

It may seem a far cry from the noxious fumes of a chemical laboratory to the prevention of dental diseases, but the same fundamental scientific principles

apply to the decaying of teeth as to the analysis of an ore sample—the only difference being in the method of application.

In studying the chemistry of the mouth naturally the composition and properties of saliva demand consideration. Saliva is secreted from the blood stream by the salivary glands and contains, in addition to a small quantity of inorganic salts, a water-soluble substance called mucin, which makes saliva stringy and causes it to froth.

The mucin is in solution in saliva as secreted, but when the saliva comes in contact with acid—the acid from one's morning grapefruit or dinner salad or from the bacterial fermentation of foods, for example—this soluble form of mucin is changed into an insoluble form of slightly differing composition, which separates out in the form of a gelatinous precipitate. The insoluble variety of mucin is quite adhesive and covers the teeth with a protective coating which prevents any fruit or other acid which may happen to be in the mouth from dissolving the enamel of the teeth.

But while these deposits of mucin are good in themselves, they should be removed frequently, thus permitting the formation of new ones—for Nature automatically renews this protection whenever acid encounters saliva.

One reason for cleaning the teeth is that in many cases the mucin adhering to them carries with it carbohydrates or other food debris and furnishes an ideal lodging place with meals thrown in for bacteria. There is always a superabundance of bacteria looking for a suitable home, so they quietly entrench themselves in the mucinous masses and there secrete lactic acid. This acid is held next the teeth by the closely clinging mucin, and in time it dissolves the enamel of the teeth. Then the persistent microorganisms invade the underlying dentin which supplies them with food in abundance, and from there they rapidly proceed to the pulp which contains the nerves of the tooth.

At this stage the neglectful owner of the tooth becomes painfully aware of the good old "ounce of prevention" adage and spends a few sleepless hours nursing "that tooth" and several anxious moments in the dentist's chair ruefully wishing that "I had listened to that dentist chap who told me to watch my teeth."

For it is the opinion of dentists that the mucinous deposits should be removed at frequent intervals, thus dislodging the bacteria and washing away the lactic

Chemistry and Preventive Dentistry

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acid formed by their activities. Such a precautionary measure would keep the acid from dissolving the enamel and would help in retarding dental decay if not in preventing it altogether.

Some lucky persons escape dental decay and boast of fine white teeth, but by and by a slight roughness along the gum-line begins to appear. This doesn't seem to be worth a moment's notice, but some fine morning the gums begin to bleed a bit when brushed—all due to the irritant action of an accumulation of unsightly tartar which has caused the bleeding. Soon thereafter the gums begin to recede and become inflamed, causing sufficient discomfort that finally the dentist is consulted—again after the mischief has been done.

The combined efforts of the dentist and the chemist have convicted mucin of being the arch criminal which causes these troubles as well as dental decay. In some mouths the insoluble mucin deposited on the teeth by the action of acids carries along with it some of the lime salts present in saliva. The nucleus so formed settles along the gum-line and clings to the tooth. Little by little successive layers of lime salts accumulate on this nucleus and the deposit grows and gets harder and harder. The gelatinous mucin is the substance which cements the lime salts together and fastens the calcareous material to the tooth.

In the early stages the deposits are soft and easily removed by proper methods, but after they begin to harden instrumentation soon becomes necessary. Here again dentists are certain that if the mucinous material is removed frequently the formation of tartar can be prevented. Obviously if tartar is not present, irritation with its harmful effects cannot occur.

Thus it will be seen that chemistry helps materially in explaining the causes of the two most common dental diseases.

Ever since the first historical records man has been trying to prevent dental disease. Some 3000 years B.C. the Egyptians record the following prescription for cleaning the teeth:

Powder of flint stones, 1 part;
"Green lead," 1 part;
Honey, 1 part.

Dentifrices of the present day may be divided into two general classes—those which depend upon the action of soap alone and those which depend upon the scrubbing action of an abrasive with or without soap for cleansing power. Various fruit acids, antiseptics

and astringents have been advocated in the different preparations, but the abrasive is expected to do the actual cleaning.

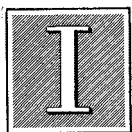
The very multiplicity of dentifrices on the market seemed to indicate that something must be lacking. Therefore a study of the dentifrice problem was undertaken last year at the Mellon Institute of Industrial Research on the request of a Pittsburgh dentist, who, during twenty years of experience, had been led to believe that if a solvent for mucin could be discovered such a material would effectually solve the problem of the thorough cleaning of the teeth.

One method of dissolving mucin is so obvious that it almost escaped attention. If you will recall, first, that mucin is dissolved in the salivary glands by a secretion from the blood stream, thus forming saliva, and second, that it is rendered insoluble by acid in the mouth, then the logical method of dissolving mucin becomes apparent. Simply reverse the action of the acid by converting the insoluble type of the mucin as deposited on the teeth into a soluble form similar to that present in the salivary glands and then dissolve it by means of a solution similar to the blood stream in composition, in this way closely imitating the secretion of saliva. Fortunately it has been possible to do both these things with a single solution.

This is quite a radical departure from the pastes and the powders to which one has been accustomed, but in order to dissolve any substance two things are necessary. First, one must choose a solvent in which the substance may dissolve—sugar will not dissolve in sand, but does so readily in liquid water. Second, the substance itself must be soluble in the particular solvent used. Mucin as deposited on the teeth is not water soluble, but the mucin present in saliva is soluble, therefore one must change mucin into the soluble form before it will dissolve.

It has been found that a solution made in accord with the principles outlined above is an efficient solvent for mucin and that it does clean the teeth without the action of an abrasive. And it is believed that chemistry has found a way to help in the prevention of dental disease, first by assisting in discovering the cause, and then by showing how to remove that cause.

The frequent occurrence in current advertising matter of such words as pyorrhea and halitosis is indication of the serious attention being given by makers of dentifrices and other toilet articles to the scientific principles underlying their use. No longer are these products compounded by blind empiricism, and used or omitted through sheer habit. The maker knows why each ingredient goes in, and the user knows exactly what the finished product is doing in his bathroom.



In ancient Egypt, the land where chemistry originated—the word chemistry is derived from Chēmi (Egypt)—the priests were both

chemists and physicians, and experimented with simple chemicals in the treatment of disease. Most ancient scientists likewise, as well as those who flourished during the Dark and Middle Ages, were chemists as well as physicians and applied their chemical knowledge to the cure of various human afflictions. But this close relationship between medicine and chemistry did not endure, and it has been only very recently that it began again to be appreciated that chemistry could render great aid to the physician and physiologist. The progress that has been made up to the present time, since the physiological chemist began to occupy himself with the treatment of disease—a progress which has been very remarkable considering the short time of its duration—leads one to much speculation as to what our knowledge of how to cure disease would have been by this time if the modern chemist had turned his attention to medicine at the very start, or if the ancient close relation between chemistry and medicine had endured up to modern times.

It is evident on the face of it that chemistry and medicine are closely related sciences. The human body is but a chemical machine, in which various chemical reactions are performed, be it the digestion of the food as it passes through the alimentary tract or the absorption of oxygen by the blood or the combination of the odor-producing agents in the perfume with the odor-detecting units in the mucous membrane of the nose to produce the sensation of smell. If anything goes wrong with us—for example, if our digestion is bad and we have dyspepsia—it is because something has happened to disturb the smooth course of the chemical action of digestion. In a chemical plant if a process gets out of order the chemist is called in to correct it; the chemist can render important aid to

Colloids and Your Health

By Ismar Ginsberg

the physician in correcting a deranged chemical process in the human organism.

So any important development in chemistry will have its significance in the treatment of disease. In recent years colloid chemistry has assumed the essential importance that it possessed, unknown to the chemist, ever since life came upon this earth. Sugar will dissolve in water to give a clear solution; so will salt. Sand or dirt or finely pulverized coal will remain suspended in water, but easily separable therefrom by filtration. The colloid stands somewhere in between. It is neither a solution like the first case nor a suspension like the second. The particles of the colloid are so fine that they will pass through the ordinary filtering medium. Many industrial products are colloidal in nature, such as rubber, milk, glue, gelatine, etc., etc.

Even at the very start Graham, the formulator of the fundamental principles of the science of colloidal chemistry, saw the importance of colloids to living matter in stating that "the colloidal state may be looked upon as the probable primary source of the force appearing in the phenomenon of vitality." Today it is generally accepted that all life processes take place in a colloidal system. This is a very important conception and the results that have been obtained in the treatment of disease, based on this principle, seem to indicate that the great future for chemistry in aiding the physician to cure human ailments is along colloidal chemical lines.

We all know how easily milk will sour due to the formation in it of lactic acid from the decomposition of the milk sugar, lactose. The same effect can be produced instantly by introducing a drop of acid into the milk. Coagulation takes place; the albumin in the

milk is precipitated. The colloidal state of the milk is destroyed, and the same thing can be done with any colloidal solution. Examination of various fluids of the body have shown that they are all colloidal in nature; in fact, the muscles and tissues are also colloidal. A drop of acid in the blood will cause the albuminous matters held in suspension therein to coagulate; in fact, the blood will coagulate when exposed to the air, a fact to which we owe the stopping of blood from a cut—otherwise we would bleed to death. from every scratch—as indeed an unfortunate few of us do whose blood is deficient in the coagulating agent. If we eat something that is bad for us, with the resulting formation of acid, which gets into the blood, there is produced a mild disturbance therein which makes us ill. If we inject acid into our veins we will die, for then complete coagulation results. Even so innocent a substance as ordinary white of egg has this effect, and it is substantially in this way that the deadly snake venoms do their work.

Inasmuch as all the fluids in the body are colloidal in nature, it is evident that anything that will impair this colloidal condition must be looked upon as a source of injury to us. In the handling of colloids in the chemical plant care must always be taken to guard against the introduction of electrolytes, that is, substances which conduct the electric current, into the process, as these substances will destroy the colloid. To remove them other substances are added. In the human body the colloidal condition is the natural condition of good health. Bad health and death are caused by the formation of products within the body, due to disease germs and other causes, which are detrimental to the maintenance of the healthy colloidal condition of the various fluids on which life depends. The proper treatment to get rid of these injurious substances is to use drugs which will promote the colloidal state and bring it back to its original status, and this is doubtless the way in which most drugs work.