applicable, its low acidity and its very slight tendency to deposit solid matter or to "gum" being properties that recommend it for this purpose. The oil dissolves readily in acetone, and more sparingly in alcohol or glacial acetic acid. This viscosity was determined

and deepest method of turning its high iodine number to practical account.

A NEW ELLIPTICAL LATHE.

By Prof. C. W. MACCORD.

THE lathe for elliptical turning, of which a description is given below, possesses several entirely novel features which render it capable of performing with ease and in a superior manner not only all that can be done with the appliances hitherto introduced for that purpose, but also work which cannot be executed at all by their aid alone.

The ordinary elliptic chuck, as all who have used it are aware, is open to one or two serious objections. These have their foundation, moreover, in the very nature of the device, which in one important particular is radically defective. In turning an ellipse, the tool is set at a definite and fixed distance from the axis of the lathe, so that the whole piece to be operated on must receive the compound motion by which the desired form is produced; it cannot, then, be supported on the back center. Consequently it must be held, by one end only, in a common chuck which again is screwed upon the projecting nose of the elliptical chuck. If the piece be long, then the work is liable to spring away from the tool; and if heavy, the overhanging weight produces an injurious strain upon the mechanism of the chuck itself, so that the range in length is quite limited. Another objectionable feature of this compound motion is that the work is not in running balance; at high speeds this tends to cause a vibration of no benefit to either chuck or lathe, and at any speed it is unfavorable to the production of fine and accurate work.

In the lathe herewith presented to notice, on the other hand, the work is mounted and driven and supported on both centers, just as in the ordinary turning of a round shaft, and its only motion is that of revolu-

Fig. 2 is a transverse section of the headstock and bed, and Fig. 3 a side view of the headstock, partly in section. A is the wheel fixed on the mandrel; it drives another wheel C of the same diameter through the intervention of the idler B , which turns upon a pin fixed in the headstock. C is keyed upon the shaft c , whose bearings (not shown) are in the lathe-bed. This shaft c runs the whole length of the bed, and projecting through the remote end, has keyed upon it a wheel C' , seen in Fig. 4, which is an end elevation, looking in the opposite direction. C' drives another wheel D of equal size, supported by a bracket fixed to the bed, and carrying on its outer face a disk, which is slotted, and provided with sliding blocks to which the bar PIH is pivoted, all as in Fig. 1. This bar PH is here shown as sliding through a socket, which by means of a binding screw can be clamped upon it at any desired position, so that the ratio of PI to PH can be varied at pleasure, thus making the adjustment for eccentricity. This socket is pivoted to another one, which in a similar manner can be clamped to an arm projecting upward from the piece E , which slides in vertical guides attached to the frame. To E is pivoted the lever FJ , which slides, first, through a block pivoted at G to another block capable of horizontal adjustment at any required distance from F , and, second, through a block pivoted to the vertically sliding piece K . Thus the velocity ratio between the motions of E and K is perfectly constant, but while the actual traverse of E is always equal to IH , that of K will be greater or less according to the position of G .

The motion of K is transmitted by a link L to a lever M , keyed upon a rock-shaft r , supported in brackets fixed to the lathe-bed. This rock-shaft runs the whole length of the bed and parallel to it, passing freely through a downward projection of the slide-rest R , as best seen in Fig. 5, which is a transverse section; it is longitudinally slotted for the reception of feather-keys fixed in the curved levers NN , which slide upon the

rock-shaft, but vibrate with it, their angular motion being the same as that of *M*. These levers have turned projecting hubs, fitting into corresponding recesses in *R*, having thus in effect bearings in the slide-rest itself, and are confined by the bracketed piece *Q*, bolted to the downward projection above mentioned, as best seen in Fig. 8, which is a top view, and in Fig. 9, which is an end view, of the lower part of the slide rest: thus the latter carries the vibrating levers with it as it travels along the bed.

The slide-rest is made in three parts, as shown in Figs. 4, 5, and 6, the latter being a vertical section by a plane parallel to the axis of the lathe. The lower, or main piece *R*, which slides lengthwise on the bed, is fitted with the usual apron and attachments for feeding either by hand or by the lead-screw *s* (Figs. 1 and 5)—all of which are omitted in the drawing. The second piece *R'* is fitted to slide upon *R* across the lathe-bed, and receives its motion from the levers *N* by means of the two links *L*, *L'*. Above this again is the third piece *R''*, which finally carries the tool-holder *T*. *R''* also slides upon *R'*, perpendicularly to the axis of the lathe, and by means of the ordinary screw and handle, a cross-feed motion is thus provided, independent of the motion of *R'*; the use of which will appear later on.

Now returning to Fig. 4, it is to be understood that the lines drawn from the center of the rock-shaft *r*, through the centers of the pins in the ends of the levers *M* and *N*, are at right angles to each other; also, the levers are of the same length, the link *L* is of the same length as *L'*, and the arrangement is such that when

metrical but not truly elliptical section, gradually approaching the latter as it is fed in by hand, and reaching it when *R'* is brought up against the stop; after which the automatic feed completes the work. It should be added that it is also essential to set the tool, just as in turning a cone in the common lathe, with its point in the same horizontal plane with the axis of the mandrel, and neither higher nor lower.

The lathe as here shown would seem adapted for outside turning only; but it is to be recollected that these are not working plans, and by extending the part *R'* of the slide-rest, the tool holder may be so placed as to adapt it for inside turning to a limited depth: but to at least as great a depth as is practicable with the elliptic chuck, while the work can be done to greater advantage on account of the steadiness of the motion.

It may be said that the construction demands the most perfect workmanship, which is true, but no more true of this than of many other machine tools for special purposes, and, in fact, no more true than it is of the elliptic chuck. If it be urged by way of objection that there is but little demand for work of this kind, there are two things to be said in reply; one is, that this may be due in part to previous difficulties in executing it; and the other is, that this lathe need not stand idle for the lack of elliptical work. For, by simply locking the wheel *D* and removing the idle wheel *B* or sliding it out of gear, we have an ordinary lathe which may be continuously employed, like any other, on circular work—all of which again calls attention to the fact that should occasion require, a piece once hung in this lathe may be made circular in one part

period was alone responsible for this difference in yield. Oat and pea forage in 1897 and the early seeding of 1898 averaged 6 tons per acre; in 1899 the yield was but 3.3 tons per acre."

To show the frequency of such drouths as that of 1899, the bulletin cites the rainfall records of Philadelphia: "The rainfall records in Philadelphia from 1825 to 1895 (70 years) show that in 88 per cent. of the years there was a deficiency of over one inch for one month, or that in 62 years out of the 70 there was one month in the growing season from April to August in which such a marked deficiency occurred as to cause a serious shortage of crop, and that for the same period there were 39 years in which the deficiency extended throughout two months, while in 21 years it extended throughout three months, or in 30 per cent. of the years included in this record there were three months during the growing period in which the average rainfall was deficient one inch or more. It is thus observed that a wide series of crops would be likely to suffer in more than one-half of the years for which the record is available, while a still larger number would suffer in nearly one-third of the years, for it must be remembered that even a slight deficiency in one month may result in serious reduction in yield and consequent loss if it occurs at a time when the crop is making its largest development."

The experiments conducted by Prof. Voorhees and reported in this bulletin were for the purpose of determining whether irrigation during these short periods of drouth would result in sufficient increase of yield to pay for the works necessary to obtain the supply of

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the latter is vertical the former is horizontal. Consequently, any error introduced into the motion by the angular vibration of *L* is neutralized by the corresponding vibration of *L'*, so that the movement of *T* in a horizontal direction is at every instant precisely the same as that of *K* in a vertical direction.

To facilitate the adjustments, provision should be made for locking the wheel *D*, Fig. 4; preferably when *H* is at its lowest point, at which instant the bar or connecting-rod *PH* will be vertical: then by the means already described, the two sockets can be so placed that the ratio of *PH* to *PI* shall be the same as that of the major to the minor axis of the required ellipse; which completes the adjustment for eccentricity.

But the vertical traverse of *E* is always equal to *IH*, while the actual travel of the tool must be equal to the linear difference between the semi-major and the semi-minor axis of the required ellipse: *G* must therefore be so placed that the vertical traverse of *K* shall be equal to that difference: in other words, when the lever *PJ* is horizontal, we must have *EG*:*GK* :: *IH*: given difference of semi-axes. At the instant mentioned, *R'* will be at the extreme outward limit of its travel, the major axis of the ellipse to be turned being horizontal; and the distance of the point of the tool from the center line of the mandrel must be equal to the semi-major axis. This is adjusted by means of the independent hand cross-feed, by which *R'* is moved to the required position: and a movable stop, not shown, should be provided, and now clamped to *R'* to prevent the tool from being fed farther in. It is now in position for the finishing cut; for the roughing cuts it may be moved farther out, when it will produce a sym-

and elliptical in another without unmounting, as for instance in forming an elliptical cam on a round shaft, something quite beyond the power of the elliptic chuck or of any analogous device previously employed.

IRRIGATION FOR THE EAST.

THE Office of Experiment Stations of the United States Department of Agriculture will soon issue Bulletin No. 87, entitled "Irrigation in New Jersey." It was prepared by Prof. E. B. Voorhees, of the New Jersey Experiment Station, and describes his experiments in irrigation for the season of 1899. It is generally thought that the necessity for irrigation in the United States exists only in the region west of the Mississippi River, but repeated crop failures in the East and successful farming in the West have called attention to the importance of controlling the moisture of soils rather than accepting the conditions as they exist. Prof. Voorhees estimates the loss to the hay crop of New Jersey from the drouth in May and early June, 1899, at \$1,500,000, while small fruits and vegetables were even more seriously affected than the grasses. The records kept by him at the experiment station show that "in 1897 and 1898, years of abundant rainfall in April and May, the yield of hay averaged 2.65 tons per acre. In 1899 it was but a fraction over 1 ton, owing to the deficiency of rainfall in April and May, at the low price of \$10 a ton, a loss for the 25 acres of over \$400. The yield of crimson clover forage for 1897 and 1898 was 8.5 tons per acre; in 1899 the yield was but 5 tons, or in a good year the yield was 70 per cent. greater. The deficiency in the rainfall at the critical

water. The tests were made on small fruits. Careful records were kept of the yields of plats, which received identical treatment, except that some were irrigated and others were not.

The yields of the irrigated plats over and above those not irrigated were as follows: Blackberries, 1,038 quarts per acre, worth \$93.42; raspberries, 329 quarts per acre, worth \$32.90; currants, 852 quarts per acre, worth \$85.20. The increase in yield would not be so marked every year as in 1899, as the drouth of that year was exceptional.

The bulletin contains detailed descriptions and statements of cost for a number of small irrigation plants in New Jersey. All of these are pumping plants. The cost of plants large enough to supply 10 acres of small fruits and garden crops has varied from \$230 to \$500. Records of the returns from these plants have not been kept, but the owners are all satisfied that their installation has been very profitable, and in nearly every instance have stated that they have made the cost of the plant in the increased crops the first year.

So far as climatic conditions are concerned, New Jersey may be considered typical of the whole eastern half of the United States. Judging from the results reported in this bulletin, there is no question but that irrigation for fruits and market gardens, even in regions of abundant rainfall, is a profitable undertaking.

The work in New Jersey is a part of an investigation of the problems of irrigation now being carried on by the Office of Experiment Stations in different regions of the United States. Owing to the greater importance of irrigation in the West, where farming is impossible without its aid, the greater part of the work is being