to attain a considerable size, 15 or 20 pound specimens being common. It is not a choice food-fish when so large, and even smaller ones are comparatively dry and tasteless. I have not found it north or west of Cedar Keys."

THE BANNER POMPANO.
(*T. glaucus*.)

This species is a member of the West Indian fauna, and occasionally occurs at the Bermudas; it has lately been noticed on the Pacific side of the Isthmus of Panama.

ON THE INEFFECTIVENESS OF TUBERCLE, WITH SPECIAL REFERENCE TO TUBERCULAR CONSUMPTION.*

By WILLIAM PIRRIE, M.D., LL.D., F.R.S.E., Professor of Surgery in the University of Aberdeen, Consulting Surgeon to the Royal Infirmary of Aberdeen.

As it is customary at these annual gatherings for the president to bring before the associated members some topic of medical or surgical interest, I have thought it would not be unprofitable to dwell for a few minutes on some of the researches in later times on the etiology of tuberculosis, as they tend to enlarge our conceptions of contagion; to correct many previously held doctrines regarding tubercle; to establish a substantial claim of contagiousness for that widespread and awfully fatal malady, consumption; to reveal to us its specific contagium or specific infecting medium; and to explain the facility with which it can be spread in a community. It has been said that one-seventh of all the deaths throughout the world and one-third of the deaths in active middle life are caused by tubercular disease. If this is correct, it must be all-important to be familiar with every addition to our knowledge of this important subject. The elaborate investigations carried on during the last few years regarding the etiology of infective diseases are of the highest interest to the practical surgeon and the sanitarian; but I intend on the present occasion to limit my remarks to the subject of the ineffectiveness of tubercle, perhaps the chief source of consumption, which is the commonest and most fatal manifestation of tubercular disease; and, as bearing on this important subject, to draw attention to the researches of recent experimental physiologists, ending with the remarkable discoveries of Koch, formerly of Breslau, and now chief of the Imperial Health Department of Berlin. Without going so far as Laennec did in his belief that phthisis is always tubercular, yet, if we grant that this widespread and fatal disease is in the main of tubercular origin, we cannot over-estimate the researches on the ineffectiveness of tubercle, which must greatly influence the therapeutics of those who believe in them.

It is not my purpose to consider whether the two processes now called by the separate names of the scrofulous and the tuberculous are really identical; nor to enumerate all the opinions promulgated on the pathology of phthisis; nor to review the facts advanced in support of the opinion that the little nodular growths, composed of giant-cells and a branched reticulum, and to which the name tubercle is now commonly limited, are always due to primary non-specific inflammatory action; but rather to trace recent experimental investigations with a view to showing how they prove that consumption is due to an infective process, and some of them to afford demonstrative proof of the morbid agent which so injures the pulmonary tissue as to lead to its subsequent consolidation and ulceration. They seem to justify claim for consumption the character of infectiveness arising from a special parasite. The contagiousness of consumption is not, however, promulgated for the first time in our own immediate day, nor even in the recent past, for in all ages, probably, some have held this belief. Thus Galen believed in its contagiousness, and ordered consumptive patients to inhale the vapors from the crater of Etna, while Morgagni, in his day, was of the same opinion. We read also that this belief has always prevailed in Italy, Spain, and other countries of Southern Europe. In our country and day many great men have denied this doctrine, while some have specially promulgated it. Thus, looking back on the more recent past, we find the late Dr. William Budd, of Bristol, thirty years ago, as the result of clinical observation, expressing the opinion that pulmonary consumption was allied to the eruptive fevers, and differed from them only in its degree of virulence, and consequent rate of progress. He entertained no doubt in his own mind that it is of a highly contagious character; that its virulence in any country is in the inverse ratio of its duration there, being most rapid and fatal on its first introduction, and becoming, by long continuance, as in our own country, of a milder type and more chronic character. Thus we are told that when first introduced into the Sandwich Islands it sometimes proved fatal in less than six weeks; and we are all familiar with the fact that it often drags on, in our own country, a slow and at times intermitting course, extending over months or years. Still, these views of Budd obtained but few adherents, for the great bulk of physicians, dependent solely on clinical observation and practical experience, were decidedly of opinion that consumption could not be spoken of as a contagious disease in the same sense as the ordinary eruptive fevers are. Within later years, however, much has been done to give us more enlarged and precise views on the subject of contagion, and much that mere practical experience and clinical observation could not determine has been solved, and made matter of demonstrative proof by recent experimental investigations.

Now, if we assume, as already remarked, that consumption is, in the main, tubercular, its widespread diffusion is easily accounted for by the results of these researches and experiments, which, at the outset, proved that there was something in tubercle which possessed infective properties, and have culminated, in the hands of Koch, in making the special contagium, or the precise infecting organism, a matter of demonstrative proof.

About twenty years ago Buhl taught that acute tuberculosis was of an infective nature, and was owing to the existence of a primary inflammatory induration which had become caseously degenerated, and to the absorption of particles from the caseous mass. His view was that the infective substance was always associated with the secondary caseous change; but recent experiments on the artificial induction of tuberculosis in animals render this view untenable.

In 1865 Villemin commenced a series of experiments to prove that tubercle was an infective disease, and demonstrated the fact that caseation of the tuberculous matter was not necessary to constitute it a focus of infection. He took little bits of tuberculous matter, about a pin's head in size, from the body of a man, or a cow, or rabbit, and inserted

them under the skin of the ears, groins, or other parts of dogs and rabbits. The result was that the wound at first healed, but afterward became red and swollen, and ultimately ulcerated, owing to the development of a tuberculous mass. If these animals were killed after fifteen days from the date of inoculation, a caseous mass, surrounded by small yellow granulations, was found at the seat of the wound; tubercles were found in the viscera, especially in the lungs; and, besides gray granulations, infiltrated masses of tubercle were discovered in varying conditions, according to the date of the animal's death. He found like changes to occur in instances where he injected hypodermically small quantities of the sputa of consumptive patients, mixed with water.

Chauveau of Lyons obtained like results from all his experiments, which were of three kinds. First, he gave some oxen, by the stomach, portions of tuberculous matter got in some instances from man, and in other cases from oxen, which are very prone as a class to what is known by the names of "pearl disease," "angle berries," or "grapes," from the peculiar condition of the serous membranes, or, generally, bovine tuberculosis; second, he inserted particles of tuberculous matter into the connective tissue; and, third, he injected into the veins water into which tuberculous matter had been placed and had been filtered. In all cases tubercle granulations were found in the lungs, and all the animals contracted tuberculosis.

We may here conveniently mention that Dr. Charles Creighton, in his interesting work on bovine tuberculosis in man, published last year, describes numerous cases in which a condition of organs in the human subject was found similar to that seen in oxen dead of tuberculosis; and he establishes the extreme probability that the disease is not unfrequently transmitted to human beings through eating the flesh or drinking the milk of diseased cows. Professor Gerlach also states that healthy oxen can be infected through the milk of sickly cows, or by taking with their food portions of tuberculous matter from the organs of affected animals.

These investigations proved that tuberculosis could be produced in suitable animals by the introduction, in various ways, into their systems of true tuberculous matter; but some years ago Dr. Burdon Sanderson and Dr. Wilson Fox performed various experiments on rabbits and guinea-pigs, which they believed to prove that tuberculosis could be produced in these animals by inoculating them with any of the products of ordinary inflammatory action, or even by such substances as fatty liver or putrid muscle—nay, even by the production of local injuries, such as a deep wound, or the insertion of a seton. For a time many concurred in these opinions, and viewed the bodies found after the experiments of Villemin, Chauveau, and others as mere inflammatory products, or infarctions, and not true tubercles at all; but the tendency of more recent experiments is to cast doubt on the assertion that any irritating foreign body could induce tuberculosis in these animals, and to confirm the belief that true tuberculous matter alone can produce general tuberculosis, and that the products of inoculation with non-tuberculous matter are not true tubercle, but what Dr. Hippolyte Martin, of Paris, calls false or "pseudo-tubercle." His experiments are so remarkable, and his statements so decided, that we must refer to them; but in doing so we may as well premise that he holds that true tubercle is an infective malady originating in a specific though undetermined virus, and that its propagation arises solely from the conveyance of this virus from body to body. By this one peculiarity, he maintains, it is possible to determine true infective tubercle from the false or non-infective. True tubercle produces general tuberculosis from a local infection, the virus increasing with successive inoculations; whereas non-tuberculous matter after inoculation produces a local tubercle, but inoculation from this secondary tubercle is quite powerless to produce general tuberculosis. He says it is always indispensable to conduct experiments on this matter with the most rigorous regard to antiseptic precautions, lest particles of real tubercle be accidentally injected, and this is the more important because, according to him, it is impossible to distinguish under the microscope, so far as anatomical characters go, between true and false tubercle—the one only distinguishing feature being the infectiveness of true tubercle. In this he is supported by Professor Cohnheim, who, though I am not able to quote his exact words, had previously given his opinion to the effect that under the head of tuberculosis should be ranked all that after its inoculation on suitable animals produces tubercle, while all that fails to do this is not tuberculous; and that the anatomical definition of tubercle is useless and must give place to the etiological.

Dr. Martin conducted two sets of experiments to prove the ineffectiveness of tubercle. With the greatest antiseptic precautions, he injected into the peritoneal cavity of guinea-pigs irritating substances of vegetable and animal nature, such as pepper, cantharides, fragments of sarcoma, particles from a carcinomatous mamma, particles from the caseation of a sarcomatous tumor, and other non-tubercular matters, with the results that in most instances the animals remained quite healthy, and when killed had no disease of the viscera. In other cases he showed that foreign bodies could set up ordinary inflammatory action, the products of which could not be anatomically distinguished by the microscope from the true tubercle, which always followed inoculation with true tuberculous matter. These secondary tubercles, after inoculation with tuberculous matter, had the distinguishing characteristic of increasing infectiveness from successive inoculations. Hence he concludes tubercle is an infective malady, owing to the presence of some morbid agent, peculiar to it, but undetermined. This agent Koch seems to have discovered in the form of a minute organism, which now goes by the name of the bacillus of tubercle. We may, however, previously enumerate experiments which, while proving that tubercle is infective, also demonstrate some additional ways in which the parasite may find an entrance into the bodies of unaffected persons.

Tappeiner, Bertheau, Weichselbaum of Vienna, and other investigators, caused dogs and some other animals to breathe an atmosphere in which the sputa of consumptive patients and other forms of tuberculous matter were diffused in the form of spray; while they made others respire air through which they diffused atomized liquids impregnated with non-tuberculous substances. The results of these experiments were as follows: In all cases where real tuberculous matter was used, tubercles were found in the lungs, kidneys, and other organs, but especially in the lungs, the abundance of the tubercle being generally proportionate to the length of the experiments and the frequency of the inhalations. In those cases again where non-tuberculous matter was sprayed into the air, either no tubercles were found, or only a very few nodules, and these, perhaps, of doubtful character.

Again, in France, M. Giboux operated on rabbits directly with the air itself expired by consumptive patients, with a view to determine whether it could induce tuberculosis in healthy animals. Into one room he placed a cage containing two healthy rabbits, and into it he passed daily, for some time, twenty or twenty-five liters of air expired by phthisical patients. Into another separated room he placed a second cage also containing two healthy rabbits, and into it he passed daily a similar amount of air expired by consumptives, but previously filtered through tow charged with carbolic acid. The consequences were, that at the end of about three months, the rabbits in the first-named cage became emaciated and showed signs of disease, and at death tubercles were found in all the organs, but especially in the lungs; whereas, in the second pair of rabbits, there seemed to be no injury to health at the end of a like period, and their organs, when the animals were killed, were found free of tubercles.

All these various modes of artificially producing tuberculosis in suitable experiment-animals—some by inoculating tuberculous matter beneath the skin, some by giving it by the stomach, some by injecting it into the veins, others by giving it through inhaling an atmosphere impregnated with tuberculously tainted spray, and others by directly administering the breath of consumptive patients—point to the conclusion that there must be some special infecting virus in real tubercular matter. About five years ago Professor Klebs stated that the contagiousness of tubercle was owing to a microphyte, and his discovery regarding tubercle was proved, by Dr. Schüller, of Greifswalde, to hold good regarding certain affections termed scrofulous; as, for example, scrofulous affections of glands and scrofulous disease of joints, in all of which he said the same microphyte was found.

We will, however, in closing, refer at greater length to the experiments of Koch, of Berlin, as they are the latest, the most striking, and, perhaps, the most decisive. Koch had previously acquired an extended and great reputation by his exhaustive researches into the contagium of splenic fever. His great aim was to discover what the precise character of the contagium was which rendered tubercular disease communicable from one individual to another, and, capable of indefinite reproduction. The result of his experiments was, that in all true tubercles found in cases of general tuberculosis, a special micro-organism was discovered. It may be fittingly asked. Do these micro-organisms or parasites occur in any numbers, do they in any degree infest the tissues of a healthy living body, or do they occur only in special states of disease? Koch and others are decidedly of opinion that they do not occur in the tissues of healthy living bodies; and they have also proved that, though different parasites live and flourish under somewhat varying temperatures and attendant circumstances, yet they all agree in this, that, when once introduced into the living body, their life and increase are greatly favored by a low state of the general health. According to Koch, the tubercle bacilli are found within the giant-cells, and they are delicate rod-shaped bodies varying in length from one-quarter to one-half the diameter of a blood-corpuscle. We are further told that these bodies are most numerous in recent and advancing tubercle, and that they become fewer in proportion as the tubercle gets older, and finally disappear on the healing up of the tubercular disease. Dr. Koch also tested the expectoration of many who were suffering from consumption, and invariably found in it multitudes of bacilli, while he could discover none in the sputa of non-consumptive patients. He also found that the bacillus of tubercle required, in inhabitants of the temperate zone, about the warmth of the animal body for its growth and increase; and, in this respect, it differs from the bacillus of other diseases, for we are told that the bacillus anthracis found in cases of splenic fever can live in a temperature much lower than that of the body—outside the body in fact. Having discovered the parasite, the next point which Koch set himself to decide was whether or not it was the real and only cause of infection; or whether some of the matters by which it was surrounded were so. To determine this point it was needful to differentiate the bacilli from the tissues in which they lay; and this he succeeded in effecting by means of a special dye. To make sure that it was the parasite alone that was the medium of infection, and not any surrounding virus, he cultivated the bacilli artificially through many successive generations. With a speck of tuberculous matter from a human lung, he infected different substances, carefully prepared, so as to afford nutriment to the parasite. From these he infected fresh nutritive material, and so on, till many broods of the parasite were obtained. After the bacilli had been several times transferred from one soil to another, the original tubercular matter was at length got rid of, and nothing but the bacilli was left behind. Now, inoculation with these bacilli, isolated from all the original surrounding matter, was followed by reproduction of the parasite, and by the induction of tuberculosis, as certainly as was inoculation with a speck of tuberculous matter containing living bacilli. The same results followed when the bacilli were placed in fluids contained in porous clay vessels—inoculation with the fluid which was sweated through the clay was innocuous, while inoculation with the bacilli was followed by their reproduction, and by tuberculosis.

We have thus traced a belief in the contagiousness of consumption held by a few probably in all ages, springing from observation and practical experience; and we have seen how it is justified by the results of experimental research in our own days, and that at last, within the past few months, the precise infecting parasite has been made a subject of microscopic demonstration.

Now, if Koch's statement, already mentioned, that one-seventh of the human race die of tubercular disease, and that this disease causes fully one-third of the deaths occurring in active middle life, be true, it is impossible to overstate the importance of his discoveries regarding the nature of the bacilli found in tubercle, and in the expectoration of consumptive patients, which he says does not lose its virulence though reduced to a state of perfect dryness. The question now arises, If consumption is an infective disease, can anything be done to destroy its virulence, or to arrest its ravages to a degree hitherto unattained? This much we may safely assert, that the results of all the experiments we have detailed clearly indicate the need of recognizing the parasitic origin of tubercle, of fortifying the body against the inroad, and against all circumstances favorable to the development of the bacilli, as well as of aiming at the destruction of those already pervading the infected organs. With this in view, we must remember the importance of attending carefully to the improvement of the general health of all consumptives, to the avoidance of close confinement in over-heated and over-crowded rooms, to the keeping the patient as much as possible in the open air in suitable

* An address delivered before the North of Scotland Medical Association, July, 1882.—*Lancet*.

weather, to the careful ventilation of sleeping apartments and sitting-rooms, while guarding against preventable draughts, to the separation of the healthy from the sick as far as possible at night, and to warning the healthy against all avoidable inhalation of the breath of consumptive patients, who, in their turn, must be kept from re-breathing their own breath. Serious attention should be bestowed also on the disinfection of the sputa of consumptive persons; and much good may be expected also from the more assiduous use of antiseptic inhalations than has been practiced in the past.

Perhaps in all that has been said we may find a plea for cottage hospitals in open suburban parts, in place of general or large special hospitals for consumptives; and one without doubt for a more careful supervision of the health of cows, whose milk is an article of daily use by the consumptive, and enters so largely into the dietary of all non-consumptives, especially into that of children; as we are told the milk of animals suffering from tubercular disease is capable of transmitting it to previously healthy human beings.

HYPODERMIC USE OF AMYL NITRITE.

DR. J. J. FREDERIC BARNES thus writes in the *British Medical Journal*:

I have administered amyl nitrite hypodermically thirty or more times during the past eighteen months. In all cases a ten per cent. solution in rectified spirit was used. In no case did any untoward inflammatory or suppurative symptoms occur afterward. The action of the drug was immediate in every case, the subjective phenomena being like those experienced when using the ordinary methods of administration. The spirit solution appears to be an excellent preparation for use, as a small quantity kept in an ordinary stoppered bottle for some months retains its full efficiency at the present time. The dose usually administered has been ten minims of the solution, equal to one minim of amyl nitrite. In lumbago, where the patient is seen at the commencement of the attack, and the disease is not of long standing, the drug given in this manner instantly relieves the symptoms; a patient who is unable, previously to its administration, to bend the trunk without the most exquisite pain, five minutes afterward can do so quite readily. In a case of paraffin poisoning, where the patient was in a state of collapse and almost pulseless, one administration (inhalation having been ineffectually tried) brought on an immediate resumption of cardiac function, the man speedily recovering. Its action in this case would, I apprehend, be due to the relief momentarily given to the congested centers by the peripheral hyperæmia induced. In another case, one of duodenal colic, the patient was found rolling on the floor, from the acuteness of the pain; when, on injecting fifteen minims of the spirit solution, the pain disappeared as if by magic, and the patient was at once able to resume his ordinary position. The value of this drug by ordinary methods of administration has already abundantly demonstrated how great a boon the discovery of Dr. Lauder Brunton is in the hands of the profession, notably in cardiac angina; and I feel confident that its utility may be still further enhanced by giving it, as here recommended, hypodermically.

BLEACHING.

PEROXIDE OF HYDROGEN AS A MEANS FOR BLEACHING, AND ITS AVAILABILITY FOR TECHNICAL, MEDICINAL, AND SURGICAL PURPOSES.*

ACCORDING to the researches of Schoenbein ozonized oxygen is said to be the active principle in grass bleaching. Later and extremely exact researches by Emil Schoene have, however, proved, in conformity with the opinions of A. Houzeau and Fr. Goppelsroeder, that ozone is not engendered in the air during the process of bleaching, but, rather, that all the reactions ascribed to the influence of ozone are due to the action of peroxide of hydrogen. Continued quantitative analyses to ascertain the air's titer of peroxide of hydrogen led to the perception that it depends in a great measure on external circumstances, such as the time of year and day, the movements of the air, etc., and Schoene is of opinion that the preponderating influence in its production must be ascribed to the light.

Atmospheric precipitations, particularly hoar-frost, originating under certain conditions, contain considerable quantities of peroxide of hydrogen, namely, 0.04 to 1 milligramme in 1 liter of liquid.

The quantities that came to earth within four months amounted to 62.9 milligrammes per square meter.

Although "grass bleaching"—bleaching with water, light, and air—has been exercised with success for thousands of years, and though there was no lack of time and labor for the perfection of the process, yet there cannot be any misconception as to the fact that it is attended with considerable inconveniences. The result of grass bleaching can never be predicted with absolute certainty, especially within a fixed time. The usual way of bleaching mostly requires a great deal of time, and is attended, besides other drawbacks, with great loss of interest.

It will be sufficient to point to the extremely interesting operation of wax bleaching. There is lying at the wax bleach-works, near Celle, material to the value of hundreds of thousands of marks, waiting for sunshine and wind. The consideration of these drawbacks will suffice to demonstrate how necessary it is to produce the bleaching medium of nature, the peroxide of hydrogen, in a concentrated form.

Chemistry has at its disposal a long series of combinations which contain oxygen only loosely bound, and which transfer it by their own decomposition to other bodies. These media of oxidation offer a base for the compensation of the oxygen of the air in bleaching, and the following are being technically used: nitric acid, nitrous acid, permanganic acid, chloric acid, chromic acid, and, lastly, the chloric gas in combination with bases in the shape of bleaching salts. However manifold these bleaching media may be, the use of all of them is attended with inconvenience, as they more or less injuriously affect the fiber to be bleached, and for this reason their application is limited and difficult. It is the peroxide of hydrogen alone which does not act in that way; it contains the effective agent operating in grass bleaching in a concentrated form, and is therefore superior to all other bleaching media, and in so far must be marked as the bleaching media of the future.

The peroxide of hydrogen was discovered in 1818 by Thénard, who obtained it by the action of acids on peroxide of barium in the presence of water. Thénard showed that the oxygen of peroxide of barium operated as an oxidizer on the water.

A great number of chemists afterward occupied themselves with the peroxide of hydrogen: Pelouze, Duprey, Balard, J. Thomson, E. Schoene. All found the above way for its production the most preferable.

The resulting solutions are always a titer of only 5 per cent. peroxide of hydrogen. The separation of the pure product H_2O_2 , is proportionately difficult, on account of its great tendency to decompose. There are two ways of effecting concentration:—(1) Freezing out; (2) Evaporation in a vacuum over sulphuric acid at a temperature of 15° to 20° C. (59° to 68° F.).

The pure peroxide of hydrogen is a sirupy liquid of 1.453 sp. gr., which yields a 475-fold volume of oxygen in its decomposition. Dilute solutions equal solution of chlorine in their effect, and will keep for months in a temperature not exceeding 25° C. (77° F.) if protected from the influence of light. A trifling addition of acid has the effect of diminishing very considerably the tendency to decompose. On the other hand, alkalis and salts producing basic reaction hasten its decomposition.

This tendency of the peroxide of hydrogen to lose its oxygen places it among the media of oxidation. It is not in every case that the real reasons are known for the peroxide of hydrogen quickly surrendering its oxygen. There is a series of bodies which accelerate the evolution of oxygen, without themselves apparently undergoing a change. For instance, all pointed, angular, sharp objects, precipitates, such as alumina and hydrated peroxide of iron, charcoal, as well as several metals when very finely grained, as silver, gold, platinum.

In a second series of cases the peroxide of hydrogen acts in the same way as any other medium of oxidation in yielding its oxygen to another body. In course of this process arsenious acid is oxidized to arsenic acid, sulphides are converted into sulphates.

Thirdly, peroxide of hydrogen can apparently exercise a reducing action, losing a portion of its oxygen in decomposing other oxidized bodies. In this manner it reduces the peroxides of lead and of manganese to oxide and protoxide.

In general, it may be said that the peroxide of hydrogen has a deoxidizing action on acids which have an inclination to yield their oxygen (permanganic acid), and an oxidizing action on oxides in alkaline solution which have the opposite tendency.

APPLICATION OF THE PEROXIDE OF HYDROGEN FOR TECHNICAL PURPOSES.

Almost every one who has treated of the subject of peroxide of hydrogen has predicted for it great future importance; the characteristic reactions almost obtrude themselves upon one's observation.

Dumas ("Handbook of Practical Chemistry," Nürnberg, 1830, vol. i., page 119) had used it for cleaning discolored oil paintings and valuable drawings. Starting, as he did, from the consideration that the fading of the paintings arose from the discoloration of the lights put on with white lead through the formation of sulphide of lead, and having regard to the regeneration of the latter by the influence of peroxide of hydrogen into white sulphate of lead, success could not but follow the trials. In spite of this, however, the peroxide was not made use of for a long time; it was only in 1870 that an intelligent perfumer employed it, making it an article of commerce in shape of a 3 per cent. watery solution, as a means for bleaching the hair, and under various names, as, "Eau de fontaine de Jouvence, golden," "Golden hair water," "Auricome." About the same period prominent men drew attention to the faculty of reaction possessed by the peroxide of hydrogen as a recommendation for its use in medicine, as A. v. Schroetter, R. Boettger ("Annals of Chemistry," 1873, page 365), then Geiger ("Handbook of Pharmacy," vol. i., page 213, 4th edition). Hager also gives methods for its production in his "Pharmaceutical Practice."

If in spite of all this peroxide of hydrogen played only a subordinate part, especially in medicine, the reasons are to be found on the one hand in the slighting treatment which was accorded to it by practical chemistry; on the other in its most valuable and specific peculiarities, which in certain directions were antagonistic, and which to superficial observation seem still inimical to its being taken into general use.

In the first place, the production of the peroxide of hydrogen, so far as regards quantities and purity of the article, was, until lately, an unsolved problem.

What practical chemistry could offer were only solutions charged with impurities in the shape of various salts and acids, and of the most uncertain and varying composition. For this reason alone, uniform thorough success in any direction could not be attained. But besides that, the price could not be but enormous in consequence of the disability to fully exhaust the materials used in its manufacture, and an entire want of demand for the article. These drawbacks are now overcome, and peroxide of hydrogen can be had in watery solution with a titer of 3 per cent. by weight, or of 10 volumes, in a uniform, chemically pure state, at low prices and in large quantities.

The doubts with regard to durability and to transport to distant parts may be considered as solved.

The watery solution corresponds in its conditions to solution of chlorine; when light is excluded, and temperature does not exceed 25° C. (77° F.), it loses only a trifling amount of its entire titer of peroxide of hydrogen, and, therefore, the "peroxide of hydrogen question" must be considered answered with regard to its first part, comprising its chemical production and its capacity of undergoing unharmed the difficulties of transport.

PEROXIDE OF HYDROGEN AS BLEACHING MATERIAL FOR PRODUCTS OF ANIMAL ORIGIN.

All products which are to be subjected to a bleaching process by peroxide of hydrogen, must be submitted to a preparatory treatment, the purpose of which is to render them capable in every part of being moistened by a watery solution of the peroxide of hydrogen. Every particle of fat, sweat, and impurity adhering to the objects to be bleached must be taken away.

Besides bathing in a solution of good soap, solutions of 3 to 5 per cent. of carbonate of ammonia have in the first place shown themselves of value; in various cases new means of solution, such as sulphide of carbon, benzene, ether, etc., have been found available.

With regard to the process of bleaching itself, two different principles can be brought into operation.

The watery solution of 10-volume peroxide of hydrogen is neutralized as far as possible by some drops of liquid ammonia and used directly as a bleaching bath.

For a continued process of bleaching it is advisable to use a series of baths, through all of which the object to be bleached passes systematically, commencing with the weak-

est. Light must be excluded, and temperature not be allowed to exceed 25° C. (77° F.).

The second method is based on the same principle, but carried out in a different way.

The objects preliminarily prepared as above stated are steeped in the solution of peroxide of hydrogen. After being fully impregnated with the liquor, they are taken out and subjected to a process of drying in a current of air, which must not exceed a temperature of 20° C. (68° F.).

The process of bleaching progresses energetically during the evaporation of the water, and the concentration of the solution of peroxide of hydrogen occasioned thereby.

It is a matter of calculation, or depends upon other circumstances, whether the one or the other proceeding is to be carried through.

BLEACHING OF HAIR WITH 3 PER CENT. SOLUTION OF PEROXIDE OF HYDROGEN.

The hair is digested for twelve hours in a solution of 3 parts carbonate of ammonia in 1,000 parts of water, at a temperature of 30° C. (86° F.), rinsed, then washed with soap, and all the fatty matter removed with the help of a fresh solution of carbonate of ammonia. Benzene can also be recommended. Prepared in this way, it is immersed in a bath of peroxide of hydrogen, fully neutralized with liquid ammonia.

It either remains in the bath until sufficiently bleached, or is dried in a room at ordinary temperature, and the immersion repeated.

The baths must only be considered fully exhausted when some drops of permanganate of potash produce in the liquor a permanent red coloration.

It has not been found feasible to bleach black hair so that it becomes perfectly white, its color only disappearing so far as to arrive at a light golden fair hue. Even a jet-black Chinese tail does not resist.

The bleaching of hair, even on living persons, does not present any difficulties. After the desired degree of bleaching has been arrived at, an after treatment by washing with water, followed by a wash with alcohol, takes place; hot liquids or drying in drying chambers, are excluded.

BLEACHING OF FEATHERS, ESPECIALLY OSTRICH FEATHERS.

As a means of bleaching feathers, the peroxide of hydrogen is far superior to all other substances proposed for the same purpose, and has proved itself of value in every way, especially for ostrich feathers.

Its superiority rests especially on the oxidation and thorough removal of coloring matter, without the slightest detriment to the structure of the feather itself.

By way of preparation, the feathers are placed into a bath of carbonate of ammonium, containing 1 to 2 parts of salt in 100 parts of water, where they are left for twelve hours at a temperature of 20° C. (68° F.), being gently moved about in the bath the while.

After this they are being steeped and moved about in a lukewarm bath of Marseilles soap, and at last well rinsed with water exempt from lime. Boiling or hot liquids must be excluded.

Treatment with pure benzene and ether has also shown very good results.

For feathers it is only admissible to bleach in baths, which must be made neutral, and not be prepared and kept in metal or wood vessels. Earthenware or stoneware vessels are the best adapted for the purpose.

In cases where the feathers are for a long time exposed to the influence of slightly acidulated liquid, there occur, as with all other organic matter, appearance of wasting away in the liquid; they begin to show signs of decay, and lose their beauty to a great degree.

The bleaching finished, the feathers are slowly dried in a low temperature and in moving air, while being repeatedly beaten. At higher temperature the formation of gluey matter easily takes place, in consequence of which the finest fibrils stick together; beating acts as preventive to that drawback.

It was formerly proposed to dust the feathers while still in a damp state with hair powder, and then only to dry them. The powder acts on the feathers in a similar way as do tanning materials in tanning; like these, it prevents the tendency to flay.

Very favorable results may be attained by steeping the bleached and still wet feathers in alcohol; this makes the gluey insoluble formations settle down, and the liquid evaporating at very low temperature, it leaves the feathers of a woolly and beautiful appearance. By steeping the feathers in benzene, and allowing it to evaporate, the same end is gained with even better results.

The further treatment of the feathers, as scraping, trimming, and curling, can only be mentioned here in passing.

The success of the bleaching of feathers in the above manner is thorough in comparison with other proceedings. Even entirely black spots are bleached after continued action of the bath.

BLEACHING OF SILK WITH PEROXIDE OF HYDROGEN.

For bleaching silk, a whole series of strong oxidizers, as permanganic acid, chromic acid, nitric acid, have been proposed, and besides them sulphurous acid has been used to advantage. As is the case with beeswax, the coloring matters of raw silk are capable of resisting bleaching materials in different degrees; some sorts of silk are easily susceptible to their influence, while others resist it strongly.

Among the latter is the product of the wild silkworm, the so-called Tussah silk, a fine and durable thread of strongly pronounced brown color.

According to our trials, peroxide of hydrogen is the best means of bleaching this silk, the objectionable brown color being reduced by its action to a but little distinguishable, pleasing yellow. After the boiling of the gum by subjecting the raw silk to a treatment with soap baths of various strengths, and final boiling in concentrated solutions of soap, it is recommended to treat it with carbonate of ammonia.

After that the scoured silk must be subjected to the action of peroxide of hydrogen, in the same way as mentioned under the head of "bleaching of hair."

Alcohol, eventually mixed with a little glycerin, has in this case also shown itself of value for an after treatment.

BLEACHING OF IVORY AND BONE.

Records as to the bleaching of bony substances and ivory are very scarce.

Almost universally the process of bleaching in sunlight by means of air and water, which is very trying to the bone, is had recourse to; for ivory, chloride of lime has been proposed.

The purpose of the preparation of the bone is, as in the case of all the other substances heretofore mentioned, the

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