when we do obtain a plumber that does his work in an honest, workmanlike, and substantial manner, at moderate cost, we shall be disposed to cherish him as a jewel of rare price.

QUICK AS WINK.

Our notions of the value of time are altogether relative. Ordinarily a minute more or less is a matter of little moment. A would-be passenger, who arrives at a railway station just in time to be too late, realizes that even a less interval than a minute may materially affect his calculations. To the timer of a closely contested race, a second is important; it may be a quarter of a second will make all the difference between fair speed and the "fastest on record." To the astronomical observer, a quarter of a second is a very long time, as an uncertainty of that amount might render worthless an observation which he can never hope to repeat, and for which he may have journeyed thousands of miles.

In some cases an interval so brief as that required for the movement which stands proverbially for instantaneous action may have a material effect on the accuracy of a calculation; indeed it is at times not only necessary to know and make allowance for the time of movements as quick as winking, but to know substantially how much quicker one man winks than another.

Though the movement of the eyelid is so rapid that there is no apparent interruption of vision, the act really involves half a dozen distinct physical and mental operations, the duration of each of which can be closely measured. If the movement is reflexive or involuntary, time is required for the transmission of the impelling sensation to the sensory center, time for its reflection to the winking muscle, time to overcome the inertia of the muscle—the period of latent excitation, as it is called—and lastly time for muscular contraction. That the sum of all these periods is something considerable can be roughly proved by counting the number of winks one can make in a second, or by timing the act by the ticking of a watch.

The purely reflexive part of the act of winking has been ingeniously timed by Dr. Sigismund Exner, who chose this act as the one best adapted to enable him to determine the time required for a complete reflex action. His apparatus consisted of a very light lever of straw, terminated at one end by a bristle which was applied to the eyelid, the other end being connected with the usual contrivance for exactly registering the beginning of muscular contraction. The stimulus was an electric spark, applied in two ways, by passing in front of the eye and thus acting on the optic nerve, or by exciting the nerve of sensation by striking directly on the cornea. He found the interval between the spark and the beginning of motion (that is, the time occupied in the transmission and reflection of the sensation, with the period of latent excitation in the muscle) to vary, with the intensity of the stimulus, from about $\frac{1}{18}$ to $\frac{1}{24}$ of a second, the stronger the spark the quicker the action. The period of latent excitation of muscle in man has never been precisely determined. Dr. Exner estimated it at about a hundredth part of a second, which would reduce the time required for the purely reflexive part of the act of winking to about $\frac{1}{22}$ of a second for a weak impression, and $\frac{1}{27}$ of a second for a stronger stimulus.

For a voluntary wink, a slightly longer time appears to be required, since a measurable interval is occupied in the act of volition.

WHAT MAKES THE APPLES ROT?

Our worst enemies are the smallest. All the ravenous beasts in the world, mad dogs included, probably destroy fewer human lives than are destroyed in this city alone by the ravages of those minute but virulent organisms of the genus *micrococcus*, to which we owe small pox, diphtheria, and some other malignant diseases. Simularly, the thousand sturdy weeds which annoy the farmer, the caterpillers and grasshoppers which occasionally devour his crops, are relatively innocent and harmless compared with the numerous microscopic pests which rust his grain, rot his potatoes and fruit, and otherwise levy their burdensome taxes without making themselves visible.

Just at this season, not the least interesting of these individually insignificant, collectively enormous, nuisances are the two forms of fungus growth which have most to do with the untimely destruction of fruit—*mucor mucedo* and *pencillium glaucum.*

Our apples decay, not because it is their nature to, as Watts might say, but because it is the nature of something else to seize on them for subsistence, as we do, at the same time making of them a *habitat*, as we do not. Kept to themselves, apples and other fruit never rot; they simply lose their juices by evaporation, shrivel, and become dry and hard, or, if kept from drying, remain substantially unchanged, as when securely canned. It is only when invaded by the organisms we have named that they lose color and quality, take on offensive tastes and odors, become covered with white or green mold—in short, develop rottenness and decay.

Formerly this process was thought to be no other than a continuation or exaggeration of the natural process of ripening, the chemical changes which produce the odor and flavor of the ripened fruit simply going on to their legitimate though less delightful end. But this theory overlooked the very common and important facts that fruit may rot without ripening, and that ripe fruit will not rot if properly protected.

It was not until the microscope was brought to bear on the problem, and the conditions of decay were so convincingly demonstrated, by Davaine, that the real nature of the process became clear. Now we know that, so far from being the complement of growth, the antithesis of life, decay is in reality the taking on of a more rapid though specifically different growth. It is synonymous not with death, but with intensely active life.

In general structure, the numerous microscopic fungi are very much alike, consisting mainly of a network of colorless cells and filaments, called the *mycelium.* This is the vegetative part. There is, besides, a reproductive part, in which is produced the seed or "spore," the structure of which is different in the different genera. In the mucor each reproductive filament bears a globular swelling at its superior extremity, in the interior of which the spores are developed. In the pencillium glaucum the reproductive filament bears a tuft of from four to eight branches, which, in turn, produce upon their extremities a chaplet of small oval spores. It is called *pencillium* on account of this pencil-like tuft of its spore-bearing filaments, and *glaucum* from their bluish green tint. The mold so frequently seen in oranges is produced by this fungus. It is comparatively of slow growth, and the alteration it produces in the properties of the fruit it lives in and upon is not so marked as that caused by the mucor.

When a fruit is invaded by either of these fungi, the vegetative filaments send their branches among and around the fruit cells, and rapidly envelop them in a network of mycelium, absorbing the substance and juice of the fruit, and producing the chemical transformation characteristic of decay. All this goes on in the interior of the fruit, the fructification of the fungus taking place only on the surface, in contact with the atmosphere. For this reason fruit covered with a firm, fine skin, like the apple, may be a mass of what we call corruption within—in other words, thoroughly decomposed by fungus growth—while no visible mold—the fructifying part—appears on the surface. On the other hand, thin-skinned fruits like the strawberry, which are easily pierced by the reproductive filaments, are often covered with an abundant fructification in a very short time, for the fecundity of these microscopic fungi is sometimes as marvelous as the rapidity of their growth. For example: A single zöospore of the *peronospora infestans*, which causes the potato rot, will envelop the cellular tissue of a potato leaf with mycelium filaments in twelve hours, and fructification will be completed in eighteen hours longer. One square line of the under surface of a leaf, where the fructification naturally takes place, may bear as many as three thousand spores. Each spore supplies half a dozen zöospores, individually capable of originating a new mycelium. From one square line, therefore, there may come, in less than two days, nearly twenty thousand reproductive bodies, and a square inch may yield nearly three millions! No wonder the disease spreads rapidly.

In the case of fruit, decay may be originated in two ways, and two only: by direct contagion or by wind-wafted spores. With firm-skinned fruit like apples, still another condition is essential, namely, a break in the skin of the fruit to allow the parasite to enter and take possession. In every case of decay in apples, the center of disturbance will be found at a bruise, scratch, or puncture; and unless such a way be opened, the apple may hang until it is dry as leather, or it may lie for weeks in direct contact with rottenness, and remain perfectly sound.

To this it may be objected that the constant presence of the fungus in decay is no proof that it is the cause of that condition, on the contrary, the breaking down of the fruit tissue by violence, and subsequent chemical action owing to access of air, may rather make the growth of the fungus possible by preparing a suitable soil for its development. The objection has been met in the investigations of Davaine. The evidence that the fungus precedes and causes the changes which we call decay is of the same character as that which establishes the connection between a vaccine pustule and inoculation by vaccine virus. When sound fruit is inoculated with the spores of pencillium, decay begins at and spreads from the point of inoculation. Apples similarly wounded, but not inoculated, remain the same.

FAT IN FORAGE PLANTS.

To any one not a chemist or a quadruped, the last place to look for fat would be a hay mow or a stack of straw; yet it appears from recent investigations that fat is not only an essential constituent of hay, straw, and similar forms of vegetation, but one of considerable economic value.

In the lower leaves of oats in blossom, Arndt found as much as ten per cent of the dry weight to consist of fat and wax, the latter appearing as the bluish bloom so conspicuous on the leaves of luxuriant cereals. In fodder crops, generally the greatest proportion of fat is found in young and thrifty plants. Thus Way found early meadow grass to contain as much as six and a half per cent of fat; while in that of the same meadow, collected in the latter part of June, there was but a little more than two per cent. The proportion of fat is increased by nitrogenous manures: the grass of a sewaged meadow at Rugby contained above four per cent of fat, while similar grass, not sewaged, afforded less than three per cent of fat.

The nature of this sort of vegetable fat was investigated some little time ago by the German chemist König, who found that by treatment with strong alcohol the fat of grass and clover hay could be separated into two parts, one a solid waxy substance, the other a fluid fat, soluble in alcohol. At first he considered the latter to be a true glycerin, but changed his mind after the investigations of Schulz, who proved that, though it contains the same proportion of carbon and hydrogen as ordinary fat, the fluid fat of hay is something quite different, since no glycerin can be obtained from it.

König has since confirmed these results and carried forward the investigation, showing that the fat of oats, rye, and vetch seed is similarly constituted. In all these forms of vegetation, hay, oat straw, the grain of oats, rye, vetches, and possibly others, he finds oleic and palmitic acids, not combined with glycerin but in a free state; and as these acids in their combinations are well known as large ingredients of nutritive fats and oils, it is likely that they have a considerable influence on the value of these plants for fodder.

König also finds in hay and in oat straw the important ingredient of animal bile, *cholesterin*; still further, cerotic acid, a waxy body which forms twenty-two per cent of ordinary beeswax; and two fatty substances new to Science, one fluid, the other solid. They are distinct compounds, having the character of fatty alcohols. Another interesting discovery in hay fat is the presence of a hydrocarbon, the relations of which are not fully made out. In several respects, it agrees with some of the paraffins.

SCIENTIFIC AND PRACTICAL INFORMATION.

EFFECTIVE POWER OF ANCIENT WEAPONS.

A curious and interesting series of experiments recently took place in France, under the auspices of the Directors of the Museum of St. Germain, which consisted in tests upon ancient war engines constructed after the basreliefs found on Trajan's column.

An onager—variety of catapult—threw stone balls to a distance of 640 feet. Bolts from another kind of catapult traveled 960 feet in six seconds of time, showing a velocity of projection of 160 feet per second. The range and adjustment of the engines were readily calculated, and accurate shots were made at a distance of 480 feet. It would seem therefore that ancient Roman artillery included weapons of by no means contemptible effect, particularly since the muskets of seventy years ago failed to carry with accuracy over a distance equal to but little more than half that last mentioned.

NEW PROCESS FOR MAKING SILVERED TELESCOPIC MIRRORS.

M. A. Nicole states that he has succeeded in producing telescopic reflecting mirrors cheaply and easily by the electroplating process. He takes the mold of a concave surface, made of a mixture which is either an electrical conductor itself or else a non-conductor metallized by the aid of nitrate of silver and phosphorus dissolved in sulphide of carbon. In either case the mold is plunged in a bath of galvanic silver, where the current, conducted very slowly to the mold determines a deposit of excellent quality.

When the silver has reached a thickness of 0·015 inch, the bath of that metal is replaced by one of copper, so as to obtain a solid backing. The mold is then dissolved or melted and the mirror removed, nothing further being necessary than a light polishing. M. Nicole adds that he has produced perfect mirrors of four inches in diameter in this manner.

COMBUSTION OF POWDER.

As the result of their extended series of experiments, details of which we have from time to time published, Messrs. Noble and Abel conclude that the explosion of gunpowder determines a temperature of 4664° Fah., comparable to that of the fusion of platinum. The products of the explosion consist in 57 per cent of solid matters and 43 per cent of permanent gases, the latter consisting of carbonic acid, nitrogen, carbonic oxide, and sulphuretted hydrogen. Small grained powders give less gas than those of large grains: but generally the variations are so great that it is impossible to express the reaction by any chemical formula. The solid matters are mainly carbonate, sulphate, and hyposulphite of potash.

MUSCARINE.

This is the poisonous principle extracted from a mushroom of the genus *agaricus*. According to Dr. Prevost, of Geneva, when it is administered in a very weak dose it acts with force upon the pancreatic and biliary, while lessening the urinary, secretions. It is known that the sulphate of atropine produces exactly the contrary effects, so that these two poisonous substances are therefore antidotes to each other.

PARAFFINIC ACID.

Submitted to the action of fuming nitric acid at 47° B., or to that of a mixture of sulphuric acid and fuming nitric acid, paraffin oxidizes and becomes transformed into an oily liquid, of a light yellowish green color, which M. Champion has named paraffinic acid, and to which he ascribes the formula $C^{26}H^{26}N\,O^{10}$.

The composition of the paraffinic acid permits paraffin to to be certainly designated by the formula $C^{48}H^{50}$. It may therefore be regarded as a clearly defined compound, and not as a mixture of different carburets of hydrogen.

ACTION OF ATMOSPHERIC VAPOR ON THE LUMINOUS AND OBSCURE HEAT OF SOLAR RAYS.

Father Provenzali, as the result of investigations on the above subject, finds that the luminous heat and the obscure heat do not maintain a constant relation, but that, while the former diminishes, the latter increases, and *vice versa.* The luminous heat diminishes in proportion as the quantity of vapor in the atmosphere augments. Such is not the case with obscure heat; for during days of the greatest absolute humidity, the obscure rays are almost always the strongest. This is ascribed to the radiating power of the aqueous vapor, which, after having absorbed the luminous rays, emits them under the form of obscure heat.

The conclusion reached is that photometric observations, continued over a long period, may be a useful means of determining the hygrometric state of the superior regions of the atmosphere.