imperfectly elastic under the most favorable conditions. The metal must originally be more or less in a soft and annealed condition in order to withstand the corrugating and bending operations. Those portions which are stretched and compressed by the process become stiffer and more elastic and the finished disk is permeated by a most complex and irregular system of internal strains. The arrangement of molecules is undoubtedly a highly unstable one, and it is not surprising that large, discontinuous, and unexpected changes take place in the readings of the finished instrument.

In 1896 I had occasion to design a meteorograph suitable for use on the kites recently employed by the Weather Bureau in making aerial observations. The lightest possible form of barometer of the aneroid type was an obvious necessity. The considerations outlined above led me to substitute steel in place of brass for the vacuum boxes, and a preliminary effort was made to profit if possible by the results brought out by Prof. Barus. Mechanical difficulties in securing a satisfactory form of recording aneroid on these lines forced me, however, to abandon this attempt at the time and adopt a type of instrument similar to the well-known Richard barograph. The vacuum boxes were made of steel instead of composition metal. The performance of these barometers, although better generally than brass instruments, has disappointed my expectations, as they have exhibited considerable after effect, which I am still convinced is due primarily and largely to the imperfect elastic properties of the boxes themselves. Boxes of small diameter were necessarily adopted, but these are inferior to those of large diameter. In support of this statement I find a very significant note in Dr. Chree's paper, p. 446, stating that the after effect in 30 barometers of special make and large size (how large is not stated), as tested at Kew, was so exceptionally small that he found it necessary to multiply the actually observed effects by seven in order to make the figures similar in size to corresponding results from ordinary aneroids.

In concluding these remarks attention is called to a certain source of error in testing aneroids that does not appear to have been mentioned hitherto, and, if not noticed or guarded against, may have an appreciable effect on results. Any sudden change in the air pressure under the receiver of a pump inevitably heats or cools the gas dynamically, in consequence of which there is a most pronounced and real "after effect" in the pressure of the air within the receiver. In my own experience I have been very greatly surprised at the slowness with which the gas acquires its stationary temperature and the magnitude of this effect on the resulting stationary pressure. The slow rate of pressure change adopted by Dr. Chree, namely, one inch in five minutes, in all probability eliminates any error of this kind, but the point is not mentioned, and it is just possible that the results of the older observations and of investigations made without due regard for this effect may be somewhat in error in consequence.—Monthly Weather Review.

OZONE AND THE PHENOMENA OF PHOSPHORESCENCE.

A STROLLER upon the sea beach at night, after a storm has occurred, will notice that the atmosphere is pervaded with a pungent odor and that the crests of the waves are slightly illuminated, while glimmering lights flit over the water like fitful will-o'-the-wisps. What is the origin of these? To what cause must we attribute them? The question is very easily answered when it is a question of those animalcules, those microscopic "lamps of the sea" that the ocean cradles by millions upon millions, and that many a navigator has met with in certain parts of the Atlantic, especially off the coast of Guinea and toward the Cape.

But let us filter this luminous water, and if we do not succeed in collecting any living being carrying the pale light by which the waves are illuminated, we shall be very much perplexed. The solution of the question, however, is very simple, and mere accident has led us to find it.

It is from the ozone found in the air that we must demand the key of the mystery. Let us, in fact, take a closed glass cylinder (Fig. 2, No. 2) provided with two cocks and fill it with air or ozonized oxygen; and then let us add to the latter about a fifth of its volume of sea

water. If we place the apparatus in darkness and shake it energetically, we shall observe in the tube a bright light that will persist for several seconds, and which, like that of the waves, will disappear and again exhibit itself upon a new agitation, and finally vanish completely.

We can, if we wish, produce a continuous luminosity by using a water tromp (Fig. 2, Nos. 1 and 3) and arranging the experiment as shown in Fig. 1. To the left is the ozone generator, *O*, consisting of an entirely new apparatus, and which is actuated by a transformer, *T*. The tromp, *E*, sucks directly into the ozonizer the air led by a conduit, *C*. The light produced has its origin at the surface of separation of the cones (as is clearly shown in Fig. 2, Nos. 1 and 3), at the point

FIG. 2.—VARIOUS EXPERIMENTAL APPARATUS.

1, tromp with three tubes; 2, ozone cylinder; 3, ordinary tromp.

where the water and ozone come into contact. The water preserves its light for five or six seconds after its exit from the tromp, and may be collected in a tank. When projected upon the floor, it falls in a stream of fire and spreads vapors of a milky aspect that are somewhat analogous to those of phosphorus.

It therefore results from these experiments that, in the absence of animalcules, the phosphorescence of the ocean is due to the action of ozone.

What is the exact cause of the phenomenon?

M. Fahrig, from experiments made with water only, concludes that the luminosity is due to the energy absorbed by the ozone at the time of its formation, but confesses that he knows of nothing in the way of proof or probability to support such a hypothesis. There is nothing in this. The luminosity produced is caused simply by the energetic oxidation of certain organic substances contained in the water. Even with very concentrated ozone, pure water gives rise to no phenomenon of phosphorescence.

Milk, urine, benzene, thiophene, and alcohol give rise with ozone to phenomena that are analogous to those which occur with water. The brightness of the light produced varies with the nature of the bodies that enter into reaction.

It is interesting to make evident the very energetic and powerful action that ozone exerts upon impure water, at a time when a dearth of spring water in entire France, and especially in Paris, is causing so legitimate an excitement.

The purification of water by ozone will probably be the solution of the grave problem that is now occupying the attention of our hygienists.—La Nature.

SOME THOUGHTS ON RETARDING THE CHANGES OF OLD AGE.

By ALBERT SEITZ, M.D., McMinnville, Tenn.

IN the study of living forms, from the protozoa to the mammals, and from the protophytes to the seed plants, we find certain changes and conditions characteristic of old age. In the human subject the principal changes which we note are atrophic and degenerative in their nature. The muscles and glands are the parts more especially involved in senile atrophy, although other soft parts are affected to some extent. There is a diminution in size of the cellular elements, though without involving any essential change in

their structure. The muscular fibers become small and are said to take on more uniformity of size, while the spleen and lymphatic glands undergo a remarkable diminution in weight and size, which increases as age advances. There is also some shrinking in volume of the glandular structures of the digestive tract. Wherever fat has accumulated it gradually wastes away. It is said that atrophy begins to take place before degeneration commences. Pigmentary and fatty infiltrations of the elements are common, as are also calcareous incrustations. As an instance of the location of this fatty degeneration, muscular fibers, both voluntary and involuntary, might be mentioned. It is also found in blood-vessels, especially the terminal arteries of the brain, and to some extent in the nerve cells and in the parenchyma of glandular organs. Pigmentary infiltration, it is claimed, is not so frequently met with as is fatty infiltration. In the pineal gland, in ligaments, cartilages, tendons, and the walls of arteries, calcareous deposits are common. In the brain and spinal cord the neuroglia increases until it frequently predominates over the nervous element, and there is a tendency to the deposition of amylaceous bodies in these parts. The fatty elements of the brain are diminished, while the water and phosphorus are increased in quantity. The height and weight of the body on account of these changes are diminished, the body as a whole being shorter and lighter, while its individual parts are also lessened in size, with the exception of the heart and kidneys. The heart, as a rule, is hypertrophied, while the kidneys are at least the size they were in middle life. Changes take place in the skin, rendering it dry and wrinkled, the hair becomes thin and white, the teeth drop out, the body bends. These changes induce a general decrease in vigor; the power of the muscles is lessened; the combustion going on in the body is diminished, as is shown by a decrease in the amount of carbonic-acid gas exhaled. The vital capacity of the lungs is decreased, although there is a quickening of the respiratory rhythm. The pulse rate rises, the secretions are diminished, and the quantity of urine is less. Such, briefly stated, are some of the characteristics of old age. This period of life is more liable to certain diseases, as those due to arterio-sclerosis, to certain forms of rheumatism and gout, and so on.

What produces these changes in the body which drag us down to the grave? Is there no way to retard or prevent them? If we could obviate them even in a measure, how great would be the benefit, and with what rejoicing would the earth's inhabitants hail the discovery, especially those among them who have begun to enter the shadows which gather about life's evening! In the cycle through which a portion of the material world revolves, from the organic to the inorganic, from the living to the dead and back again to the living, it would appear that, as old age approaches, the material of the animal body takes on more and more the nature of the inorganic and becomes more and more akin to the mineral world. When an individual starts in life, he appears to be endowed with a certain power or ability to maintain his status in the highly organized animal world, and to resist largely the tendency of his tissues to become in their chemical nature more nearly akin to the mineral kingdom. What this power consists in I do not know; but it seems to be greatly impaired by age. Now, if by introducing into the body certain agents which might render the excess of accumulating mineral matter more soluble, so that it could be more easily eliminated from the body, we might get rid of one element that contributes largely to the deterioration and degeneration that come with old age. Again, all animal and vegetable tissues when young possess in a large measure

FIG. 1.—ARRANGEMENT OF APPARATUS FOR THE REPRODUCTION OF THE PHENOMENON OF THE PHOSPHORESCENCE OF THE OCEAN.

this resistance toward the changes that take place in senility. Then why would it not be a feasible and rational idea for those who are approaching the period of life when senile changes begin to make their appearance to take as nourishment only the tissues of young animals and vegetables, and thereby supplement their waning power of resistance with that of those organisms which contain it in abundance? And, also, as we now have a process of treating certain diseased conditions of different organs of the body with the products of the corresponding organs of animal bodies (and I believe with some success), why could benefit not be derived by administering the quintessence of the organs of young and healthy animals to those whose bodies are beginning to show the effects of age, and in that way furnish them artificially with the power to resist the encroachments of time? Two or three times a year, for instance, we might administer this treatment for a week or two at a time; and who can say that we might not retard in this way the capture of life's citadel by the king of the glass and scythe?—Medical Record.

ANCIENT TREPPANNING.

THE curious custom of trepanning—that is, of removing small pieces of bone from the living head—is very ancient and widely spread, says Nature. In his recently published book, "Prehistoric Problems," Dr. Munro has devoted a chapter to "Prehistoric trepanning and cranial amulets." About the same time, Drs. H. Malbot and R. Verneau published in L'Anthropologie (tome vii.) a memoir on the Chaouias and the trepanning of the skull in the Aurès. The Djebel-Aurès, "Mountains of the Cedars," form the southeast border of the Algerian plateau; here and in the neighboring Djebel-Chechar is the center of trepanning. The natives are carefully described; they belong to the Berber stem; a portion—perhaps one-eighth—are fair; thus the external, as well as the cranial, characters show them to be a somewhat mixed people. The method of trepanning is very fully described, and a native doctor showed Dr. Malbot a skull with over a dozen circular holes, two slits, and a large irregular orifice, all of which had been pierced when the man was alive! The skull, though taken from a grave, was kept hidden, and it evidently was used as an example by the local doctors. The enthusiastic French doctor says, "The Chaouias respect their tombs, and on no pretext will rifle them; the love of science alone can explain this profanation on the part of our trepanner. It is the same sentiment which has led to our possession of the specimen." Dr. Malbot describes how he acquired the specimen which is now in the Museum d'histoire naturelle in Paris. The natives have recourse to trepanning for blows or wounds on the head; it does not matter how long before the blow may have been given, if only a sick person can remember that he has had one. The operation is by no means a severe one, as the people have a most remarkable recuperative constitution. A woman, tired of the conjugal yoke, has been known to call in the services of a trepanner in order to procure a divorce from her husband by producing a piece of her skull, which she affirmed had been broken by his ill treatment.

THE POWER OF WOOD SAWS.

PROF. O. G. DODGE has recently made some tests in order to determine the power required to drive wood-working machinery at the navy yard in Washington. With a circular rip-saw, 28 inches in diameter and running at 1,200 revolutions per minute (or 8,800 lineal feet per minute) and ripping seasoned hard oak 7½ inches thick, with a feed of 10 feet per minute, 18½ mechanical horse power was used. The motor and saw running idle absorbed 2.1 horse power. In other tests with rip-saws of 24 inches, 14 inches and 12 inches in diameter, and at varying speeds of from 1,500 to 2,000 revolutions per minute, the mechanical horse power output ranged from 2.6 to 8.9 horse power. A band-saw running at 160 revolutions per minute (or 3,017 lineal feet per minute) required 10.4 mechanical horse-power when the motor was running idle. When ripping seasoned ash 10¾ inches thick with a feed of 6 feet per minute, but 14.8 horse power was consumed. In ripping yellow pine 12 inches thick and running 20 feet per minute, 17.6 horse power was consumed. A contrast was afforded by the work done by a band-saw having a pulley 28 inches in diameter and running 480 revolutions per minute. With a belt pulley 12 inches in diameter and 3½ inches face and with the motor belted to the saw shaft the motor consumed 0.9 horse power when running idle, and but 1.3 horse power when ripping seasoned oak 3 inches thick and with a speed in one case of 2½ feet per minute and in the other cases of 4 feet per minute, the difference in speed apparently making no difference in the consumption of power.—Industries and Iron.

Schweinfurt, in Bavaria, is the seat of the largest manufacture in Europe of steel balls for bicycle bearings. The two factories owned by one firm there produce annually 2,000,000 gross, with 600 men working ten hours a day. Since 1896 a fierce competition has sprung up in this trade, owing to the large profits made by this firm, as will be seen from the following figures: The factories for making steel balls in Germany increased from five in 1896 to twenty-five in 1897 and the production rose from 1,500,000 to 4,500,000 gross. The factories in France increased in the same time from four to fourteen, and the production from 300,000 to 500,000 gross. Those in England increased from four to seven factories, and the production from 250,000 to 500,000 gross. The weekly hours of labor are sixty, sixty-six, and fifty-two in Germany, France, and England respectively. Lately, too, the United States has exported steel balls to Germany, as well as to England, which has seriously affected Germany's export in these commodities to England, and owing to the over-production, prices have fallen by 65 per cent., while materials and labor, etc., have risen by 38 to 42 per cent. since 1896. At present, 95 per cent. of the steel balls are used for bicycles, so the future of the trade depends greatly on their utilization as well as for other mechanical purposes and machinery. The "Automatic" Steel Ball Company, at Schweinfurt, exported \$35,000 worth of steel balls to England in 1897.

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