manner. There would seem to be no risk whatever of injury to the sinuses themselves.

The field now obtained is very remarkable. In the centre lies the torcular, the lateral sinuses spreading outwards on each side, whilst above these the occipital lobes are exposed to an extent of perhaps two inches. Ideal access to the cerebellum is offered, and, if necessary, the posterior arch of the atlas can be removed. But most important of all is the relaxation of the tentorium which results from the removal of its posterior support, so that it can now move upwards freely and release the pressure on the medulla. Provided there is no undue pressure on the upper chamber this may provide sufficient decompression without any opening of the dura, and in a case of mid-brain tumour with secondary hydrocephalus this procedure alone was sufficient to secure permanent relief. In any case a combination of this with aspiration of the ventricles will give all the relief of tension that can be desired.

Mobilization of the tentorium, so far as I am aware, is an entirely new procedure, and it is only rendered possible by the occipital osteoplastic flap which has been described. Without the craniotomy the formation of such a flap is scarcely a mechanical possibility, for it demands the clean cutting of the densest part of the skull over a very large circle. The trauma to the patient which would result from attempting to do this by any other method would be so serious as to prohibit its performance. Moreover, the flap must be turned down with great rapidity if serious haemorrhage is to be avoided from the large emissary vein, to which reference has been made. With the method here described the actual turning down of the bone flap is practically instantaneous, and in no case has the bleeding remained uncontrolled for a longer period than two seconds. I am so impressed with the value of mobilization of the tentorium that I feel that this possibility alone justifies the invention of the craniotomy.

Anterior approach is rendered much easier by the frontal scalp flap, which has already been described. This places the whole of the frontal region at our disposal, and allows the formation of osteoplastic flaps on a generous scale. The thick anterior portion of the temporal muscle, the origin of which extends right up to the angular process of the frontal bone, furnishes an ideal hinge and preserves an adequate blood supply. If the craniotomy is used the centre will generally be placed a little above the temporal line, and the line of division of the bone will be just above the superciliary arch and to one side of the middle line, although the latter may be crossed without risk if a really full exposure is desired.

This method of approach furnishes admirable access to the frontal lobe, and, if this is displaced, to the falx cerebri, in its anterior portion. It is, however, of still greater value in the approach which it offers to the pituitary gland. If the bone flap is properly formed it will be found that the whole of the bone overlying the frontal lobe has been removed, and that the lobe can therefore be displaced upwards with quite unusual facility. If the hyperextended position of the head is adopted it will be found that the frontal lobe actually falls away from the orbital plate, so that the route to the pituitary is opened up even without mechanical retraction, and all contusion of the brain is avoided.

There is no art in which the human factor is more important than in surgery, and it is therefore well that surgeons should have at their disposal a large variety of methods from which to choose. The stock of any instrument maker will show the efforts that have been made to meet their individual requirements, but I have sometimes wished that surgeons themselves would realize the essentially mechanical nature of some of the problems by which they are faced and the technical skill required to use successfully the elaborate appliances now placed at their disposal. It would be an immense advantage to the student if at some point of his training he were taught something of the mechanic's art, and realized the cunning of the hand involved in the dexterous use of even the simplest tool; for whatever the ingenuity of the instruments provided for the surgeon's use their success must ultimately depend on the skill of the hand which uses them.

THE SPA TREATMENT OF DISEASE.*

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ALTHOUGH it cannot be claimed that there is anything strikingly new or original in the remarks that follow, it should in extenuation be borne in mind that systematic study of this branch of medicine has hitherto, I believe, found no place even in British universities so enlightened as that which this Branch is fortunate enough to possess within its area, and a presentation of some of the problems involved may not be without interest.

The virtues of the chalybeate waters of Spa, near Liège in Belgium, were known as early as the fourteenth century, and so famous was this resort some 300 years later that the word "spa" or "spaw" was adopted in this country as the generic term for any spring or well possessing medicinal properties, and later became extended to comprise any town or locality in the neighbourhood of such a spring.

The use of natural waters in the treatment of disease is, however, much older than this, and has obtained from remote times in most widely separated parts of the world—for instance, amongst the Greeks, Romans, Mexicans, Japanese, and Russians, to mention only a few. Even the Father of Medicine himself, Hippocrates, admittedly the greatest exponent of the healing art of all time, has every right to be regarded as a spa physician, since the site of the temple at Cos, where he practised, was, like that of the other Asclepia, selected for its climatic and other natural advantages, and great use was made of hydrotherapeutic and other physical methods of treatment—combined, however, it must be confessed, with a good deal of ritual and mystification. At one time there were as many as sixty or seventy of these temples of health or Asclepia in Greece, and many of them, being situated in the neighbourhood of healing springs, may be said to have combined the functions of present-day hospitals and spas.

In the early days of the revival of spa treatment haphazard drinking of, and bathing in, the waters were resorted to, but with their later development, as the result of experience and the scientific study of hydrology, their internal administration and external application became to some extent systematized, though modifications were, and always will be, necessary to meet individual needs. Many valuable adjuncts in the form of douches, massage, electrical treatments, physiotherapy, and so on have been added.

It is estimated that every year over one million persons seek relief at the European spas alone, and the fact that spa treatment has held its own for so long and is increasing rather than waning in popularity—notwithstanding the fierce competition of the latest synthetic drugs, animal extracts, vaccines, serums, psychotherapy, and the great development of surgery—leads to the natural query, What are the factors to which its success is to be ascribed? The answer, even by those who firmly believe that certain classes of patient will obtain benefit from spa treatment which they will obtain so rapidly and completely in no other way, is by no means easy.

These factors may be considered under three heads. The first may be termed the hydrotherapeutic—namely, the benefit to be gained from the administration of water internally and its application externally, considered as water simply and without regard to any other constituents. Secondly, the pharmacological factor—that is to say, the effect of the salts, gases, colloids, radium emanations, etc., which may be present in the water concerned, its electrical conductivity, and osmotic function. And thirdly, the general hygienic and psychical factors.

Internal Administration of Waters.

It is possible that much of the benefit of spa treatment is due to drinking large quantities of water. Many natural waters are isotonic, or nearly so, and can be taken in

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considerable amounts without damage to the gastric mucous membrane. This is not true of distilled water or other water of extreme purity, such as glacier water or that of the so-called "poison spring" at Gastein, which are known to have a definitely deleterious effect on digestion. Many natural waters, too, are thermal, and in certain cases it may be an advantage to avoid the abstraction of heat occasioned by the ingestion of much cold fluid. It was found, for instance, by Winternitz that the drinking of 500 c.cm. of water of a temperature of 46.5° F. caused a fall in the rectal temperature of nearly two degrees in twenty minutes.

Both reason and experience dictate that the ingestion of large quantities of water, such as is the practice at many spas, should take place when the stomach is empty. Otherwise, not only may digestion be retarded by dilution of the gastric juice and distension of the stomach, but absorption and excretion proceed less rapidly; and since, according to prevailing views, the object to be attained is a flushing effect on the tissues, this would be an obvious disadvantage. It has been shown that water taken when the alimentary tract is relatively empty reaches the duodenum in thirty seconds and the colon in five or six minutes, so that it is very rapidly absorbed and excreted, and conceivably helps in the elimination of bacterial toxins or poisons formed as the result of faulty metabolism.

Copious water-drinking leads to an augmented excretion of fluid—to some extent from the bowel, to a greater extent from the skin, but more still, at ordinary temperatures, from the kidneys. Not only is a greater amount of water passed, but there is said to be also increased excretion of urea, chlorides, sulphates, and phosphates. With regard to chlorides the increase is but temporary and is followed by a diminution, so that the total quantity of chlorides voided remains the same. The increase of urea, of phosphates, and of sulphates, however, is persistent—that is to say, continues as long as the additional fluid is imbibed—and, since no loss of body weight occurs, the probability is that not only is there a greater disintegration of the tissue elements which give rise to these, but that there is, in addition, an increased formation—in other words, a definite quickening of metabolism. This is confirmed by the recent experiments of J. B. Orr,¹ which show that excessive ingestion of water in healthy individuals leads to increased excretion of urinary nitrogen, increase of total nitrogen excreted as urea, marked increase in excretion of ammonia, and decrease in faecal nitrogen—results which he considers as evidence that both the anabolic and katabolic phases of protein metabolism are accelerated.

It was shown as long ago as 1910 that increased water ingestion diminished the number of bacteria in the faeces, and since one source of the pressor substances responsible for hyperpiesis appears undoubtedly to be bacterial action upon the proteins in the intestine, it is interesting to note that Orr² has found a definite fall of the systolic and diastolic pressures in both normal and hypertensive individuals after drinking three or four litres of water, though where diuresis is unable to keep pace with the intake the fall may be preceded by a rise above the original level. Increase in the parotid and pancreatic secretions has been observed in animals after copious water-drinking; the bile, too, is said to be increased both as regards its fluid and solid constituents, and its specific gravity diminished.

External Application of Waters.

With regard to the external application of water there is no need, after the admirable cinematograph demonstration given to the society as recently as last year by Dr. R. G. Gordon, even to enumerate the various methods employed, but some of the physiological alterations produced in the body may perhaps be considered—that is, as far as they are known, for although many careful and exhaustive experiments have been carried out there still remains much to be learned.

It has been calculated that the pressure in an ordinary bath of plain water is as much as 500 kilograms. The tendency of this pressure—a tendency which, however, may be counteracted by other factors—is to constrict the superficial blood vessels and thus to drive the blood into internal parts. This is probably the explanation of the diuresis which may result even from hot bathing. The chief effects

of baths, however, probably depend upon the temperature at which they are administered. Baths at or about the temperature of the skin—namely, 93° F.—are designated athermal or indifferent. They have no thermal results, but have a markedly sedative action on the nerve endings in the skin, and through them on the nervous system as a whole, and are thus of value in relieving pain and facilitating movement in conditions where muscular spasm is present, as in some cases of chronic arthritis and the results of injury.

The subjects of paralysis from organic disease of the nervous system at one time formed a considerable proportion of those sent to spas, and R. G. Gordon³ has of recent years given an impetus to the revival of this practice by stressing the value of the sedative influence of warm baths in relaxing muscle rigidity and the counteraction of the effect of gravity by the water in rendering passive and re-educative movements more readily performed. Baths of a higher temperature have additional effects. In the first place, the amount of perspiration is increased, and as much as a pound of weight may be lost in sweat by immersion in a bath for thirty minutes at a temperature of 100° F., or for a less period at a higher temperature; whilst Raimont's researches at the Royal Mineral Water Hospital show that its composition may undergo modifications the significance of which we are not yet in a position to appreciate. At the same time the body temperature rises. This is only to be expected, since loss of heat from the skin, whereby some 90 per cent. of heat loss normally takes place, is, with the exception of the small area of the face and scalp, entirely prevented. It is difficult to imagine in these circumstances, with the body immersed in a medium hotter than itself so that loss of heat by conduction, by radiation, and by evaporation is almost completely in abeyance, how the temperature can fail to rise if the production of heat is maintained at the former level. Indeed, it seems wonderful that it does not rise to a greater extent than is actually the case, for observations show that the intake of oxygen and the output of carbon dioxide may be increased by as much as 50 to 100 per cent., indicating apparently that metabolism is not diminished and slowed down, as might be anticipated, but actually increased. These facts are very difficult to reconcile, since the body temperature seldom rises as high as that of the bath, though Dr. J. B. Burt⁴ found a slight rise of temperature in patients bathing in simple water at a temperature below blood heat—namely, about 96° F.

Recent experiments at the Department of Physiology at Pennsylvania showed that immersion in baths at 36° C., rapidly raised at the end of an hour to 40.2° to 43° C., caused a rise in body temperature at the rate of from 1.9° to 5.3° C. per hour, greater depth and rapidity of breathing, with marked diminution of the alveolar carbon dioxide tension, increase of the pH value of the plasma, and diminution of carbon dioxide in the blood. The urine was increased in quantity and became alkaline, in half the cases becoming even more alkaline than the blood.

These observations seem to show that the effect of hot bathing on metabolism is much more complex than was formerly supposed, and other detailed investigations into this interesting problem might profitably be undertaken. It is easy to understand, for instance, how an air temperature of 70° F. feels comfortably warm, whilst a bath at the same temperature feels cold, since water is a much better conductor of heat than is air; but it is difficult to explain the difference in one's sensations in water and in air at temperatures ranging from 100° to 105° F. The artificial pyrexia may persist for an hour or more after the bath, and is in all probability an important factor, especially in many so-called rheumatic conditions where the body temperature tends to be subnormal.

Of equal importance with the temperature is the length of stay in the bath. A hot bath of brief duration acts as a stimulant, but a bath too prolonged is succeeded by a condition of lassitude and debility, and even of tetany—results carefully to be avoided in practice. In this country the best results, where thermal effects are desired, have usually been obtained from baths at a temperature of 99° to 105° F., with a duration of fifteen to twenty minutes.

At Kusatsu in Japan the temperature of the water is 130° F.; the bather has to be encouraged to enter the water by the beating of gongs, and can only remain there two or three minutes. As a contrast to this, at Kawanaka, also in Japan, where the temperature of the water is just below blood heat, the patient stays in the bath for weeks on end, with stones in his lap to prevent him floating during sleep.

It has been stated that one result of hot bathing is to augment the amount of urea excreted; but the evidence on this point is conflicting, and though, as has been explained, it is difficult to conceive that metabolic processes can be increased whilst the person is actually in the bath, and while they, with the exception of the lungs and respiratory muscles, are perhaps rested, it may be that they are speeded up subsequently, especially if, as is frequently the custom, the patient is packed in hot blankets afterwards.

Schamberg and Rule⁵ have demonstrated that syphilitic infection of rabbits after testicular implantation of the virus can be prevented by eleven daily baths, each for fifteen minutes, at 113° F., with an average rise of body temperature of 5° F., if the first bath be given within three or four days of inoculation; and that the disease in the chancre stage can be completely cured by fifteen such baths. Schamberg and Tseng showed that an emulsion of *Spirochaeta pallida* heated for one hour at a temperature of 40° C. failed to produce syphilis, though the spirochaetes were still motile. In treating by hot baths human beings suffering from syphilis they found perceptible improvement in the cutaneous manifestations, sometimes to the point of disappearance, but only a slight change in the Wassermann reaction. It must be borne in mind, however, that the normal temperature of rabbits is some four or five degrees Fahrenheit higher than that of man, and while the temperature of the rabbits was in some cases raised as high as 109° F., the highest point reached in human beings was several degrees lower.

These experiments suggest the possibility that the rise in temperature produced by hot bathing may have either a direct devitalizing action on the micro-organisms responsible for some forms of infection, or else may have an effect in raising the body resistance. Colebrook, Eidinow, and Hill,⁶ in an inquiry into the effect of radiant and other heat on the bactericidal power of the blood, came to the conclusion that heat and other "insults" to the skin provoke or increase the defensive power of the body (a) by a direct effect in improving immunity, and (b) by stimulating the immunizing mechanism through the absorption of the products of tissue damage. Schamberg and Tseng also found, consequent on the hot baths given to syphilitic subjects, (a) a transient leucocytosis, followed by a brief reduction in the white cells; (b) a slight rise in systolic blood pressure and frequently a great drop in the diastolic pressure, both of temporary duration; (c) a fall in the blood cholesterol averaging 10 per cent.; (d) a rise in the blood sugar averaging 10 per cent.; and (e) no material influence upon the urea, nitrogen, blood uric acid, or proteolytic or lipolytic enzymes. Both hot and cold stimuli of a gentle nature are said to assist the circulation by stimulating the unstriated muscle fibres of the blood vessels, causing an alternate contraction and relaxation, the so-called peripheral heart of Onimus.

It is also claimed that bathing has an important effect on the "perspiratio insensibilis," which may include fluid not only from the sweat glands, but also water from the body tissues and the blood stream itself, whereby waste products, probably mainly acid, which the lungs are unable to deal with, are eliminated in the form of gases or vapours. Baruch showed, in a number of experiments on both healthy and diseased persons, that the number of red blood cells and leucocytes was almost constantly increased after hot bathing, and that there was a less marked increase of haemoglobin. A considerable increase of the relative quantity of acid phosphate in the blood, sometimes to as great an extent as 100 per cent., has also been demonstrated. The action of vapour baths, which, however, are given at a higher temperature—100° to 115° F.—resembles that of hot immersion baths as regards the production of pyrexia; but with hot-air baths, there being no hindrance to evaporation from the skin, there is little or no rise of body heat, whilst the amount of perspiration is even greater.

The effect of douches varies with the temperature at which they are given and the pressure employed. At extremes of temperature they are powerful stimulants, both locally, to the circulation at the spot where applied, and generally, by their reflex action on the nervous system. Subthermal douches at a low pressure are, on the other hand, pronounced sedatives.

The action of cold baths need not be exhaustively considered, since their chief therapeutic indications are in acute diseases rather than in the chronic maladies dealt

with at spas. They cause an enormous increase of heat production, a slowing and strengthening of the circulation, and rise of blood pressure, and are, or should be, followed by a reaction in which the skin flushes and the mental and bodily vigour is increased. Cold, either as a brief immersion bath or as a douche, has therefore a valuable stimulant effect where this power of reaction is present, but must be used with caution in the debilitated and at the extremes of life, where this power is apt to be lacking. Of great importance, however, is the improvement which can be wrought by these means in the power of reaction of the skin. The Russian is said to go straight from his vapour bath to roll in the snow, and though it is not usual in this country to aim at a contrast quite so violent as this, there is no doubt that the nutrition and readiness of response of this organ, so essential in a changeable climate, can be vastly bettered by suitably adjusted hydrotherapeutic measures.

Pharmacological Effects.

When we come to discuss the pharmacological effects of natural mineral waters we find ourselves on even more debatable ground. Though he does not appear to be referring exclusively to waters of this kind, Hippocrates, over two thousand years ago, said that "as waters differ in their taste and weight so do they differ in their action upon the body."

Spa waters may be divided into the following groups: (1) the indifferent thermal, (2) alkaline, (3) acidulated, (4) calcareous, (5) sulphur, (6) muriated, (7) sulphated, (8) chalybeate, and (9) arsenical. Whilst many of these waters may produce the pharmacological effects to be expected from their chemical constituents it is not proposed to spend time on these, but to consider whether there may be, in addition, any specific factor or factors common, perhaps, to all, for it cannot be denied that waters differing widely in their characters often appear to be beneficial in the same classes of disorders.

The, at first sight, astounding theory has been advanced by some geologists that many thermal waters, and perhaps other natural mineral waters, are not derived, like the water of ordinary springs, by percolation from the earth's surface, but are formed primitively in the bowels of the earth by the union of nascent hydrogen and oxygen liberated in the breaking up by heat of granite rocks. Be this as it may, it appears to be established beyond question that it is impossible to reproduce by artificial means the conditions which are found in a natural mineral water, and there are various properties to which the therapeutic value of spa waters has been attributed, such as radio-activity, the presence of elements in the form of free ions, the colloidal condition of the substances present, and the presence of rare metals in minute quantity; whilst some hold that it is not so much in the variety of the elements and in their respective quantities, as in the relative proportions of those elements, that the property of a mineral water resides.

Although the water of ordinary springs, and even tap water, may contain traces of radio-activity, the amount is usually very much greater in the waters of spas, and some hold that this is an important therapeutic factor, especially since benefit has been claimed in diseases such as are usually alleviated at spas by the administration of artificially prepared radio-active water, which, too, has been shown to produce diuresis and increase the excretion of uric acid, carbon dioxide, etc., and to lower the blood pressure.

If radio-activity is indeed a factor of importance it affords a reasonable explanation of the time-honoured dictum that a spa water must be drunk at its source and not taken away in a bottle, for radium emanation is rapidly disintegrated, its period of decay, according to Ramsay, being four days. It must not be forgotten, however, that the quantity of radium or its products varies enormously in the different mineral waters, and that spas having little, claim—probably with justice—as good results for the same class of disorders as those having much, and it has recently been suggested that the secret may lie in the ionized or in the colloidal state of substances contained

in the water, or in the interrelationship between radioactive substance, ions, and colloids.

Noteworthy in this connexion are some experiments by Sarmiento and Kopaczewski⁷ with the water of Vidago, an alkaline water somewhat similar to that of Vichy, which, however, on standing becomes first opalescent, then yellowish, and finally clear again as the suspended particles settle. These investigators injected thirty-six guinea-pigs each with 0.4 c.cm. of 5 per cent. rabbit serum. Six were kept as controls; of the remainder, fifteen were injected daily with 3 c.cm. of fresh Vidago water, and fifteen with water which had been kept four or more days. At the end of twenty days all the guinea-pigs received an injection of 0.2 c.cm. of horse serum. The six controls died of anaphylactic shock. The animals injected with "dead" water showed distress, some becoming comatose, but all recovered within a few minutes. Those injected with fresh water showed no symptoms whatever.

Ferreylles⁸ has shown that guinea-pigs and rabbits injected intraperitoneally or intravenously with Choussy Perriere water exhibited an increase of leucocytes in the blood to, roughly, double their previous number. A similar injection fifteen days later produced no leucocytosis, while a dose of typhoid toxin, lethal for animals of similar size, produced no effect.

Billard⁹ injected three guinea-pigs with a dose of tetanus toxin—lethal in ninety-two hours—two days, seven days, and ten days respectively after injecting them with Choussy Perriere water. The first showed local tetanus of the abdominal wall but eventually recovered, the two others showed no symptoms. Billard has further demonstrated that certain neurotoxins—such as sparteine, snake venom, diphtheria toxin, and tetanus toxin—when mixed with various mineral waters may be inactivated so that doses ordinarily lethal produce no effect, different mineral waters inactivating different toxins.

Results such as these, of which only a few examples have been quoted of numerous similar experiments carried out on the Continent, suggest that there is still much to be learned if full use is to be made of these natural agencies.

Sneider, Bricaud, and Grigaut, in an examination of the blood of gouty patients undergoing treatment at Contrexéville, found that uric acid, excessive at the start, instead of diminishing, actually increased during the course of treatment, but was found to be much less a month or two later, the explanation suggested being that excess of uric acid in the tissues was being "washed out" into the blood, and only gradually eliminated by the kidneys. These findings have been confirmed at Buxton, the average increase of blood uric acid at the end of a three weeks' course being 1.9 per cent., while at the end of a further three weeks a reduction equal to 25.5 per cent. had taken place.

Another property of spa waters which has of recent years been the subject of investigation is their power of activating ferments. It has been shown, for instance, that trypsin added to various of the French natural mineral waters has from two to five times the digestive power of an equal amount in distilled or tap water, and no description of a French mineral water is now considered complete without mention of its "zymosthenic index." Examination of spa water by modern methods, and especially by the use of the quartz spectrograph, has in many cases revealed the presence of a much greater number of metals than older analyses showed, and when we learn that so infinitesimal a quantity of manganese as 1 part in 40,000,000 parts of water will determine the fruiting or not of certain plants, and that broad beans will perish unless they get boron, though so little as 1 part in 12,500,000 is sufficient, we may well hesitate to conclude that traces of rare metals such as caesium or rubidium are altogether without therapeutic effect.

J. B. Burt claims that there are three phenomena characteristic of the action of natural thermal baths which are not found after the use of simple baths: (1) that diseases are alleviated, the action on true gout being so decided that it might almost be called specific; (2) the occurrence of thermal crises, usually in the second week of treatment, characterized by increase of pains, lassitude, and mental depression; and (3) the supervision after treatment by too many baths or baths of too long duration of the condition known as thermal debility. None of these, he states, follow the use of baths of ordinary water. In a patient with a biliary fistula, Mayo Robson found that an aerated alkaline water increased the flow of bile more than any of the reputed cholagogues; other experimenters, however, have failed to confirm this.

Conclusions arrived at as the result of investigations into the effect of spa waters on the output of urine are somewhat at variance. Race¹⁰ found that Buxton water given to gouty subjects has a definite and specific diuretic effect over and above that of distilled water; that it increases the elimination of sodium chloride; and that it decreases

the hydrogen-ion concentration and favourably influences nitrogen metabolism by increasing the percentage excreted as urea and reducing the percentage excreted as uric acid and undetermined nitrogen.

It is important, of course, to remember, both as regards diuresis and diaphoresis in the maladies treated at spas, that it is not as a rule simply the elimination of water that is aimed at, but the removal by these means of deleterious substances or the products of increased tissue change.

Peskett and Raiment,¹¹ in a careful and laborious investigation, found that in healthy subjects Bath mineral water had no effect, as compared with tap water, in increasing either the volume of urine or the amount of total nitrogen, urea, or uric acid contained in it, but that there was some increased excretion of acid radicles and of phosphates. The value of their experiments, however, is very largely, if not entirely, discounted by the fact that the mineral water was given with meals, and not, as has always been the spa custom, on an empty stomach. Although its mineralization is so low as to bring it into the class of "indifferent" waters, the total solids only amounting to about 230 parts per 100,000, the Bath water when fresh presents under the ultramicroscope a perfect colloidal picture, and if the most recent views with regard to the importance of the degree of colloidal dispersion are correct, and when it is realized how readily the colloidal condition is destroyed by, for instance, an acid, it may well be that the time-honoured practice of insisting on these waters being taken before meals may be of paramount importance, and no experiments can be regarded as in any way conclusive unless carried out under these conditions.

General Factors in Spa Treatment.

Finally, there remains to be considered the influence of the various subsidiary factors which come under the heading of general hygienic and psychical. Every practitioner is alive to the profound effect which may be produced by transference from a bleak, dry, wind-swept area to a soft sheltered one, or, conversely, from a still, enervating climate to one fresh and bracing. Other differences of environment are of almost equal importance. Of still greater value is the enforced rest from the strain and anxieties of business, the worries of domestic details, or the enervating effects of dissipation. Change of diet, too, plays a part in assisting the change in metabolism which spa treatment is directed to bring about, while the drinking of large quantities of water, besides the physiological effects which have been mentioned, may mean the drinking of less whisky or less tea—no mean advantage in some instances. Then comes the question as to what part suggestion plays. The very use of the word "cure" for a course of treatment—considered by some a master stroke on the part of whoever originated it—at the outset tends to put a patient in the right frame of mind for responding to the influences that are brought to bear on him, and the effect is doubtless enhanced by the optimism of bath attendants, masseurs, etc., and by mingling with others who are receiving or have received benefit. Another factor of importance is the special experience that masseurs and masseuses obtain in regard to the particular class of patient that frequents the spa. Further, physicians at spas amass an experience of certain diseases much greater than falls to the lot of the general practitioner, and naturally tend to take a keener interest in them, especially since, being as a rule diseases of a chronic nature and not endangering life, they are likely to appeal less strongly to the family doctor than more dramatic happenings.

The foregoing observations, imperfect though they be, may incline you to believe that the potentialities of balneology are not inconsiderable. It will be evident, however, that treatment to be effective must be varied to meet different conditions and to suit different constitutions, and that any attempt to stereotype methods in the many diverse departures from health amenable to spa treatment is foredoomed to failure.

If there be, as many think, some specific influence in these natural waters, it must ever be remembered that it is not to be supposed that diseases will be cured by any direct action of such a remedy, but rather that it will,

like any other remedy, act as a stimulus to those defensive powers in the human body which need to be called into play, and that different individuals cannot all be expected to respond to the same stimulus to the same extent or even in the same manner. Analogies with the treatment of syphilis are suggestive in this connexion; it is well recognized that over-treatment of this malady may be as bad as, or perhaps worse than, no treatment at all, and that the problem in the cure of syphilis is not to get as much of the specific remedy into the body as possible, but that amount which is capable of producing the optimum response by the tissue defences in the individual concerned. Such a view of the mode of the specific action, if any, of a mineral water would go far to explain certain difficulties and anomalies which are sometimes encountered.

There is no doubt that there is a vast field for experimental research into the many problems connected with spa treatment, of which only the borders have as yet been explored. Further, there is need for more publication of the results of treatment of series of cases. It is to be regretted that physicians at spas so seldom put on record their experiences. For this there are probably three reasons: first, a natural, but perhaps undue, apprehension that such a proceeding lays the writer open to the charge of advertisement; secondly, the difficulty of following up the after-histories of patients who are only under direct observation for a short time; and, thirdly, the fact that many of the cases met with are of a very chronic character, and that so much damage has been already done that several courses of treatment may be necessary before the complaint is brought to a standstill, and even then full functional restoration may be impossible. I think it was Sydenham who said, "Chronic diseases require chronic treatment," and this is as true of spa therapy as of any other—a point perhaps not sufficiently recognized and insisted upon.

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FRACTURES OF THE LOWER END OF THE RADIUS IN ADULTS (COLLES'S FRACTURE AND BACKFIRE FRACTURE).

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THE following account is based on an analysis of 424 cases of fracture of the lower end of the radius treated in the fracture clinic of King's College Hospital during the three years 1924-26. Of these fractures 251 occurred in women and 173 in men and youths. Of the latter number, no fewer than 84 were caused by backfire injury from cranking a car. The remainder, and all those occurring in women, with one exception—a backfire fracture—were of the Colles type. Cases of separation of the lower epiphysis of the radius, except those occurring from backfire injury, have not been included within the scope of this article.

THE COLLES TYPE OF FRACTURE.

In all there were 339 cases which might be regarded as of the Colles type, and sustained by falling on the outstretched hand; 250 were in women, and 89 in men. Radiograms, both antero-posterior and lateral, were available for examination in 275 of these cases.

(a) The Radial Fracture.

In the majority of cases the fracture was transverse, and at the upper limit of the radial surface which enters into the formation of the inferior radio-ulnar joint (Fig. 1). In a few cases the fracture was at a higher level (Fig. 2), and in others a shade lower (Fig. 3). In one case the line

of fracture ran obliquely downwards from a point fully $1\frac{1}{2}$ inches above the radial styloid process (Fig 4). In cases where severe comminution was present the radiating line of fracture ran vertically up the shaft, and in some cases down to the joint surface. In a number of cases there was a single vertical split passing from the transverse fracture to the joint surface. Radial rotation of the lower fragment was present in all cases, but varied very much in degree in different fractures.

Lateral views showed a varied picture. In some there was no sign of fracture in the lateral plane. In a fair proportion of the cases the posterior lip of the radial articular surface was broken off. In a few cases there

was little or no appreciable displacement, but in the vast majority there was backward tilt of the lower fragment, so that the articular surface of the radius faced downwards and backwards. This was usually, but not invariably, associated with bodily backward displacement of the lower fragment. In cases where the posterior lip of the radial articular surface was fractured the backward tilt was very marked. In a few cases the carpus was carried bodily backwards with the fractured posterior lip, so that the condition was actually a fracture-subluxation. It is important to remember that this is likely to be present when the deformity is gross, so that steps may be taken to ensure complete reduction. The articular surface appeared to be involved, usually in the manner described above, in 95 of the cases. It is not always possible to be certain of this point from the radiograms, but the figure indicates that the wrist-joint is involved in a high percentage of the cases.

It is doubtful how often the inferior radio-ulnar joint was involved, it being extremely difficult to determine this point. In some cases the joint was very obviously involved, but in the majority the fracture appeared to be just above the upper limit of that joint. It is a common experience to find pronation and supination the last movements to return fully after fracture, and although no correlation between delay in obtaining these movements and fracture into this joint has been found possible in this series, it appears very probable that joint involvement is the cause of the delay in most instances.

(b) The Ulnar Fracture.

In 158 of the 339 cases the ulna was fractured. In all but 8 of these the fracture was of the styloid process. In one case it was through the shaft fully three-quarters of an inch from the lower end. Fracture of the styloid process occurred in all situations, from the base to the tip. In one case two fragments were broken off.

Whether the ulnar styloid does or does not fracture depends to a great extent upon the amount of radial abduction into which the hand is forced at the time of impact. It would also appear to depend upon the anatomy of the styloid process itself. This varies very considerably. In some cases it is long and narrow, with a curve to the radial