interested in the two methods of its use—in smoking and chewing. The usual analysis of tobacco now accepted is that of Posselt and Reinmann, which is as follows:

<i>Analysis of the Leaf.</i>	
Nicotine.....	0.060
Volatile oil.....	0.010
Bitter extractive matter.....	2.870
Gum and malate of lime.....	1.740
Chlorophyll.....	0.267
Albumen and gluten.....	1.308
Malic acid.....	0.510
Salts of pot. cin. and ammonia.....	0.734
Silica.....	0.058
Water.....	88.280
	100.00

Leaving out from this analysis the volatile oil, extractive matter, albumen, gluten, and chlorophyll, and negative and inert matter, and we have left a substance containing one part of nicotine, 4 parts of salts of lime, ammonia, etc., with 88 parts of water in 100. It is interesting to note, in this connection, that the percentage of nicotine in various kinds of tobacco varies, and that Havana tobacco contains but two per cent. of this poisonous element, while Virginia tobacco contains about seven per cent., according to some analyses. The moral of this is that we should always smoke the choicest brands of Havana cigars. In smoking, the ammonia salt may become the source of considerable discomfort in the burning and smarting tongue which results from excessive and continuous practice of the habit; of course, in chewing this action is not noticeable.

We thus are reduced to the action of nicotine for the possible deleterious influence of the plant. This element, as before stated, is present in varying proportions in the tobacco leaf; according to some writers, from one to seven per cent. It is a clear and colorless fluid, highly volatile, and of an extremely pungent, disagreeable odor and strong, burning taste. It is rapidly absorbed into the fluids of the body, and is one of the most deadly poisons known. It is rendered volatile by burning the leaf, and is present in the smoke of the tobacco. It is generally accepted that the volatilized nicotine in the tobacco smoke is more actively absorbed than is the case when the leaf is chewed, but in either case the nicotine absorption is the essential element in the production of all of the evils which can be charged to the habit.

Nicotine acts on the heart, nervous system, stomach, and upper air passages. The prominent symptoms which may be caused by nicotine, with reference to the heart, are intermission and palpitation; that is, it produces certain functional disturbances of the heart which, for the time, may be the source of more or less discomfort to the patient; but the important point is, does this condition ever lead to one of organic lesion?

I find but one writer bold enough to say that this occurs, and he only hazards the opinion (Dr. Kennedy, of Dublin) that the functional disorder may in cases eventually lead to the development of fatty changes in the muscular structure of the heart. On the other hand, there is abundant evidence to show that this is an extremely rare event. Few of us but have met with what we call a smoker's heart, one characterized prominently by the intermittent beat with some little irregularity of action and with which there may be the clinical history of occasional attacks of moderate palpitation brought on by overexertion. We keep these cases under notice, it may be for years, and we rarely, if ever, discover anything that we can call an unfavorable progress, the development of any new symptom or any evidence of weakness of the muscular structure of the heart. I confess that this is not easily to be explained. I am disposed to regard the term functional disorder as merely a cloak to conceal our ignorance of the real pathological condition, and believe that there is really a structural change of some kind which escapes our present methods of exploration, and while such imperfection exists in our means of physical diagnosis, we must continue to use the term functional disease. Still, in the case in point, whatever be the cause or explanation, we have a purely functional derangement which may exist for months or years without the occurrence of any grave or serious complication to cause apprehension.

The true explanation of the action of nicotine on the heart is probably to be found in its action on the general nervous system, and especially on the pneumogastric nerve. In acute nicotine poisoning, death has been known to take place in thirty seconds. This can only be explained by its action on the nervous system. (Of course, the prominent symptoms of acute poisoning are on the circulatory and respiratory movements. It arrests respiration or markedly interferes with it, and if sufficient of the drug has been given it arrests the heart's action, producing almost instant death. We may, of course, say this is due to its immediate action on the medulla, or to its action on the pneumogastric nerve. Certainly, there is abundant clinical evidence to show an especial affinity of the drug for this nerve, whether in cases of mild or severe poisoning, as in acute or chronic cases. We may, then, sum up its action on the nervous system in producing disturbance of vision, giddiness, muscular tremors with exhaustion, sleeplessness, and depression of spirits. In addition to these, the irregularity of the heart's action may be classed as a nerve symptom, dependent on the impairment of control which the pneumogastric nerve exercises over it.

Another organ prominently affected by the tobacco habit is the stomach, giving rise to a gastric catarrh, with its usual train of symptoms, gastralgia, acidity, nausea, anorexia, etc., and which it is, of course, unnecessary to describe. The idea that this is due to the local irritant action of the nicotine or of the saline constituents of the tobacco is not to be entertained. For although, occasionally, we meet with a tobacco chewer who swallows the saliva impregnated with the tobacco juice, he possesses happily a very rare and unusual organization who can do this with impunity. The nicotine action, then, on the stomach must also be explained by its parietic action on the pneumogastric nerve. In this case we have to do with a secreting organ whose healthy functional activity depends largely on the nerve force supplied by this nerve. If now the nerve is under the influence of this powerful narcotic, the organ when called upon for the performance of its normal digestive function is found un-

equal to the task, and the ingesta act as a local irritant, with the result of producing a local catarrh, and each subsequent demand upon it only serves to aggravate the existing condition.

Coming, now, to the upper air passages, we find here a portion of the body which is not a glandular structure or a secreting organ *per se*, and hence one which is not liable to such impairment or perversion of function as may react in any way on the general system. It is merely a passage lined with mucous membrane, through which the inspired air carries oxygen to the air cells. Now, the use of tobacco may affect this either by direct contact or it may affect it indirectly through the effect of the nicotine on the general system. Its action through the general system can be but limited, as its effect here would be simply in diminishing secretion. We must look, therefore, for its injurious effect upon the direct contact of the smoke with the mucous membrane. Now, in those in the habit of smoking, the fumes of the tobacco come in contact with the upper air passages ordinarily in but a limited extent. In fact, of two persons in a room whose atmosphere is surcharged with tobacco smoke, one smoking and the other not accustomed to the habit, it is the non-smoker who will suffer. Furthermore, if we examine the physical characters of tobacco smoke more carefully, we find its analysis is as follows: Nicotianin, carbonate of ammonia, acetate of ammonia, empyreumatic oil, carbonaceous matter, moisture, and several juices.

Passing over these latter as merely the result of the destruction of the woody fiber, we have again the salts of ammonia and the nicotine comprising the essential elements of the tobacco smoke. So that, whether smoked or chewed, we find the active elements of possible influence of the plant in the nicotine and the saline constituents. The saline elements need but a passing word. They are in a high state of solution and their action is but feeble. Absorbed by the mucous membrane, their action is nothing. Their local action on the mucous membrane of the mouth and throat is merely as a feeble stimulant and irritant. If their action be long continued, this irritation may become quite prominent. This we have all noticed who have been addicted to something more than moderate smoking.

It is a fair inference, I think, then, that the use of tobacco, in its influence on the respiratory tract, does not directly produce the morbid condition which it is usual to charge upon it by direct action, but that it is only through the indirect influence of the nicotine absorption through the general nervous system. Now, the evidences of chronic nicotine poisoning are well known and easily recognized by the muscular tremor or unsteady hand, the dull headache, the retarded or irregular heart action, the sleeplessness, and other symptoms; and unless we have some evidence, as shown by some of these symptoms in persons addicted to smoking or chewing, of this chronic poisoning, I do not think that we are justified in attributing the existence of a pharyngeal or nasal catarrh to the use of tobacco, although undoubtedly, in many cases, an existing catarrhal condition of the fauces may be aggravated by the use of tobacco, its action being possibly the slightly irritating effect of the volatilized saline constituents of the smoke and possibly the empyreumatic oils, but mainly, I take it, through the constitutional effect of the drug as acting upon the secretions through the nerves which regulate this function.

While, therefore, by no means advocating the use of tobacco, the point which I desire to make is: Are we not often liable to fall into a mistake in universally condemning its use without sufficient grounds, and is it not better when our advice, as physicians, is asked, in this respect, to base our answers entirely on the evidences of the effect of the drug upon each individual patient and, furthermore, to recognize the fact that this effect is shown by well marked and easily recognized subjective symptoms? I have frequently, when asked this question, "Does smoking hurt me?" frankly said to my patients, "You know better than I do; no man uses tobacco to his harm without being fully conscious of it."

As regards its effect on the diseases of the upper air passages, in a practice of twenty years largely devoted to treatment of these affections, I recall but exceedingly few cases wherein I have found it necessary to interdict the use of tobacco as injuriously affecting in any way these passages, or as interfering with the success of treatment.

The object of my paper, then, is not a plea for the use of tobacco, but simply to suggest whether we had not best abandon the idea that it is a drug whose use is pernicious in every way to body, mind and morals, and rather to take the view that it is one of God's good gifts to man; a "virtuous herb, divine, rare, super-excellent tobacco" when properly used, but when taken "as tinkers do ale, 'tis hellish, devilish, and damned tobacco."—*Medical Record*.

REMOVAL OF TATTOO MARKS.

NEARLY every year we have one or more letters of inquiry as to the means for removing tattoo marks, and we have been obliged to reply that, practically, it is not possible. Dr. G. Variot, of the Paris Biological Society, has however lately proposed a process which he declares to be invariably successful in removing blue and red tattoo marks. As the doctor is attached to the central infirmary of the Paris prisons, he has undoubtedly abundant opportunities for experimenting, and should be able to speak intelligently. Dr. Variot operates as follows:

The tattooed parts are first wetted with a concentrated solution of tannin, and then, with a set of tattooing needles, the skin is punctured all over the colored portions to the depth usually adopted by professional tattooers. All the parts tattooed with tannin are then rubbed over with a crayon of nitrate of silver until the needle pricks have turned black. Excess of liquid now being wiped off, matters are allowed to take their own course. The whole surface treated will soon turn black. The pain, which is quite moderate during the operation, continues to be slight for the first two days, and is attended with some local inflammation. After the third or fourth day no pain is felt, and, excepting for large marks, no dressing will be necessary. After fourteen or eighteen days the eschar will fall off, and leave, instead of the tattoo marks, a reddish, superficial

cicatrix, which will gradually turn pale, and after two months will almost disappear.

TRAUMATIC EPILEPSY SUCCESSFULLY TREATED BY TREPHINING.

By F. A. SOUTHAM, M.B. Oxon., F.R.C.S., Assistant Surgeon to the Manchester Royal Infirmary and Surgeon to the Clinical Hospital for Women and Children.

WILLIAM F—, aged thirty-two, telegraphist, came under my care as an out patient at the Manchester Royal Infirmary in August, 1887, with the following history. In December, 1886, having previously enjoyed good health, he fell from a height of sixteen feet and sustained an injury to the head in the left temporal region, apparently a severe scalp wound without any fracture. He was removed in an unconscious condition to a local hospital, where he remained for about three weeks.

At the end of this period he was discharged, having quite recovered from the effects of the accident. Shortly afterward he began to suffer from attacks of a somewhat peculiar nature. Without any warning, he would suddenly be seized with twitchings limited to the muscles of the right side of the face, and almost simultaneously he would become dizzy and fall to the ground in a state of complete unconsciousness, remaining in this condition for a varying period, often for several hours. In the intervals there was no evidence of paresis in the muscles of the face or any other part of the body; speech was not affected, and there was no loss of sensation or impairment of any of the special senses.

The attacks recurred at irregular intervals, sometimes as many as six daily, sometimes three or four a week; occasionally a week, but rarely longer, would pass without one. He again sought treatment at the same hospital, and underwent two operations, which from his description consisted in liberating the scar on the scalp by dissecting it up from the bone beneath; each operation was followed by a temporary cessation of the fits, which, however, soon recurred.

The man was suffering from a continuance of the same symptoms, which completely incapacitated him from following his occupation, when he came under my observation. On examination, a well-marked adherent cicatrix about an inch in length was found in the left temporal region; no depression could be felt in the bone beneath indicating that there had been a fracture. He was put on a course of bromide and iodide of potassium for three weeks, but without any relief to the symptoms, the fits recurring as before. My colleague, Dr. Ross, then examined the patient with me, and as the case appeared to be one of traumatic epilepsy, due to irritation of the brain at the seat of injury, he recommended that the skull should be trephined at this spot. On Sept. 7, 1887, the operation of trephining was performed with careful antiseptic precautions. The old scar was dissected up from the bone beneath, and the pericranium having been reflected, a crown of bone the size of a shilling was removed at a point two inches and a half above and one inch behind the external angular process of the frontal bone. The piece of bone removed did not present any evidence of fracture, but was irregularly thickened and sclerosed, the diploe having disappeared and been replaced by dense, compact, osseous tissue; its outer surface was roughened, and at one point on its under surface there was a bossy elevation, a quarter of an inch in diameter, whiter in color and of denser consistency than the surrounding bone.

The exposed portion of the dura mater was rough and unduly adherent to the bone; otherwise it presented a healthy appearance; as it did not bulge into the trephine opening, and there were no evidences of intracranial tension, it was not incised, for it was thought that the irritation caused by the pressure of the thickened bone was sufficient to account for the symptoms. The wound was then closed, the pericranium being brought together with catgut and the scalp with silver sutures, and a small drainage tube inserted.

Healing rapidly occurred, with very little suppuration, the temperature never rising above 99°. On the eleventh day the patient was sitting up in the ward, and on the twenty-third day he left the hospital, there having been no return of the fits since the operation. About a fortnight later, however, they began to recur at irregular intervals, but in a very much milder form than previously, consisting merely of attacks of giddiness accompanied by pain in the head, but without any loss of consciousness, and, except on one occasion, without any twitching of the muscles of the face. These attacks gradually became slighter and less frequent, and since January, 1888, he has been entirely free from them. In the following April he was able to resume his occupation as telegraphist on the railway, and at the present time is in the enjoyment of perfect health, being as well as he was previously to the accident. The seat of the operation is now indicated by a depressed scar. There is no tenderness on pressure over it, and no pulsation can be detected.

Remarks.—As regards the explanation of the epileptic attacks, which were the secondary result of the injury to the head, it is probable that at the time of the accident, in addition to the wound of the scalp, more or less bruising or contusion of the bone beneath was also produced. This was followed by inflammatory changes in the bone, and probably also by some inflammation of the subjacent dura mater, in consequence of which the bone became thickened and sclerosed and unduly adherent to the membrane beneath. The result was that pressure was produced on the cortex of the brain, and this, acting as a source of irritation, gave rise to the fits from which the patient suffered.

It is interesting to note that the fits commenced with twitchings of the facial muscles on the opposite side to that which was the seat of injury.

According to the observations of different experimenters, the center which presides over the movements of the face is situated in the lower and middle part of the ascending frontal, the lower end of the ascending parietal, and the posterior end of the middle frontal convolutions. Now, the portion of bone removed with the trephine would overlie the posterior end of the middle frontal convolution, and the successful result of the operation is doubtless to be explained by the fact that the pressure upon the surface of the brain at this

spot, which acted as a source of irritation, was relieved by the removal of the thickened bone. As the patient has now been free from any recurrence of the fits for a year, the cure may probably be regarded as complete and permanent.—*Lancet*.

COMPOSITE GEARING.

INVOLUTE AND EPICYCLOIDAL SYSTEMS COMBINED.

By Prof. C. W. MACCORD, Sc.D.

THE accompanying diagram, Fig. 1, shows the construction of the teeth of a wheel and pinion in which the involute and the epicycloidal systems are combined in such a way as to secure advantages which could not, under the given conditions, be realized by the use of either system alone.

These teeth were designed for the special case of a train of clockwork in which the chief desideratum was a perfectly smooth action and uniform transmission of motion, with as little frictional resistance as might be; the pinions, of twelve teeth each, being driven by the wheels, which have from ninety to one hundred and forty-four teeth.

The involute system is peculiarly well adapted for work of this description, on account of the constant obliquity of the line of action, which gives an unvarying component of side pressure tending to take up the necessary "side shake" of the pivots in their bearings; but this obliquity must not be too great. And the amount of obliquity necessary depends upon two things—the relative diameters of the driver and follower and the magnitude of the arc of recess. In view of the well established fact that the friction after passing the line of centers is less injurious in its effects than that before reaching that line, it was considered desirable in the present case to make the arc of recess equal to the pitch, and the arc of approach one-half as great.

Now, these conditions could be satisfied by using purely involute teeth, since a pinion of 12 leaves can be driven by a wheel of only 59 teeth, with the above mentioned arc of recess; but that is an exact limiting case, the teeth of the wheel being pointed; and the requisite obliquity is $27^{\circ} 35' 12''$.

To be sure, since the proposed wheels have more than 59 teeth, there would be a slight thickness at the top of the tooth; but the curvature of the involute does not diminish very rapidly as the number of teeth is increased; and even with an obliquity of 30° and an arc of recess equal to only three-fourths of the pitch, the wheel of 144 teeth presents the appearance shown in Fig. 2. The thickness of the tooth at the top is none too great for practical purposes, but the obliquity certainly is, and yet the receding action is much less than is wanted.

On the other hand, although the desired proportion between the arcs of approach and recess might readily be attained by using epicycloidal teeth, there is this objection to their use in the present case: that at the instant of passing the line of centers the obliquity of the line of action becomes nil; so that the side component of pressure vanishes. In the event, then, that, owing to any inaccuracy in spacing or cutting, the next pair of teeth had not by that time come into action, a slight play of the pivot in its bearing might result, thus interfering with the perfect smoothness of the action.

In these circumstances the following course was adopted in the construction illustrated in Fig. 1.

Draw through P the common point of the pitch circles, the line of action with an obliquity of 15° , and let fall upon it perpendiculars from the centers of the wheel and the pinion, thus determining in the usual way the radii of the base circles; then the outer part of the pinion tooth, and the inner part of the wheel tooth, will be involutes of these circles. The involute of the larger circle cannot extend above the point A, which is the root of the conjugate involute of the smaller circle. But, describing a circle upon PC as a diameter, its circumference will pass through A; and by rolling this circle upon the pitch circle of the wheel, an epicycloidal extension of the wheel tooth is generated, which by construction is tangent to the lower or involute portion, and will work correctly with the radial line AC, which is the hypocycloid traced by rolling the same circle within the smaller pitch circle. Continuing this epicycloid to the height required to secure the assigned amount of receding action, the maximum obliquity is 30° , the mean obliquity during the last half of the recess is $22^{\circ} 30'$, and the average obliquity during the whole action is only $17^{\circ} 30'$; which is well within a reasonable practical limit.

The action, when the wheel drives in the direction indicated by the arrow, begins at m and ends at n, the path of contact being made up of the straight line m P A and the circular arc A n. It might at first sight appear that because m A is not tangent to A n, there would be an effect due to this abrupt change in the direction of the path of contact, injurious to the smooth running of the wheels. But a moment's consideration will show that the effect of this change will be no more perceptible than though the entire contour of the tooth were an epicycloid with the same generating circle; for in that case, when the point of contact had reached A, the line of action would be P A, exactly as it is now; any objection to this composite tooth, then, taken upon this ground, is equally valid against the whole epicycloidal system.

In the special case illustrated in Fig. 1, the point A is the root of the involute of the pinion's tooth; but it must not be inferred that the two systems can be combined under such conditions only; it is plain that the same describing circle can be used for the epicycloidal part of the wheel's tooth, whatever the diameter of the pinion's pitch circle. Suppose the latter to be larger than here shown; then the hypocycloid generated will not be radial, nor a right line, but it will still be tangent at A to the involute of the corresponding base circle, though at a point above its root; and it will also be conjugate to the epicycloidal part of the tooth of the lower wheel.

And, in short, it is easy to construct a series of interchangeable wheels upon this composite plan, the faces of all the teeth being partly involute and partly epicycloidal, the flanks partly involute and partly hypocycloidal. This will be apparent by the aid of Fig. 3, which shows the forms of the teeth of a rack, in which the upper parts of the faces and the lower parts of the flanks are cycloids, described by rolling equal circles on opposite sides of the pitch line, and these curves are

joined by tangent right lines inclined at an angle of 75° to the pitch line. Now if a series of wheels be made to work with this rack, they will work with each other indiscriminately, and the central part of the contour of each tooth will be an involute, with a constant obliquity of 15° .

It has already been suggested that the disappearance of the obliquity at the pitch point, in the action of epicycloidal teeth pure and simple, may in some circumstances prove not to be an advantage without a drawback.

It may be of interest to note that the abrupt change in the path of contact at A, in Fig. 1, is due to the fact that although the involute and the epicycloid forming the contour of the tooth are tangent to each other at that point, they have not the same radius of curvature. Now, referring again to Fig. 3, it will be seen that the contour of the rack tooth there shown differs but little from a sinusoidal curve. If then it were made of the exact form of the sinusoid which approximates most closely to it, the result would be that the path of contact would become a continuous curve,

FIG. 1.

FIG. 2.

FIG. 3.

And the question may be worth considering whether the fact that at the pitch line the radius of curvature for both the face and the flank of an epicycloidal tooth is zero does not render the making of the cutter, and in some cases the cutting of the tooth, more difficult than it would be were that radius always of sensible magnitude.

If this is so, the circumstance has the same bearing in relation to making the patterns for the teeth of wheels intended to be cast; and in either case, the method of procedure above indicated provides a means of evading these difficulties, simple in principle, easy of execution, and open to no objection which does not apply with equal force to at least one of the two well-known systems thus combined.

very flat in the region of the pitch point P in Fig. 1, at which point its tangent would coincide with the present line of action of the involute. The contour of such a rack would be as easily laid out as the one given in the figure; but the forms of the conjugate teeth for wheels of any assigned numbers of teeth could not be so readily determined. In making patterns of teeth for cast wheels, then, such a system could not well be adopted; but in the case of cut gearing, the difficulty may be easily evaded by making the rack solve the problem automatically and cut the teeth for the whole series of wheels—a process already successfully accomplished. This, however, is offered merely as a suggestion, showing that a continuous curvature of the path of contact can be easily obtained if desired, and is not