the projectile, in a relatively gradual scale, through all the stages, and thus impart to the same the utmost possible velocity. Now, in the case of gunpowder, there is regular combustion, layer by layer; and the amount of gas developed depends directly upon the extent of the burning surface. Consequently, if the size of the grains be increased, the weight of the charge remaining the same, there will be less surface exposed to combustion, less gas evolved in the first instants of time, and less pressure on the gun. In gun cotton, however, there is, in lieu of combustion, a disintegration which occurs instantly throughout the entire mass; and thus, while the explosion of powder is such that it may be easily controlled, no mode of preparing gun cotton in any particular shape changes its peculiarity of instant detonation.

When a grain of gunpowder is fired in the gun, the first gas that is evolved starts the projectile; and as the latter travels, the combustion area of the powder is constantly augmented until, by the time the flame reaches the interior of the grain, the small remainder of the same is incompetent to evolve by its combustion gas enough to compensate for the increased area over which it must act. Hence that nucleus of the grain serves no useful purpose, and certainly affords no acceleration to the shot: but in the new "compensating" powder, which Captain Charles A. L. Totten, U.S.A., has devised, this nucleus is made to render an accelerating force through being formed of gun cotton, which, exploding in an increased area, exerts little strain on the gun, and checks the tendency of the gas to lose its tension, thus compensating for the increasing space in rear of the projectile. Not only does the inventor claim for this compound explosive high impulsive power, but he states that the waste of large grained powder, which is blown out of the gun with the grain still burning, often reaches 60 per cent of the charge, and that this is saved by the addition of the gun cotton nucleus. In general, he affirms that the combined gun cotton and powder is lighter, and four and a half times more effective, charge for charge, than gunpowder. If this can be substantiated by experiment, there can be little question but that the new explosive will be of the greatest value in modern large artillery, in which gunpowder has been proved too weak to project the immense shot and shell with proper effective velocity. Captain Totten finds, by test, that no chemical change attributable to the mutual action of gunpowder and gun cotton occurs in his powder. The gun cotton nucleus is spherical, and half an inch in diameter, the powder envelope raising the diameter to one inch. No special machinery has yet been invented for its manufacture.

We may add that the present is the time for inventors to turn their attention to inventions of this class. The war in Europe will result in a great demand for improved arms and explosives of all kinds; and an efficient substitute for gunpowder in cannon, which shall be much stronger in its effects and at the same time as easily controlled, would be of the greatest value to both contending parties.

WHY FRESH WATER FISH CANNOT LIVE IN SALT WATER.

It is well known that fresh water fish cannot live in salt water, and *vice versa;* and it has been supposed that the reason existed in some poisonous effect which the inappropriate water exerted. M. Paul Bert has recently been investigating this subject, and his conclusion is that the death of the creature is not due to any toxic action, but is simply a phenomenon of osmosis or transmission of fluids through the membranes. In order to prove this, it is only necessary to weigh the animal before and after the experiment. A frog, for example, plunged in sea water loses one third its weight. If only the foot of the frog be introduced, the blood globules can be seen to leave the vessels and distribute themselves under the skin. If an animal be taken, the skin of which is not entirely osmotic, the same phenomena occur in the bronchial system.

There are certain fish, however, which exist sometimes in salt, sometimes in fresh, water, changing their habitat in different periods of life or of the year. It therefore, in view of the above, becomes interesting to see how M. Bert applies his discovery to such apparent exceptions to the general rule. A fresh water salmon, for instance, plunged abruptly in sea water, resists the effects longer than other fresh water fishes; but he dies within five or six hours. This shows, according to M. Bert, that the fish never proceed suddenly from fresh to salt water, but enter brackish water where the tide ebbs and flows, and live there a sufficient time to habituate themselves to the change. This accounts for the frequent discovery of large numbers of such migratory fish in the vicinity of the mouths of the rivers which they ascend.

A fresh water eel, plunged in salt water, does not seem to be affected. But in investigating the peculiarities of this species, M. Bert was led into a wrong conclusion, which may be cited to show how easy it is, often by pure accident, to reach an erroneous determination in laboratory experimenting. After having himself placed several fresh water eels in salt water, he found, as already stated, that they remained alive and unharmed. Wishing to continue the experiments, he directed his assistant to introduce the fish, and report results. To his surprise, the eels then persistently died after a three or four hours' sojourn in salt water, and long search failed to discover the reason why it was that, when M. Bert placed them in the tanks, they lived, while, when the assistant did so, they perished. Finally M. Bert found that his assistant, doubtless on account of the slipperiness of the eels, lifted them with a piece of cloth in his hand. The cloth rubbed off a little of the natural slime of the animal, which protected it from the salt water. Osmosis then occurred in the denuded portion, and the eel eventually died.

The converse experiment, of inserting sea fish in fresh water, produced analogous results. The gills were the seat of alterations, the same as those noted in fresh water fish placed in salt water. M. Bert also observed that the life of the sea fish could be prolonged by adding salt to the fresh water, thus adding further confirmation to his theory.

"LOST HIS AMBITION."

We met, the other day, an expert workman who said that he had lost his ambition. "Where is my incentive?" said he. "I am only a mortal, just like other men. Energy among others is a means to an end. Health, fame, ease, and luxury are the prizes for which men strive. Show me the man who is energetic in a single cause in which one of these is not the aim, the incentive, and the reward, and answer me honestly how can I make an exercise of more than common energy or industry subservient towards giving me one of these prizes."

"You will never be out of work and will always command respect," was the answer. He smiled, and holding a scraper in one hand and a file in the other, replied: "I never was out of work a day; I am too well known. I put forth my energy when I want work, and get it at once. Having got it, I work along easily and pleasantly; am always on the best of terms with my employer, get the best wages, work ten hours a day, and jog discontentedly along, my ambition, energy, and extra ability rusting away for want of the incentive which all men require to call forth more than ordinary exertion. Now, where is my remedy?" "Piecework," was the suggestion made in reply.

"You have struck it," was the response. "When I worked on piecework, the work I did seemed mine; every job well done brought me more work; I engaged other men, and taught the boys all I knew; every scrap of information I gave to my men or boys brought me in money by increasing their skill; every extra dozen blows I struck were represented in my wages on Saturday night. I looked well ahead at my work, often preventing blunders from being committed; I was a hardworking, happy man, putting by something for old age. But where am I to get piecework now? One establishment has been working short time, another is doing little or nothing, and most of the others don't see the advantages of the piecework system, which can and has been carried to the greatest of success, even in repair shops."

We have often suggested piecework, but the reply is that it cannot be adopted in a repair shop or on promiscuous work. Why not? An average job, even in a small shop, lasts a day; and how much trouble would it be to estimate the value and keep an account (in a small shop) of six jobs a week? Any job done in a shop a second time can be estimated upon for piecework. Sometimes people say: "We do not know what the job is worth." Of course they do not. If a man ties his arm in a sling, he must expect it to grow weak. Just the same with the judgment and perception: men used to piecework can estimate how much there is in a job down to an hour's work in a week; but men who never give the subject a moment's thought cannot. "When I'm too old to work at all," said our friend, "there will be no such thing as daywork, except for laborers."

How to Live Long.

The desire for length of days seems to have been far greater in times past than it is now. With a view of bestowing some timely hints on our active business men, who are rushing on in pursuit of riches regardless of the exhaustion of their physical and mental faculties, our contemporary the New York *Sun* publishes a lengthy article, from which we condense the following:

Nearly all the principal writers on longevity are agreed that human beings may, under the most favorable conditions, live to a hundred, and several have recorded instances of persons reaching a much greater age; but the instances given do not in any case satisfactorily bear rigid examination. Hufeland, public lecturer at Jena, who published a work on longevity in the last century, thus describes the sort of man who has the best prospect of long life: He has a well proportioned stature, without, however, being too tall. He is rather of the middle size, and somewhat thick-set. His complexion is not too florid—at any rate, too much ruddiness in youth is seldom a sign of longevity. Hair approaches rather to the fair than to the black; his skin is strong, but not rough. His head is not too big. He has large veins at the extremities, and his shoulders are rather round than flat; his neck is not too long; his belly does not project, and his hands are large but not too deeply cleft. His foot is rather thick than long, and his legs are firm and round. He has also a broad chest and strong voice, and the faculty of retaining his breath for a long time without difficulty. In general there is complete harmony in all his parts. His senses are good, but not too delicate; his pulse is slow and regular. His appetite is good, and his digestion easy. He has not too much thirst, which is always a sign of rapid self-consumption. His passions never become too violent or destructive. If he gives way to anger, he experiences a glow of warmth without an overflowing of the gall. He likes employment, particularly calm meditation and agreeable speculations—is an optimist, a friend to Nature and domestic felicity—has no thirst after either honors or riches, and banishes all thought of to-morrow. This power of banishing anxiety has an immense deal to do with longevity. It is, in fact, that "management of the mind" which Dr. Johnson so justly told Boswell was "a great art," adding that a man when miserable should not go to his chamber and try to think his trouble down, but should seek every possible means to divert it. Dwelling on misery at once affects, and most seriously, the digestive organs.

There are not a few people the very fineness of whose constitution proves their ruin. They draw so extravagantly upon their powers that they are dust and ashes forty years before the creaky wheels who started in the race with them have done running. In this country we discount our future more heavily, perhaps, than in any other; not by dissipation, but by overtaxing our energies. A very large proportion of men who die rich here die twenty years before they ought if they had properly husbanded their vital resources. Mr. Macy, the well known fancy dealer, was, we believe, only 56 or 58, and had been slaving his whole life; in fact, his complete break-up was explained by his intense toil. Such a career seems like getting very little out of life. A still more striking instance of the kind was that of Mr. Augustus Hemingway, of Boston, who worked himself into a lunatic asylum, whence he came worth some $15,000,000, only to get into his grave a few months later. We doubt whether the history of the world could show a more reckless disregard of life than is shown by commercial men in this country. The science of combining intense application with those habits which conduce to longevity is one that they have not acquired. That it may be acquired cannot be doubted. Newton lived to a great age; and great lawyers have been famous for long life. There seems to be a lack of wisdom in commercial men as to the real value of life. They put a wholly inordinate estimate upon the power of getting and spending.

Rest assured that there is, in brief, only one golden rule to be followed by all who seek longevity—moderation in all things, and management of the mind.

Preparation of Phthalic Acid.

A convenient method for the preparation of phthalic acid for the laboratory is given by Haüssermann in *Dingler's Journal*, page 310. A mixture of one part naphthaline and two parts chlorate of potassium is thrown, small quantities at a time, into five parts of common hydrochloric acid; and the brownish-yellow products, a mixture of addition and substitution products of naphthaline, is thoroughly washed with lukewarm water by decantation. The mass is then dried at a gentle heat to prevent its freezing together, or, as Böttger suggests, it is pressed between white blotting paper,* and then shaken in a flask with petroleum ether (naphtha) to remove the liquid chlorides mixed with it and inclosed within the mass. After filtering and washing with naphtha, and drying the mass, which consists chiefly of tetrachloride of naphthaline, is snow white. It is heated in a sand bath with five or six times its weight of nitric acid, which should not be stronger than 1·35 specific gravity. Several hours are necessary to render the liquid homogeneous. After expelling the excess of nitric acid, it is allowed to cool, when the phthalic acid crystallizes out. The acid is purified by recrystallizing it several times from hot water.

If the nitric acid employed to decompose the tetrachloride of naphthaline is stronger than 1·35, the reaction will go on more rapidly, but an easily perceptible quantity of nitronaphthalic acid is formed, which cannot be easily separated from the phthalic acid.

To convert the phthalic acid into the anhydride, it is only necessary to fuse it and keep it at a temperature of 180° C., or 356° Fah., as long as moisture escapes, although some of the anhydride may sublime off. If the temperature has not exceeded 180° C., the residue will consist of anhydrous phthalic acid pure enough for the manufacture of fluorescine and other compounds. By this method, 30 parts of the anhydride can be obtained from 100 parts of naphthaline. To make it perfectly pure, the acid is boiled with water, and the anhydride purified by sublimation.

For the preparation of phthalic acid on a commercial scale, the method above described is quite expensive, owing to the cost of the materials employed; but for laboratory use and experimental purposes this method is worthy of a trial.

New Weighing Instrument.

The ordinary chemical balance is, of course, rather a costly instrument, it being difficult to make the two halves sufficiently alike, and to combine stability with sensitiveness. M. Pager proposes the following arrangement for small weights. A two-armed tube is filled with mercury, and on one of the mercury surfaces is placed a well fitting plate, which can move in the tube without friction. This serves as the balance scale, and the body to be weighed is placed on it. The liquid will rise in the other arm correspondingly, and equilibrium is at once obtained with great certainty. Place a known weight, 1 grain, for example, and note how high the mercury rises. Then place a second grain and note the additional rise. Going on in this way, a scale may easily be constructed. As for each rise in one arm there is an equal sinking in the other, this scale can be applied to the other leg also, of course in opposite direction. The sensitiveness of the arrangement is considerable. It can be increased by use of the Torricellian vacuum, the plate, with the body to be weighed resting, in this case, on the mercury in the open arm. The scale can here have no fixed zero, since the air pressure varies, which is only a slight inconvenience.

* We suggest the use of infusorial silica to absorb the moisture.—EDS.