more easily performed. For ether and alcohol the specific gravity test is the only one available.

Very few of our readers, we imagine, require to be told that the specific gravity of a substance is the weight of a given bulk of it at 62 degrees Fahrenheit as compared with an equal bulk of some other substance which is reckoned as unity. Distilled water is universally adopted as the standard for liquids and solids, merely on account of its uniform composition and the fact that it is always at hand or readily obtainable. At present we are not concerned in the specific gravity of solids, and shall, therefore, confine ourselves to a description of the various methods in vogue for determining the density of liquids such as fall within the experience of photographers, though it may be remarked that the same means are equally available to every description of liquid, whether it be a simple substance or a solution, and either heavier or lighter than water.

For many purposes connected with the arts and manufactures the result is attained by means of an instrument commonly known as the hydrometer, of which there are several forms, differing slightly in construction but identical in principle, which will be familiar to most of our readers in the "argentometer." These are chiefly useful in testing spirits, oils, saccharine solutions, and other liquids, the commercial value of which depends to a great extent upon their specific gravity, but are not so well adapted to the purposes of the chemist. The latter proceeds by ascertaining the actual weight of a known volume of the substance to be examined, from which the specific gravity is obtained by simply dividing the result by the weight of the same bulk of distilled water, each of the liquids being weighed at the standard temperature of 62 degrees.

The instrument employed for this purpose is called a "specific gravity bottle," and consists in its simplest form of a thin glass bottle or flask with a somewhat long and narrow neck, and of such capacity that when filled to a point in the neck (at which a scratch is made with a diamond or fine file) it shall contain a known weight of distilled water at the standard temperature. More delicate instruments are provided with an accurately-fitting glass stopper, through which is drilled a small hole, so that when the bottle is filled with liquid and the stopper inserted any excess will escape by the perforation, and the contents be always invariable in volume. A further refinement consists in the addition of a small thermometer, forming part of the stopper, for the purpose of noting variations in temperature in cases where the liquid cannot be conveniently raised or lowered to the standard of 62°. In very delicate experiments the chemist is frequently obliged to resort to special means which need not be described here.

The capacity of the specific gravity bottle is a matter of no importance, provided it be accurately determined, but, for the sake of convenience in saving subsequent calculation, one containing 1,000 grains is to be preferred. All that is necessary in that case after weighing the liquid is to point off three figures of the result as decimals, and the number thus obtained is the specific gravity required. Thus we find the weight of a sample of sulphuric acid to be 1845 grains; we mark off the last three figures, and we have s. g. 1.845. Or a sample of ether is found to weigh 720 grains; we place the decimal point before the first figure, thus—s. g. .720. If a bottle of half the capacity be employed the final result is the same, but we have to divide the result by 500 (the weight of the same volume of water), or, which amounts to the same thing, consider the weight as a decimal number, and multiply by 2. So, with the same examples given above, we find the weights to be 922.5 grains and 360 grains respectively, and dividing by 500 we get s. g. 1.845 and s. g. .720.

But even with the most perfect apparatus obtainable the result will be far from accurate if the item of temperature be disregarded, and it is here where we should expect those inexperienced in chemical manipulations to be most likely to fail. However, by adopting a slightly modified course, a result, which though perhaps not strictly accurate is sufficiently near for all photographic purposes, may be easily obtained. It consists in weighing the liquid to be examined and also the water at the same temperature (the normal temperature of the atmosphere, regardless of the standard), and working out the calculation with the figures thus obtained. It will be found very much easier to proceed in this manner than to produce the standard temperature and retain it throughout the operation, either in the cold of winter or in the late tropical heat.

In order to obtain as clearly as possible this assimilation of temperature, the specific gravity bottle should be filled with the liquid under examination, and plunged up to the neck in a vessel of rain water previously boiled and allowed to cool. After remaining a quarter of an hour or so the stopper is inserted, the surplus expelled, and the bottle carefully wiped and weighed. The s. g. bottle is then emptied of its contents, thoroughly rinsed at the tap, and refilled from the vessel in which it was previously immersed, and the second weight taken. Theoretically this plan is open to the objection that, as different liquids do not expand equally under variations of temperature, different results would be obtained in summer and winter with the same substance; but practically the error is so slight that for photographic purposes it may be wholly disregarded. An actual experiment performed during the recent very hot weather will demonstrate this.

We operated upon a sample of sulphuric ether, employing a specific gravity bottle of fifty grammes capacity. The particular sample of ether we found by a recent trial, carefully conducted, at the standard temperature to register s. g. .725 (strictly speaking, a little more, perhaps .7252). Under the conditions described above the weight of the ether was found to be 555 grains, and of the water 767 grains. Dividing the weight of the ether by that of the water, we have $\frac{555}{767} = .7236$, or .0016 below the true result—a difference which could scarcely be expected to cause any serious injury if totally disregarded. In like manner we found that a sample of so-called absolute alcohol showed a specific gravity of .812, the real figures being a little higher. To show the result of disregarding the temperature—at least so far as concerns the ether—it may be noticed that the actual weight of water contained by the bottle at 62° is 771.7 grains, and adopting these figures the ether would show a s. g. of .719.

In conclusion, those of our readers who wish to avoid the expense of a specific gravity bottle may construct a very efficient substitute at a small cost. Procure a narrow-necked, one-ounce stoppered bottle (the "squat" shape will be the more convenient), and file a groove down one side of the stopper, so as to provide a means of escape for the surplus liquid. This may be filled with distilled water and weighed at 62 degrees, or the absolute weight may be taken at each experiment as we have described. A counterpoise is easily made from a piece of lead or brass carefully filed down to

the exact balance. In emulsion experiments, or in the manufacture of pyroxyline, such an adjunct to the laboratory will be found of very great use, but especially so in the latter case. We recently had occasion to doubt the strength of some acids we had been using for that purpose, when we found the nitric to be s. g. 1.36 and the sulphuric s. g. 1.67, instead of, as reputed, 1.42 and 1.85 respectively—a sufficient difference to entirely alter the character of the pyroxyline made with them.—*British Journal of Photography*.

INSTANTANEOUS PHOTOGRAPHY.

By ERNEST BOIVIN.

On the return of the photographic season I have resumed my investigations, which were suspended during the winter. I am now able to obtain with great certainty dry plates of extreme sensitiveness by combining either an ordinary emulsified collodion or a washed emulsion with gelatine bromine. The following is the method that I have adopted:

On a plate previously coated with a substratum of caoutchouc, so as to avoid bubbles, I flow a collodion emulsion; it is washed with cold water, and then laid in a pan of warm water. After draining it, I again flow over this sensitive film another one of a hot six per cent. solution of gelatine bromide, made with Kennett's pellicle dissolved in a liquid consisting of equal parts of water and beer. Finally, I lay it horizontally to dry in the drying oven. An exposure of a few seconds only is required, and I use an alkaline developer mixed with beer, to which I add some drops of ammonium glucoside. The image develops without any fog, and has a very marked intensity, and I have met with no instance of failure of any of the different operations.

One of the principal elements of success with the gelatino-bromide process I have observed to be the rapid and regular drying of the sensitive film. To effect this I have availed myself of the excellent directions of M. Odagiri for the construction of a proper drying-box, and have introduced certain modifications, which, as they are of importance, I am glad to have the opportunity of making known. In my drying-box the air is admitted through a tube of about ten centimeters in length and from four to five centimeters in diameter; this is filled loosely with cotton-wool, so as to prevent dust being drawn in with the current of air when the apparatus is working. This current I produce by means either of a lamp or of water. In the latter case, the box is connected by an India-rubber tube with the upper part of a cistern of water hermetically closed. When the box is filled with plates for drying I open a cock in the lower part of the cistern, and a current of air is immediately set up. By means of this cock the flow of water can be controlled so as to increase or diminish the current of air, and in this way a rapid desiccation is obtained, and one which is regular and free from dust—essential conditions in the gelatino-bromide process.—*Moniteur de la Photographie*.

MEDICAL USES OF CARBOLIC ACID.

A Clinical Lecture delivered at the Norfolk and Norwich Hospital, England.

By PETER EADE, M. D., London, F.R.C.P., Physician to the Hospital.

SEVERAL cases are now in the hospital under my care in which you will have observed that carbolic acid has formed some portion of the medicinal treatment. At the present moment three cases of phthisical disease are using this drug in the form of inhalation, and one patient suffering from strumous sores is applying it locally in the form of lotion and of carbolic oil. Other cases of medical disease in which it has been used have also recently been under your observation, and I have therefore thought this is a favorable time for calling your attention to some of what may be termed the medical uses of this drug, apart from or in addition to its employment in the more purely surgical cases of disease or injury. Your familiarity with such surgical uses of carbolic acid I cannot doubt; but beyond these there are so many diseases, in which it is of service, which are either purely medical or at least quite commonly come under the care of the physician, that I shall not be stepping out of my province in choosing carbolic acid as the subject of my lecture to-day.

PROPERTIES OF CARBOLIC ACID.

This carbolic acid (or phenic acid, as it was formerly called) is, as you know, one of the products derived from the oil of coal-tar, and has a chemical composition of $C_6H_5O + HO$. It is met with either as an oily liquid or in the crystalline form, and has an acrid burning taste, and a strong odor closely resembling that of creosote. It is slightly volatile, and is readily soluble in water, oil, or glycerine. One of its most valuable properties is that of preventing the decomposition of animal tissue—a property which it possesses in common with salicylic, boric, chromic, and other acids and substances; but it is more generally useful than either of these, because it is not only more certain in its action, but may be employed in a more concentrated form without risk of injuring the parts or tissues to which it is applied.

Carbolic acid is an antiseptic. It prevents putrefaction, or the destruction and resolution of organized animal tissue into its chemical elements. But how does it do this? or, rather, in what does this process of change consist? For a full demonstration of the potential causes of putrefaction I cannot do better than refer you to the able addresses of Dr. Roberts, of Manchester, and Professor Lister, of King's College, published last year in the medical journals, in which it is pretty conclusively shown that the active agent in such decomposition or putrefaction is a microscopic vegetable body called "bacterium." And although Dr. Richardson has expressed the opinion that the cause of septic or putrefactive change is a chemical or glandular rather than such a vital agent, yet I think the present state of our knowledge justifies me in telling you that a living and self-producing agent is the constant accompaniment and potential cause of such a change.

BACTERIA—HOW DESTROYED.

Not very much is known about the life history of bacteria. They are vegetable organisms which, under moderate powers of the microscope, appear as minute lines, but under higher powers are seen to be rod-like bodies showing a sort of jointing from imperfect transverse divisions, and having usually a slight vacillating movement. They have been found not only in decaying animal tissues, but in milk, in the blood, in urine, and in other animal substances. Ehrenberg and others considered them to be animalcular, but they are now generally believed to be of a vegetable nature, either algoid or fungoid.

Now, putrefactive or septic action consisting in a destructive change brought about by the life and multiplication of

these little vegetable germs, antiseptic action is the influence exerted by substances in preventing such life and development—in either destroying this life or its living power of multiplying at the expense of the material which furnishes its pabulum.

MEDICAL PREPARATION AND ACTION OF CARBOLIC ACID.

Such a property has been found to exist (among others) in carbolic acid, and, because of its special suitability, this agent is the one now generally employed for this purpose in surgical diseases and operations. It may be used in various ways. It is too acrid, almost too much of a caustic, to be used in its undiluted form except in the smallest quantities; but dissolved in water, oil, or glycerine, it may be used of almost any strength that may be thought desirable. The weakest form of lotion commonly employed contains about one part of acid to eighty or a hundred parts of water; and from this dilute solution it may be used for ordinary purposes of any strength up to that of the glycerinum acidi carbolicum of the London Pharmacopoeia, which contains one part of carbolic acid to four parts of glycerine. For local use in limited quantity, however, it may be used of much greater strength even than this; and I am in the habit (as you have seen) of applying with marked advantage a glycerine solution of the acid to the granular and excoriated os and cervix uteri, of the strength of four parts of the acid to one part of the glycerine.

The efficacy of the acid in checking diseased or septic action appears to depend upon its being brought into absolute contact with the part to be acted on, and it would seem to exert no beneficial effect beyond the exact limit of the part so touched. The explanation of this is very easy when we remember that its action is the destruction of the life of the germs living and flourishing in and upon the diseased part, and probably also—in the case of a suppurating surface—some check to the exuberant growth and development of the rapidly-secreted mucus and pus and altered epithelial cells, which have unquestionably a certain amount of inherent independent life and vitality.

But besides its destructive influence upon the vitality of the bacterium, carbolic acid appears to exercise the same power of destroying other vegetable germs which are the intimate causes of various diseases in or upon the human body. You are aware that a large class of diseases of the skin are now known to be due to the parasite growth in the cutaneous tissues of different fungoid germs, and in many of these carbolic acid has been found to be of signal service.

SKIN DISEASES, BOILS, CARBUNCLES, FESTERS, RINGWORMS, ETC., CURED BY CARBOLIC ACID.

The diseases in which I have found the carbolic acid especially useful are: 1. All that class of local festering, pustulating diseases of the skin which are at once so common and so difficult to cure. They include all kinds of pustules, boils and carbuncles; sycosis, pustular acne and festering ringworm. 2. Such strumous sores (especially of the neck) as come under the care of the physician. 3. Excoriations of the os and canal of the cervix uteri. 4. Phthisis in its second and third stages, and cases of chronic bronchitis accompanied with more or less purulent expectoration.

HOW TO USE CARBOLIC ACID.

I have said that in order to be effective the carbolic acid must be brought into contact with the part to be acted on, and I doubt not that in many cases where it has been found ineffective the failure has been due to a neglect to insure this contact. In the pustulating and suppurating diseases of the skin I have mentioned it is never sufficient to apply the solution of the acid, of whatever strength, upon or to the outside of the skin. It must always be introduced into the interior of the sore or pustule itself, and so as to come sufficiently in contact with every part of the diseased surface. Of its efficacy thus applied I have now had a very considerable experience, and so certain am I of its curative powers in these cases that I state with the utmost confidence that all cases of boils and carbuncles in their earlier stages can be absolutely aborted and cured, while even in later stages their further increase can be almost surely prevented. For this purpose a very strong glycerine solution should be employed, and it is best conveyed into the interior of the pustule, boil or suppurating spot, by a new quill pen dipped into the solution, and introduced by a rotatory motion through its apex, where a sufficient aperture will generally be found. In carbuncles, which are necessarily larger, and have often several openings, several such introductions may be necessary, or, at a later period, threads of lint soaked in the fluid, may be passed with a probe well into all the sieve-like openings. Occasionally, as when the mass is large and solid, a watery solution of the acid may be injected with a hypodermic syringe into various parts of the hardened growth. The same plan of treatment is often quite effective in cases of sycosis, pustular acne, and festering ringworm. And it is doubtless so because it destroys germs which, living in the involutions of the skin, are the essential cause of these various diseases. In the case of acne, and of boils and carbuncles, the essential dependence of these diseases upon vegetable germs has scarcely been demonstrated,* but their mode of origin and growth, their whole life history, and their curability by such local means alone, go far to prove that they, like other skin diseases, are due to the development in the cutaneous textures or glands of parasitic growth. As, however, I have already published in the medical journals several papers on this subject, I will no longer dwell upon it now. Not long ago it was stated that the development of the vaccine vesicle could be prevented by the application of carbolic acid to the vaccinated sore. If this is so, it would seem highly probable that the same kind of destructive influence would be exerted upon the small-pox eruption if the acid were applied to the pustules before or during the process of their maturation. The process of introducing a little of the strong acid solution into the apex of each pimple would be tedious and disagreeable, but, if effective, it might not only save much disfigurement, but possibly even life itself. Darkening of the patient's room, blackening of the face, covering up the pimples with wet clay (as practiced by some savage tribes)—all expedients for preventing the free development of the local disease—appear to diminish its virulence somewhat, and possibly this more direct interference with the special virus might do much more to mitigate its severity. Various applications to the general surface have been tried and failed more or less completely, and Velpeau has advised the cauterization of the individual

* Mr. Startin has written that in a few cases of boils and carbuncles he has found cryptogamic vegetation like that seen in sycosis, and I have recently had a case of small carbuncle, in which, among the masses of plastic and other cells obtained from its interior, I observed, on pressure, a cloud of small rounded granules suddenly to diffuse themselves in the fluid in the field of the microscope, which were undistinguishable from those of the Achroion Schonleinii.