

great presumption, no doubt, to say that in both cases the patients would have lost their lives except for the saving properties of the bisulphite of soda administered; but I still cannot avoid believing that the sulphurous acid did prevent the spreading of the catalytic principle by rendering it incapable of re-producing itself;^a and, while keeping it in abeyance, allowed time for its elimination by the ordinary powers of nature; and I think we have a confirmation of this view in the occurrence of a relapse in both cases, where it would appear as if, when the bisulphite was stopped, all the poison had not yet been eliminated, the blood disease breaking out again the moment that the poison was freed of its antagonist; and a cure being effected by administering more of the anti-catalytic remedy until every trace of the animal poison was eliminated.

(*To be continued.*)

ART. V.—*On English and Continental Spas, their Physiological Effects, and their Therapeutical Use.* By JULIUS ALTHAUS, M.D., M.R.C.P., Lond., Physician to the Royal Infirmary for Diseases of the Chest.

THIS paper is intended to be a guide to the practitioner in prescribing those mineral waters of England and the Continent of Europe, which are at present generally used for therapeutical purposes. I shall successively consider the alkaline acidulous springs, the muriated alkaline acidulous waters, the alkaline saline, and the bitter waters; the simple muriated and the muriated lithia waters, the brines, the iodo-bromated and earthy waters, the indifferent thermal springs, the chalybeates, and the sulphurous waters.

1. *Alkaline Acidulous Waters.*—The chief ingredients of these are carbonic acid and bicarbonate of soda, and the most important spas of this class are Vichy, in France, Fachingen and Geilnau, in Nassau, and Bilin, in Bohemia. The quantity of bicarbonate of

^a The action of the sulphites on zymotic or catalytic principles is very peculiar; it does not seem to kill them outright, but only to neutralize their action for the time being, so that in treating a case depending on a catalytic poison a relapse may be surely expected if the remedy is discontinued too soon, and before the powers of nature have been able to eliminate it completely from the system.

soda contained in the several springs amounts to from 8·14 to 37·50 grains, and the carbonic acid from 10 to 47 cubic inches in the pound of water. Their therapeutical effects are mainly due to the water, its temperature, and the two ingredients just named.

Carbonated water, when drunk, quenches thirst and has a pleasant effect upon the palate. Carbonic acid being the chief spice contained in cold drinks, especially in fermented liquors, water has a very flat taste when devoid of this gas; and even breast milk is rendered more palatable by it to the infant. Carbonated water stimulates the gustatory nerves, increases the flow of saliva, and thereby promotes digestion; at the same time the earthy salines, which are contained in the food, are more easily dissolved. Part of the gas is generally brought up by eructation, especially if the stomach is full and the quantity of water drunk considerable. Another part is absorbed and carried to the portal vein and the liver, and afterwards to the brain and other remote organs. When taken in moderate quantities, acidulated waters accelerate the pulse, render the head clear, and the mind cheerful. Large doses, such as from ten to twenty tumblerfuls, cause sickness, vomiting, and congestion of the brain; and unless the carbonic acid is quickly eliminated, apoplexy may be the result. In such cases the physiological effects of the gas are combined with those of a mechanical distension of the stomach, whereby a pressure upon the heart and the great vessels is produced.

Bicarbonate of soda when internally administered exalts the natural alkalinity of the blood and renders the urine alkaline. It also increases the quantity of excretions, and promotes menstruation.

The taste of the alkaline acidulous waters varies according to the quantity of carbonic acid, and solids contained in them, and is pleasant if the former, and unpleasant if the latter predominate. They increase the appetite, but scarcely ever act as aperients. A diuretic action is the rule; but perspiration is generally not increased. The mucous secretion of the bladder becomes less tenacious. Their action upon the urine differs according to the state of the stomach, and that of the system generally. In persons suffering from excessive acidity in the stomach, the alkali is neutralized in the *primæ viæ*, and it therefore does not alter the reaction of the urine. But where little acid is present in the stomach, as, for instance, in a healthy person before breakfast, the urine quickly becomes alkaline. Large doses produce irritation and inflammation

of the stomach and the kidneys, whereby the urine is prevented from becoming alkaline. Thus a small quantity of Vichy water may cause the urine to become alkaline; while, if a large amount is taken, it may remain acid. A too much prolonged use of these waters has frequently a noxious effect upon the composition of the liquids and tissues of the body, and may induce general prostration.

Acidulous alkaline springs are useful remedies in those forms of indigestion which arise from deficient innervation, and secretion of the gastric juice, or from chronic inflammation of, and excessive acidity in, the stomach. Carbonic acid improves the innervation and secretion, while, by the bicarbonate of soda the surplus acid is neutralized, and the tenacious mucus, which, in cases of chronic catarrh adheres to the mucous membrane, is fluidified. In icterus arising from catarrh of the hepatic ducts and gall-stones the waters of this class frequently prove curative, especially where there is no disposition to congestion and hemorrhage, nor any great excitability of the nervous system. In gout the waters have not quite answered the expectations that were entertained of them for this affection; but, if the dyspeptic symptoms are very prominent, they deserve a trial. In uric acid diathesis, and in renal calculi and gravel, they are useful, especially in combination with carbonated water baths.

Their reputation as solvents of stone in the bladder is totally unjustified; but in atony of the bladder in old people they may serve as diuretics, and so act as preventives of calculus, as they do not allow an accumulation of mucus in that organ, which might become the nucleus of stone. In chronic bronchitis they are often employed, but are far inferior to the muriated acidulous alkalines; while in portal plethora, on the whole, the alkaline salines are preferable. In diabetes, especially if it is connected with gout and disordered liver, the Vichy waters have frequently a beneficial action; and although it is scarcely to be assumed that they should ever prove curative, yet, by their use, all the symptoms of diabetes have been made to disappear for years.

Baths of Vichy water render the urine neutral or even alkaline; and if they are used for some time the perspiration and saliva also become alkaline. This is most probably due to the local influence of the water upon the skin; the absorption of bicarbonate of soda from the bath being exceedingly doubtful. These baths are useful in most cases in which the water is internally administered.

2. *Muriated Alkaline Acidulous Waters.*—The chief constituents

of these are carbonic acid, bicarbonate of soda, and chloride of sodium; and the most important spas of this class are—Ems, Selters, and Weilbach, in Nassau, Salzbrunn, in Silesia, and Luhatschowitz, in Moravia. The amount of bicarbonate of soda contained in them is from 7·37 (Weilbach) to 44·21 (Luhatschowitz); that of chloride of sodium, from 9·77 (Selters) to 33·47 (Luhatschowitz); that of the carbonic acid, from 6 (Ems) to 50 cubic inches (Luhatschowitz); the temperature is from 45° (Salzbrunn) to 117° 5' (Ems, Neue Quelle); so that in this as in the former class, there is a great variety of similar remedial agents at our disposal.

Chloride of sodium essentially promotes digestion. It not only causes a more considerable secretion of gastric juice and bile, but it also facilitates the absorption of chyle by the capillary vessels of the intestines; and is effectual in preventing fermentation and putrefaction in the intestinal canal. Moreover, as the phosphate of lime is more easily soluble in a solution of chloride of sodium than in ordinary water the absorption of this important substance is facilitated. The feces are rendered more fluid and are more easily voided, there being a more abundant secretion of the intestinal mucus, and desquamation of epithelial cells. The formation and elimination of urea is augmented, and the retrogressive metamorphosis of matter altogether promoted.

By the internal administration of Ems water the urine is generally rendered alkaline after a certain time. Sometimes its use is followed by considerable diuresis and diaphoresis, while at other times purging is induced. If the weather is damp, diuresis is increased; but in dry weather, and in persons whose skin acts freely, the water has a more diaphoretic effect. Its action depends also in a great measure upon the quantity and temperature of the water taken. It also excites the motion of the ciliated cells and of the spermatozoa; from which it has been concluded that the beneficial effect of Ems in chronic bronchitis may be due to the influence of the water upon the epithelium of the air-passages, and that the effect of the same spa in curing sterility may be ascribed partly to a diminution of the acidity of the vaginal and uterine mucus, which, according to Donné, is very detrimental to the viability of the spermatozoa; and partly to the direct action of the water upon the spermatozoa themselves.

The waters of Ems are the only thermals of this class, and are, on account of their high temperature, useful in many cases where

cold springs of a similar character are not applicable. Bronchitis, if caused by cold, or when it occurs in children after measles, or in gouty persons, where it sometimes alternates with true fits of gout, is frequently cured at Ems; but this spa should be avoided where there is a tendency to hemoptoe and tuberculosis. Obersalzbrunn has a special reputation in cases of bronchitis connected with hemorrhoidal complaints, and Luhatschowitz, where there is a complication with scrofula. The same holds good for laryngitis. In emphysema, by the use of the same spas, dyspnea is relieved, expectoration promoted, and the abdominal circulation improved. In dyspepsia dependent upon disturbances in the portal circulation, in chronic intestinal catarrh, where constipation alternates with diarrhea, in certain forms of jaundice and hemorrhoidal affections, the spas of this class are also often used, although they are in this respect inferior to Carlsbad, Marienbad, and other springs. In chronic inflammation of the bladder Ems is preferable to Vichy, if the patients are of delicate constitution, and for whom the Vichy waters would be too potent. Gravel and renal calculi are frequently discharged during the use of the Kesselbrunnen, of Ems. In gout these waters may be used, where true fits of gout do not take place, and the patients are weak and irritable. Ems possesses the reputation of being almost a panacea for chronic parenchymatous metritis and allied diseases of the womb; and there is no doubt that in a great number of such cases the internal use of this water and the Bubenquelle, administered in the form of the ascending douche, prove curative after every other method of treatment had failed. The same spa is often useful in hysterical convulsions and paralysis, and in some diseases of the skin, such as eczema, occurring in young women who suffer from difficult menstruation; and in certain cases of prurigo.

3. *Alkaline Saline Springs.*—The chief contents of these springs are bicarbonate and sulphate of soda. The quantity of the former substance contained in Marienbad (Kreuzbrunnen) is 12·39; in Tarasp, 27·22; in Carlsbad (Sprudel), 9·06; of the latter Marienbad contains 36·26; Carlsbad, 19·96; and Tarasp, 16·54 grains saline in the pound. The temperature of the Tarasp springs is 37°; in the several waters of Marienbad it varies from 43° to 53°; and in those of Carlsbad from 117° to 162°.

The taste of Carlsbad water is slightly saline and alkaline, and resembles that of weak chicken broth. If it has been standing for

some time the taste becomes more strongly alkaline, and consequently more unpleasant. If a moderate amount of it is drunk, no striking effects of any kind are produced in healthy persons. The water seldom causes sickness. In former times, when it was customary for patients to drink from three to ten quarts of Sprudel per diem, and even more, and when it was not taken in the immediate neighbourhood of the spring, but carried into the house of the patient, where it was only drunk after having become cold, and lost its carbonic acid, purgative effects were more frequently observed than they are now-a-days; and Carlsbad has for this reason unjustly acquired the reputation of being a strongly aperient water. In many persons no purgative effects whatever are produced by it; and even the addition to it of Carlsbad salt is not always sufficient for relieving the constipation which sometimes follows. In most cases defecation is moderately increased, while in some there is obstinate costiveness, so that it is necessary to clear the bowels by enemata or purgatives. In some persons Carlsbad causes salivation, even when mercury has not been previously given. The quantity of the biliary constituents of the feces is generally augmented. The feces frequently appear black in the second week of the treatment; they afterwards become green, and then brown, and towards the end of the course their colour is again dark green. Sexual desire is sometimes increased; but diuretic effects are scarcely ever observed. The urine is generally alkaline in the morning, a short time after the water has been drunk; but that discharged in the evening and during the night is always acid.

The specific gravity of the urine is diminished in some, while in others it is increased; the elimination of urea and uric acid is considerably diminished; phosphoric and sulphuric acid are generally increased, while chloride of sodium is diminished. The weight of the body is almost always increased.

Patients suffering from disturbance of the abdominal circulation are those most frequently sent to the alkaline saline spas, and are generally improved or cured, if the stagnation of blood is owing to habitual constipation, pressure from accumulated feces, and certain diseases of the liver; especially if brought on by excessive eating, drinking, or smoking, and by sedentary habits or the effects of climate. In cases of abdominal plethora, the action of the skin is generally very sluggish, and baths of mineral water, moor-baths, or moor-cataplasms, are therefore an excellent auxiliary to a cure. In moor-baths the body is able to bear a far higher degree of heat

than in ordinary water or mineral water baths. In obstinate constipation Marienbad is preferable to Carlsbad, as it contains a more considerable amount of sulphate of soda, whereby it is rendered somewhat similar to the bitter waters; from these latter it is, however, distinguished by containing bicarbonate of soda, carbonic acid, and bicarbonate of iron. These ingredients have the effect of accelerating the circulation and increasing the retrogressive metamorphosis of matter, while, at the same time, the system is not so much weakened as is done by the use of the stronger bitter waters.

In hyperemia of the liver arising from abdominal plethora or from ague, the Carlsbad Sprudel is an excellent remedy. The same may be said of fatty degeneration of the liver when not combined with other structural diseases, and granulated liver in its first stage, when this organ has not yet become atrophic. Icterus arising from catarrh of the hepatic ducts, gall-stones, or hyperemia of the liver, are often cured by the same waters; while in cases which are consequent upon granulated liver in the second stage, cancer and other tumours pressing upon the ducts, the use of the waters must be avoided. The discharge of gall-stones during the administration of Carlsbad water is an event of very frequent occurrence. Similar effects are also produced in renal calculi and gravel. In diabetes the same water deserves a fair trial. We know of no radical cure of diabetes by this treatment, but the patients are often temporarily restored to perfect health, especially if this disease is complicated with gout and disordered liver. Great and lasting effects may also be expected from these springs in those forms of gout in which dyspepsia, hyperemia of the liver, and abdominal plethora are prominent symptoms.

The question often arises, whether a patient had better be sent to Vichy, Carlsbad, Marienbad, or Tarasp, as all these springs may promise to be beneficial in certain cases. From Vichy, Carlsbad is distinguished by the absence of any considerable amount of carbonic acid, and by the presence of sulphate of soda. The function of the stomach is therefore more excited by Vichy than by Carlsbad water; and, on the other hand, the latter can be advantageously used in subacute inflammation of the stomach and the intestines, in which the former is likely to do harm. By the sulphate of soda it contains Carlsbad water acts more powerfully upon abdominal circulation than Vichy water. Marienbad is preferable to Carlsbad in cases where an accumulation of fecal matter is the cause of the

disease, and a thorough clearing of the bowels is advisable; and also, for stout persons who suffer from the effects of too generous living. Tarasp is, by its chemical composition and the low temperature of the water, more closely allied to Marienbad than to Carlsbad, and may be employed with advantage in all cases in which Marienbad is suitable.

4. *Bitter Waters.*—The chief contents of bitter waters are the sulphate of soda and magnesia; and the most important springs of this class are those of Püllna, Sedlitz, and Saidschütz, in Bohemia; of Kissingen, in Bavaria; and of Friedrichshall, in Saxe-Meiningen. The quantity of sulphate of soda contained in the pound of water is from 46·5 grains (Friedrichshall) to 123·8 grains (Püllna); that of sulphate of magnesia from 39·5 (Friedrichshall) to 93 (Püllna). The bitter waters of Friedrichshall and Kissingen are distinguished by containing, besides the sulphates just mentioned, a considerable amount of chloride of sodium (61 grains in the pound), by which their action is so advantageously modified that they should be used with preference whenever the use of bitter waters is required. A protracted use of such bitter waters as contain only sulphates, is very apt to impair digestion; they cause a considerable accumulation of fluid in the intestinal canal, and only a very small amount of the salines is absorbed. A proportionate mixture of the sulphates and table-salt seems to prevent any injurious effects following. The Kissingen bitter water differs from that of Friedrichshall merely by containing a certain amount of carbonic acid, whereby it is rendered more palatable and agreeable to the stomach. The physiological effect of the sulphate of magnesia is, on the whole, very similar to that of the sulphate of soda; but the former seems to be more noxious to the system than the latter; thus, after an injection of a solution of sulphate of magnesia into the veins, the heart and the voluntary muscles become paralysed, while, if sulphate of soda be injected, the contractile power of the muscles is in no way diminished.

The physiological effects of the Friedrichshall bitter water have been minutely investigated by Dr. Mosler, with special regard to the weight of the body, animal temperature, the rate of pulsation and respiration, and the condition of the feces and urine. From these experiments it appears that the *purgative* action of the mineral water is more considerable if taken on an empty stomach; but that the *diuretic* effect of the water is greater if taken after a meal.

With regard to the elimination of the solid constituents of the urine, it appears that urea and chloride of sodium are increased, while the quantity of uric acid is diminished, and the increase of sulphuric acid which is perceived is merely due to the quantity of sulphates ingested with the mineral water. The rate of pulsation and respiration is somewhat increased; but animal heat scarcely altered. The weight of the body is reduced, but immediately increased again when the use of the mineral water is discontinued. The waste of tissue induced by it is chiefly confined to the fat. A considerable contrast has thus, by the researches of Drs. Seegen and Mosler, been shown to exist between the Carlsbad and the Friedrichshall mineral waters. Friedrichshall is both a purgative and diuretic, while Carlsbad has only little effect in stimulating the action of the bowel, and may even cause constipation; and, on the other hand, far from being a diuretic, it does not even allow the whole quantity of water ingested to be again eliminated. Friedrichshall increases the elimination of the solid constituents of the urine, and more especially that of urea and chloride of sodium; Carlsbad, on the contrary, diminishes the excretion of urea, uric acid, and chloride of sodium. Friedrichshall, if taken in large doses, diminishes the weight of the body, which is increased by the use of Carlsbad water. As to the mode of using Friedrichshall, I may remark, that it should be drunk before breakfast, if we wish to cause a purgative action; and after breakfast, if we desire to act on the kidneys.

Cases in which it is advisable to administer a mild purgative and diuretic, which is well borne by the stomach and does not weaken the system, are extremely numerous. If there is a considerable accumulation of feces, or congestion towards the head and the lungs, large doses of Friedrichshall, viz., from one to two pints, may be taken at short intervals. In abdominal plethora, especially where it occurs in pregnant women, or when due to sedentary habits, disease of the heart, and indulgence in the pleasures of the table, one tumblerful in the morning, and another in the evening are sufficient. As a diuretic, the water may be given in certain cases of dropsy, and pleuritic and other effusions. Finally, it proves eminently useful in scrofula; especially in swellings of the cervical glands, tumours of the cellular tissue, chronic inflammation of the mucous membranes, and eruptions of the skin.

There are two waters of this class in England which deserve a far more extensive trial at the hands of the medical profession of

this country than has hitherto been given them, as they are, by their chemical composition, admirably suited for the treatment of many cases of disease, and quite equal to the Continental spas of this class. These are the bitter waters of Cherry Rock, near Kingswood, in Gloucestershire, and the Purton Spa, near Swindon, in Wiltshire. The combination of sulphates, chloride of sodium, and carbonic acid, in these waters is peculiarly valuable; and it is a matter of surprise that they have, up to the present time, been so little used. The Purton Spa is in so far superior to that of Cherry Rock as it also contains carbonate of potash, whereby the diuretic effects are increased. In my opinion, little or no value can be attached to the bromine and iodine contained in this water, the quantity of these substances being exceedingly small; but its effects are, no doubt, chiefly due to the sulphates, the chloride of sodium, and the carbonate of potash; while carbonic acid serves to render the water palatable and agreeable to the stomach. I am not aware whether the water of Cherry Rock is at present at all medically employed; that of Purton has, for the last few years, been used in diseases of the skin, certain abdominal affections, and other allied disorders. The two waters mentioned are probably destined to occupy a foremost position amongst all English mineral waters.

5. *Simple Muriated Waters.*—The spas of this class are distinguished by containing a somewhat considerable amount of chloride of sodium as chief ingredient; and the most important springs of this class are the thermals of Wiesbaden, Baden-Baden, and Bourbonne-les-Bains (149° to 155° F.); the tepid waters of Soden, Mondorf, and Canstatt (61° to 77°); and the cold springs of Kissingen, Homburg, and Cheltenham (50° to 53°). The quantity of chloride of sodium contained in the pound of water is from 17 to 114 grains; the Kochbrunnen, of Wiesbaden, contains 52; and the Ragozi, of Kissingen, 44 grains of this substance. These waters, when taken internally, excite the mucous membrane of the stomach, increase the appetite, promote the secretion of gastric juice, and intestinal mucus, and accelerate the desquamation of epithelial cells; the feces are fluidified, and their evacuation is thereby facilitated. The mucous membrane of the respiratory organs is likewise stimulated, and the general metamorphosis of matter considerably altered. After the use of the waters the urine contains more urea than under ordinary circumstances.

Baths of muriated waters have also a considerable influence upon

the system, and which is proportionate to the amount of chloride of sodium contained in the water.

Chloride of sodium is not absorbed by the skin, but it acts as a powerful stimulus to the cutaneous nerves; it promotes peripheral circulation, and may, by reflex action, exercise an important influence upon remote organs, and even upon the centres of the nervous system. The elimination of matter through the skin and the kidneys is, at the same time, increased, especially if motherlye is added to the bath. Brine vapour baths stimulate the mucous membrane of the respiratory organs and promote expectoration.

The physiological effects of the muriated springs are considerably modified by the temperature of the water, which, as I have just remarked, is very different in the several spas of this class. The cold muriated waters of Kissingen and Homburg, contain, besides the chloride of sodium, a very large amount of carbonic acid, by which, if the waters are used internally, the stimulation of the mucous membranes is further augmented; and, if baths are taken, the combined effects of carbonated and muriated water upon the skin are produced. Two of the Kissingen springs also contain a small amount of carbonate of iron, which was formerly believed to be an important constituent of the same; but it is more probable, that it is only the water, the carbonic acid, and the chloride of sodium which are the really active elements of these springs. The mineral waters of Homburg contain a much larger amount of iron than those of Kissingen; and, if the waters are used internally, this ingredient exercises a great influence upon the composition of the blood. The taste of these waters is refreshing, slightly bitter, salty, and astringent. The secretion of saliva is generally diminished by drinking them; but they cause a tough and alkaline mucus to be secreted in the mouth and gullet. Eructations generally follow, and a feeling of warmth is produced in the stomach. Hunger and thirst are increased; the pulse becomes faster, fuller, and harder; and diuresis is augmented. During the use of Homburg water the feces assume a dark colour; sulphuret of iron being formed in the bowel. Concerning the effect of the waters upon the intestines, they at first not unfrequently produce costiveness; more especially the Homburg water. The effect of the Kissingen springs upon the bowels is more considerable if it is allowed to stand for some time, as great part of the carbonic acid then escapes. The physiological effects increase in proportion to the quantity of water taken, and to the time its use is continued.

The thermals of Wiesbaden taste like chicken broth highly salted; they increase the flow of saliva and buccal mucus, induce frequent deglutition and acuteness of taste, and cause eructations, increase of appetite, and warmth in the epigastrium. One or two hours after drinking even small quantities of the water the flow of urine is increased, and it contains larger quantities of urea, uric acid, and chloride of sodium than is the case if corresponding quantities of ordinary water are drunk. The absorption of the chloride of sodium is facilitated by the high temperature of the water, and the action of the bowel is therefore rather diminished than increased, especially if only small doses are taken. Larger quantities have a more considerable effect upon the bowels; they augment the secretions of the skin and all the mucous membranes; menstruation becomes more abundant, and ensues earlier than otherwise; the pulse is accelerated, and the weight of the body sometimes diminished. If the water has been used for six or eight weeks in succession symptoms come on which indicate saturation of the system. Great aversion to the water is then experienced; the tongue becomes furred; thirst is troublesome; and there is a feeling of heaviness in the stomach, with other gastric symptoms. These are signs that the use of the water should be discontinued; or vomiting, diarrhea, and congestions towards the head and chest would follow.

The effects of the waters of Baden-Baden and Bourbonne-les-Bains upon the metamorphosis of matter, are only imperfectly known. The former spa is more a resort for healthy persons in search of pleasure and relaxation than a refuge for patients; beside which, the water of that place, if used for medical purposes, is scarcely ever administered in its natural state. The chief action of the water, when taken as it is, seems to be, to induce constipation, which is probably due to its high temperature, and the use of aperient medicines therefore become necessary. The physicians at Baden-Baden are in the habit of adding to the water Carlsbad salt, bicarbonate of soda, iodide of potassium, lactate of iron, and other medicines. The thermal water used for bathing is generally mixed with Kreutznach motherlye.

The muriated waters are chiefly efficacious in gout, rheumatism, scrofula, and abdominal plethora. They act by exciting the secretions of the intestines, kidneys, and the skin, and thereby reducing the habitual plethora, eliminating the gouty poison, and promoting a healthy metamorphosis of matter. The Wiesbaden treatment is

very successful in chronic rheumatism, tic-douloureux, and sciatica. In dyspepsia which is owing to chronic catarrh of the stomach, liver disease, abuse of intoxicating liquors, or deficient secretion of gastric juice, arising from sedentary habits and other causes, the internal use of the Kissingen Ragozi should be combined with warm brine baths. In chronic diarrhea, arising from intestinal catarrh, the Kochbrunnen, of Wiesbaden, is the best water of this class that can be chosen. In abdominal plethora, in weak, irritable, and scrofulous patients, to whom the use of the bitter waters and of Marienbad might prove detrimental, the Ragozi or the Homburg Elisabethbrunnen should be prescribed. If judiciously administered, these waters cause neither constipation nor relaxation of the bowels. The thermals of Wiesbaden are appropriate in the milder forms of abdominal plethora, where constipation, hemorrhoids, and hyperemia of the liver are troublesome; but, in severe forms of this disease Carlsbad is preferable. If catarrh of the bronchial tubes is at the same time present, we may order the waters of Soden or those of Canstatt, which contain a rather considerable amount of sulphates, whereby both the effects of the bitter waters and the muriated springs may be produced. Amongst the English spas of this class Cheltenham is the one most closely allied to Canstatt; but, as the Cheltenham water contains very little carbonic acid, it is inferior to the latter.

Muriated waters often prove curative in catarrh of the larynx and the lungs; those containing a moderate quantity of solids being generally better suited for cases of this kind than the strong muriated waters. They have also been warmly recommended for consumptive patients. They cannot cure phthisis; but if patients affected with this disease suffer, at the same time, from troublesome catarrh, indigestion, and disturbed nutrition, several springs of this class may be taken with great advantage, for allaying the irritation of the respiratory organs, for promoting digestion, and giving tone to the system generally. A prolonged stay at Soden is very beneficial, as the climate there is exceedingly temperate and not subject to sudden changes. The tranquillity of this place contrasts favourably with the noise and bustle of Baden, Wiesbaden, and Homburg, which spas are centres of gambling and fashion, and on this account frequently prove ruinous to patients unable to bear excitement.

Muriated springs are of great therapeutical value in certain diseases of the liver, such as hyperemia of that organ, when

arising from want of exercise, too generous diet, and accumulation of fat; icterus due to catarrh of the mucous membrane of the duodenum, and simple induration and enlargement of the liver. Gallstones are, under the influence of the same treatment, discharged, probably in consequence of the augmented secretion of bile washing out the excretory ducts of the liver. The waters are also successful in tumour of the spleen arising from ague, suppressed catamenia, or hemorrhoids.

Chronic diseases of the skin connected with abdominal plethora, arthritic ulcers, and old gun-shot wounds, are often cured at Wiesbaden and Bourbonne-les-Bains, even if projectiles and pieces of necrotic bone are still present. These latter often pass away after the baths have been taken for some time, after which the ulcers heal. The waters should, however, only be prescribed some time after the accident, and when the inflammation has subsided; for, if they are used in too early stages, the result may be unfavourable. They must also be avoided by persons having suffered from fractures, and where union has only recently taken place. Whether the waters have a tendency to soften fibro-cartilaginous and osseous tissue, as has been asserted, is by no means settled; but, it is a fact that recently united bones often fracture again if these waters are used.

6. *Muriated Lithia Waters.*—Small quantities of lithium are probably contained in all mineral waters which are rich in chloride of sodium; but, until now, we know of only two springs which contain so much lithium that this may be said to be the characteristic feature of the water. These are the Murquelle and the Fettquelle, of Baden-Baden, in the former of which Professor Bunsen has discovered 2·4 grains, and in the latter 0·2 grains of chloride of lithium in the pound of water. They have only within the last two years been medically employed, chiefly in cases of gout and lithiasis; and there is, consequently, as yet no sufficient experience concerning their therapeutical powers; but, from what we know about the pharmaceutical properties of lithia, they may be safely recommended in cases of uric acid diathesis connected with gravel, and in cases of chronic gout. The experience already made at Baden-Baden with these waters is, on the whole, very favourable.

7. *Brines.*—The brines contain a very large amount of chloride of sodium which is extracted from them for commercial purposes.

Those of Rehme, or Oeynhausen, in Westphalia, and of Nauheim, in Electoral Hesse, have the greatest reputation as therapeutical agents. The chief spring of Rehme contains 256, and that of Nauheim 181 grains of table salt in the pound of water. Brines are only seldom internally administered—and if so used, they are diluted with fresh water. Brine baths, on the contrary, are most extensively employed, and their action upon the system has lately been investigated by several observers. From these experiments it appears that the primary effects of the brine baths are only due to their influence upon the cutaneous nerves, for neither chloride of sodium nor water is absorbed by the skin. The chief effects are increase of the waste of tissue and of diaphoresis; at the same time the nervous and muscular system are stirred up, the appetite is increased, the bowels are more easily voided, the abdomen and the chest become expanded, the pulse rises, the sexual desire becomes stronger, and the mind more settled and cheerful. But if the use of the baths is continued too long, febrile symptoms, emaciation, pain in the back, &c., are apt to follow.

Brines do much good in diseases caused by impaired nutrition and innervation, such as scrofula and anemia, and in complaints in which excitation of the skin is desirable, as, for instance, in rheumatism, certain forms of paralysis, and catarrh of the mucous membranes. In scrofula they are most effective where there are no considerable local affections, and in children; while in adults, and where there are glandular tumours and scrofulous diseases of the skin, little or no benefit is to be expected. Scrofulous affections of the mucous membranes, such as subacute and chronic bronchitis, ozena, otitis externa, and catarrh of the vagina, are amenable to the treatment. The remedial powers of brines are often strikingly displayed in scrofulous diseases of the bones, such as caries, necrosis, osteo-porosis, &c., even if the constitution has already given way, and hectic fever should be present.

Brines are not advisable for patients suffering from phthisis; and Rehme should be particularly avoided by them, as the air of that place is too bracing. Patients affected with secondary syphilis have also sometimes been sent there. They experience no benefit whatever from the treatment; but, on the contrary, become so much worse that in cases where the diagnosis is doubtful, these baths may be advised as a valuable means for recognizing the nature of the disease.

Brine baths are often said to be apt to produce congestion to the

head, and apoplexy; but this is by no means the case provided they are judiciously used. In cases of paralysis after typhoid and other fevers, or after parturition, they frequently do a great deal of good. In these affections, and in hysterical, rheumatic, and reflex paralysis, as well as in lead palsy, their use should be combined with Faradization of the suffering parts. They produce absorption of rheumatic and gouty effusions, and may arrest the further growth of fibrous tumour of the uterus. They can be strongly recommended for decrepitude in old persons, and in such as have become prematurely old; they also have a favourable influence upon the evolution of persons who have just attained the period of puberty, and upon that of the fetus.

8. *Iodo-Bromated Muriated Springs.*—These waters, the most important amongst which are those of Kreuznach, Hall, Dürkheim, Wildegg, and Castrocaro, contain chiefly chloride of sodium (from 38 to 404), iodide of sodium (0.02 to 0.96), and bromide of magnesium (0.01 to 0.51). Most of them are cold; the only iodated thermals in Europe being those of Montecatini, in Tuscany (92° F.); and of Lipsick, in Sclavonia (115° F.).

Very little is at present known concerning the effects of the iodo-bromated muriated springs upon the general metamorphosis of matter. The action of such waters depends chiefly upon the proportion of iodine and bromine to the quantity of other salines found in them. There are some springs, as, for instance, those of Castrocaro, which contain a comparatively large amount of iodide of sodium, and bromide of magnesium; but, at the same time, so much chloride of sodium that they must be considerably diluted before they can be used internally, whereby the production of the specific effects of iodine and bromine is retarded; on the other hand, such waters as contain comparatively little iodine and bromine, as well as only little table salt, and which can therefore be used as they are, will more readily cause the peculiar effects of the two former substances. If baths of these waters are taken, neither iodine nor bromine is absorbed by the skin. Taken internally, the waters promote the secretion of saliva and the appetite, and stimulate the mucous membranes generally. If they, at the same time, contain a certain amount of sulphate of soda, the bowels are likewise acted upon; and large quantities promote diuresis. A too prolonged use of them may produce the well known symptoms of iodism.

As therapeutical agents, these waters are chiefly successful in

scrofulous infiltrations of the glands, where brines fail to afford relief; also in scrofulous diseases of the skin, particularly lupus, sycosis, lichen, and scrofulous ulcers; and even in caries and necrosis they not unfrequently prove curative. While brines are more beneficial in cases of short duration, and in children, the waters we are now treating of are chiefly effective in cases of long standing and in scrofulous affections of adults.

They are likewise to be recommended in chronic metritis and oophoritis, with consequent anomalies and swelling of the ovaries; and in enlargement of the prostate and the testicle, when this is due to inflammation. In fibroid tumour of the uterus the waters act, according to Scanzoni, chiefly by reducing the size of the womb, after which the troublesome symptoms which are owing to the enlargement of the organ, such as hemorrhage, uterine colics, &c., disappear. In tumours of the ovaries, Scanzoni does not advise the use of the waters if the tumour is of a carcinomatous character, and so long as there are symptoms of congestion; but in other tumours of this organ their further growth may be arrested or retarded. The waters are also efficacious in tertiary syphilis, more especially in patients who have taken much mercury, and in whom syphilis is associated with scrofula.

The waters of Hall, in Austria Proper, enjoy a special reputation in cases of bronchocele; and it is generally known as Kropf-wasser. It is true, that in lymphatic bronchocele where the thyroid body is infiltrated with colloid matter, favourable results may be expected from this spa; but in other forms of this disease the Kropf-wasser does not justify its name.

9. *Earthy Springs*.—The chief contents of these waters are sulphate and carbonate of lime, to which is added a certain amount of chloride of calcium, carbonic acid, and chloride of sodium; and the most important earthy springs are those of Wildungen, Leuk, Lippspringe, Weissenburg, Bath, Lucca, and Pisa. The quantity of carbonate of lime is from 2 to 10·2; that of sulphate of lime from 0·5 to 17·2.

Most springs of this kind are thermals, their temperature varying from 81 to 123. No exact researches have as yet been made concerning the physiological effects of earthy springs. If drunk, a feeling of warmth is produced in the stomach, the appetite is increased, and digestion promoted. Constipation sometimes follows the use of small doses, while large quantities, on the contrary,

cause diarrhea. In some persons even small doses of these waters produce fulness in the head, sleepiness, vertigo, and pressure in the epigastrium. The excretion of the kidneys and the skin is generally increased. The water being very hard, baths of it cause a rather unpleasant sensation in the skin. Their action seems to be, on the whole, exciting and astringent. It is, however, very different according to the temperature of, and to the length of time the patient remains in, the bath. If they do so for a considerable time, such as five hours and more every day, for three or more weeks consecutively, as is the custom at Leuk, Schintznach, and other Swiss spas, a peculiar eruption appears on the skin which sometimes resembles herpes; in other cases erythema, or the scarlet rash, or small thickly-studded papulæ are formed.

The Wildungen water is distinguished from the other spas of this class by containing a very considerable amount of free carbonic acid by which its effects are much modified. It has a special and well deserved reputation for its curative powers in gravel and lithic diathesis. It is no solvent of renal calculi, nor of stone of the bladder; but it is a capital diuretic, and not only promotes the elimination of gravel and renal calculi, but, by its tonic action on the mucous membrane of the urinary passages, seems to prevent the formation of fresh concretions. It is also much used for chronic catarrh of the bladder, neuralgia of the urethra and the neck of the bladder, dysuria, ischuria, and incontinence of the urine.

The waters of Leuk are mostly employed in atonic ulcers and in chronic diseases of the skin, such as eczema and psoriasis. Bathing is of chief importance in the thermal establishment of that place; and there can be no doubt, that very obstinate cases of skin disease in persons of torpid constitution may be improved or cured by the Leuk treatment, a modification of which, according to the principles of modern medicine is, however, to be strongly recommended to the physicians of that spa. The baths are also much used for gouty and rheumatic effusions, and the functional disturbances caused thereby, especially in patients of impaired nutrition and diminished activity of the skin.

The spas of Lippspringe, in Westphalia, and of Weissenburg, in the Canton of Berne, are of much repute as remedies for diseases of the respiratory organs. At Lippspringe it is chiefly the nitrogen ascending from the springs, and which is inhaled by the patients, to which the beneficial effects of the treatment are ascribed, while the physicians of Weissenburg insist upon the lime being the cause of

the curative effects obtained. It seems that in the incipient stage of consumption, where there is much irritation and tendency to inflammation, together with bloody expectoration, much improvement may result from the use of these spas. Time will show whether they are really successful in the latter stages of this disease.

Bath, Pisa, and Lucca, have often proved successful in gout and rheumatism, certain forms of paralysis, atony of the stomach and intestines, and diseases of the skin.

10. *Indifferent Thermal Waters.*—These contain only a few grains of salines (from 2 to 4), and are of a high temperature. The water is limpid, colourless, or slightly blue, devoid of odour and of any physical peculiarities different from those of ordinary warm water. The temperature in the several spas of this class, the most important of which are Gastein and Wildbad, is from 81° (Landeck) to 120° (Teplitz). The Wildbad water has exactly the temperature of the blood. All these waters, but especially those which have a somewhat higher temperature, possess very remarkable physiological and therapeutical properties. Baths of them promote the action of the skin, and excite the peripheral nerves; and, by reflex action, the nervous centres are affected, especially if they are weakened. Effects of the latter kind are chiefly caused by such thermals as issue at high altitudes; and it is probable that the diluted air and the diminished pressure which exists in those regions essentially contribute to the effects of the waters.

The waters of Gastein are chiefly used for bathing. These baths, which are taken in tubs of stone, are not exciting in the ordinary meaning of the term; for persons with habitus apoplecticus, heart disease, and even hemiplegic patients shortly after a seizure, often bathe in this water without any unpleasant consequences, but are, on the contrary, improved by it. The pulse is only accelerated if the water is very hot; but if the temperature is somewhat cooler the pulse is retarded. Gastein is mostly resorted to by decrepit, old, and paralytic persons, who are, by the use of the baths, often restored to comparative health and vigour. The average duration of the baths is from a quarter of an hour to an hour, and even more; and that of the treatment, from four to six weeks.

The baths of Wildbad, in Wurtemberg, are chiefly taken in piscines, or swimming baths. These are large reservoirs the soil of which is covered with fine sand, through which the water rises from

the depth at a temperature just suitable for bathing. It is therefore not necessary to heat or cool the water, and a constant renewal of it is also rendered easy. Bubbles of nitrogen, in which the Wildbad water is very rich, continually glide along the surface of the body, and produce a sort of titillation which is by no means unpleasant. If the stay in the bath is too prolonged, weariness, fatigue, headache, and febrile symptoms are apt to follow. The baths prove most beneficial in the several forms of rheumatism and morbid affections consequent upon it, even when of a severe kind and of long standing.

The springs of Pfäfers, in Switzerland, are used for drinking as well as for bathing. This water agrees very well with the stomach even of weak persons. The elimination of urine and the perspiration are increased by its use; but it has no action on the bowels. The baths have different effects according to their temperature and duration. The usual dose for drinking is from four to eight tumblerfuls. The climate and neighbourhood of Pfäfers are so gloomy and wild, that patients who require more exhilarating and genial surroundings had better not be sent to that spa. In this respect Ragatz is more pleasant; but, as a large number of tourists are continually on the move at this latter place, it is not suited for patients to whom quiet is necessary.

The waters of Teplitz, in Bohemia, are of great therapeutical value in all forms of paralysis and hyperesthesia in which there are no such structural diseases as would preclude the possibility of a cure. Besides the thermal baths, the douche, moor-baths, and moor-cataplasms, are used there. The Hauptquelle of this place has a temperature of 120°.

The water of Schlangenbad, in Nassau, is almost exclusively used for bathing. It has a soft velvety feel if taken between the fingers, and imparts a most pleasurable sensation to the skin. Baths of this water render the skin exceedingly soft, supple, and delicate, and are therefore extensively used by ladies, especially by those in a somewhat advanced age. They also do good in irritability of the nervous system, especially if due to, and connected with, disturbances of the menstrual function, neuralgic dysmenorrhea, &c.

The springs of Warmbrum, in Silesia, and of Tüffer, in Styria, are applicable in all cases for which the other indifferent thermals are used. Those of Clifton, Buxton, Landeck, and Plombières, are, on account of their lower temperature, suitable for the milder forms

of those diseases in which Gastein and the other more powerful spas of this class are chiefly employed.

11. *Chalybeates*.—In chalybeate springs, bicarbonate of protoxide of iron is the principal ingredient; and this is generally accompanied by carbonic acid and bicarbonate of manganese, by which the effects of the iron are much modified. The most powerful chalybeates are those in which, with the exception of iron, only a small amount of solid ingredients and much carbonic acid is contained. The quantity of iron found in the true chalybeates varies from 0.25 to 0.8 grains in sixteen ounces of water; springs containing less iron than 0.2 are no chalybeates. True chalybeates are generally limpid and devoid of smell; the taste is that of carbonated water slightly mixed with that of iron. The physiological action of carbonic acid is, in many respects, similar to that of iron. By small quantities of both digestion is promoted, the activity of the heart, and muscular and nervous power strengthened. The acidulous chalybeates are most admirable remedies for anemia and all morbid conditions consequent upon it, such as certain forms of indigestion, constipation and diarrhea, amenorrhea, neuralgic dysmenorrhea, blennorrhea of the uterus and the vagina, sterility, and tendency to abortion. In certain diseases of the nervous system, in headache, neuralgia in the back, chorea, tremor, paralysis, hypochondriasis, and hysteria, the spas of this class also prove beneficial. The waters of Schwalbach, in Nassau, Spaa, in Belgium, and Pyrmont, in the Principality of Waldeck, enjoy the greatest reputation for their curative powers. Those of St. Moritz, in the upper Engadin will, no doubt, shortly rival in fame its fellows of more ancient renown.

A second class of chalybeate springs are those called saline acidulous chalybeates, which, besides bicarbonate of iron and carbonic acid, also contain a certain quantity of carbonate and sulphate of soda, and chloride of sodium. They act beneficially in most diseases in which the alkaline acidulous waters, the alkaline salines, and the muriated waters are employed, especially if a certain degree of anemia is associated with those complaints. In many cases it is difficult to decide whether a true or a saline acidulous chalybeate should be prescribed; but, it may be laid down, as a general rule, that in pure anemia the former, and in anemia complicated with abdominal disturbances, the latter are preferable. The most important spa of this group is Franzensbad, in

Bohemia, where several saline chalybeates of unrivalled composition rise from mica-slate. The amount of iron contained in the principal spring of this place is 0·37, that of sulphate of soda 25·2, that of carbonate of soda 4·3, that of chloride of sodium 9·3 grains, and that of carbonic acid 4·5 cubic inches in the pound of water. The iron mineral moor which is employed for baths and cataplasms, has a most invigorating influence upon the system. Moor-baths are chiefly used in certain forms of paralysis, gout, and rheumatism, in patients who are below par.

12. *Sulphurous Waters.*—The physiological effects of the sulphurous springs, the chief contents of which are sulphureted hydrogen or sulphurets of metals, are widely different according to their temperature, and the other solid and gaseous ingredients contained in them. Sulphurous thermal springs considerably accelerate circulation. The waters of Eaux Bonnes, when taken internally, produce agitation, sleeplessness, and general excitement of the system, the same as is caused by drinking strong coffee. The power of the muscles appears increased, the complexion becomes florid, a sensation of heat in the pharynx, and pains behind the sternum and between the shoulders are felt. Sometimes there is increased appetite, pain in the abdomen, and constipation.

The waters of Saint Sauveur, if used for bathing, have a sedative effect on the system. They contain a large quantity of Barègne which imparts an oily feel to the water. On the other hand, the springs of Barèges are very exciting. They augment all secretions, and after a few days use, produce febrile symptoms.

Exact physiological researches on the effects of the cold and thermal sulphurous springs are almost entirely wanting. The only observer who has made a few experiments on this subject is Dr. Böcker, who was led to the conclusion that after the use of such waters, the exhalation of carbonic acid by the lungs, and the elimination of uric acid by the kidneys were increased.

The therapeutical action of the sulphurous spas is due to the sulphur, the water, its temperature, and the salines contained in it. They are extensively used in diseases of the skin, and prove particularly beneficial not only in cases of acne, but also in the milder forms of pityriasis, psoriasis, prurigo, and sycosis. In a variety of cases where effusions are to be absorbed, as in swellings of the joints, in caries, and necrosis, in old gun-shot wounds, and in gout and rheumatism, they are used with advantage, provided all inflammatory

symptoms have subsided. In ozena, clergymen's sore-throat, chronic catarrh of the larynx and the bronchial tubes, they frequently afford relief. In chronic poisoning by mercury, lead, and copper, they favour the elimination of the poison and promote recovery. They have been much praised as remedies for abdominal plethora, and more especially for hemorrhoids; it seems, however, that they only do good in such cases if, besides the sulphur, a certain amount of salines is contained in them, or if baths of a high temperature are given. Finally, they may serve as means of diagnosis in cases of secondary syphilis. Under their use syphilitic affections of the most various kinds are very much aggravated; and if no visible symptoms of the distemper exist, but this is latent in the blood, it frequently manifests itself by specific affections of the mucous membranes and other parts, after the sulphurous spas have been used for a week or fortnight. The sulphurous waters are employed externally and internally, and mineral mud-baths form a valuable auxiliary to this treatment.

The most important sulphurous thermals are those of Aix-la-Chapelle; the principal spring there has a temperature of 131°, and contains 0·07 grains of sulphuret of sodium, and 20 grains of chloride of sodium. The waters of Baden, near Vienna, are, on account of their lower temperature (from 89° to 95°), inferior to those of Aix-la-Chapelle, especially for cases of rheumatism and rheumatic paralysis; but, as the air in Baden is much more bracing than at Aix, the former spa is more appropriate for catarrh and scrofula. Amongst the Pyrenean sulphurous baths, those of Bagnères de Luchon are the most important, and prove useful in most complaints in which Aix and Baden are generally prescribed.

ART. VI.—*Contagion Viewed Practically.* By D. C. O'CONNOR, A.B., M.B., T.C.D., L.R.C.S.I., Professor of Practice of Physic, Queen's College, Cork.

A subject viewed scientifically becomes a widely different thing from the same subject when viewed practically. In the former manner we ascertain the truth of a general law, or a fact. In the latter we view the same things in their relation to ourselves or our interests. For instance, nobody doubts, that during a thunder storm, he may be killed by lightning. Still, this occurrence is so rare