

Section of Balneology and Climatology.

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The Scientific Basis of the Practice of Medical Hydrology.

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THE task which I have set myself is to ascertain whether medical hydrology has been based upon a secure foundation of accurate observation and scientific research, and may claim therefore to be looked upon, not as pure empiricism, but as a sound branch of medical science. I shall, incidentally, indicate how far this Section has contributed towards the fulfilment of the second of the three objects of its founders, that is the encouragement of investigation and study. I hope to show that medical hydrology occupies an honourable position, which cannot be superseded by any other forms of treatment; and that it might be applied in practice more extensively than hitherto in this country, provided that the subject was efficiently taught in the schools.

The history of medical hydrology goes back to Hippocrates, 450 B.C.; up to that time baths and waters, as used by the Egyptians, Indians, Persians and Greeks, were controlled by priests, who erected temples near the springs and used them for a religious ceremonial rather than for therapy. Though cures undoubtedly took place, there are few, if any, records of scientific value, of the effects of water on diseases.

Immersion in water was probably an earlier custom than drinking it. The first reliable observations of the effect of water upon the body were made by Hippocrates. He observed clinically and maintained—

(1) That cold water warms, (2) whilst warm water cools the body; (3) that warm shower baths induce sleep, (4) and that cold water stimulates; (5) he recommended cold water to assuage fever and pain.

Baths were used extensively by the Greeks, and physicians, such as Asclepiades of Prusa and his pupils, introduced the Hippocratic teaching to the Romans. This bore fruit in the development of bathing establishments in the Roman Empire.¹

The luxurious fresh-water bathing establishments fell into decay, but the use of waters and baths at the various thermal stations, especially in the Roman colonies, survived. Thus, in our own country Bath (aqua solis) and Buxton, and abroad Aix, Vichy, Baden-baden, Wiesbaden, Aachen, Acqui, Bormio, Bajoe, Baden-bei-Zurich, Hamman Rihra and many others were all thermal stations from early Roman times.

During the Middle Ages thermal baths and waters were used intermittently, but cold water treatment, advocated by the older physicians, such as Asclepiades, Celsus, Musa, Paulus Aegineta, in the seventh century, and Van der Heyden, as late as the twelfth century, gradually ceased, and was not revived until Floyer's

¹ "Bäder und Bade-anstalten," Schleyer, 1909.

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time. Mediæval fresh-water baths, once so popular, fell into the hands of quacks, and actual opposition to their use arose.

Two points about the ancient history of baths, before scientific investigation began, bear special relation to my subject.

The first is that, from the time of Hippocrates onwards, *clinical observations* were being made to guide the method of the physicians who practised at these thermal stations, many of which have been recorded. Empirical observations gradually accumulated, providing data subsequently to be submitted to scientific investigation.

Ignorance of the true nature of disease confused all clear observations, and science, as we know it to-day, had no existence; it was therefore impossible for spa physicians to make the accurate and complete observations which are possible to-day. Still, their observations were valuable. As Tanchou wrote, "La théorie est boiteuse et ne doit venir qu'après les faits." It is necessary to collect accurate data before theorizing.

The second point of interest is that the methods of applying water treatment available even up to comparatively modern times, were *very simple*. They consisted of: (1) Immersion baths, hot, temperate and cold. (There were no means of measuring temperature.) (2) Affusions or shower baths. (3) Steam, vapour and hot-air baths. (4) Fango or mud baths. (5) Shampooing or massage. (6) Water drinking.

Observations were based on these simple means of hydrological treatment, coupled, of course, with suitable diet, etc.

Use of the *douche* dates back possibly to A.D. 1000, but it was said to have been introduced by Pietro Tusignano of Bormio in Italy about 1336, and again in 1480, by Savonarola, the grandfather of the famous Florentine, and later, in 1731, by Le Drau into France.

Wet packs, another form of applying cold water, were introduced by Lucas, not earlier than 1750. The drip sheet was introduced about 1820.

The application of *spinal ice bags* was adopted by Chapman in 1863, his method being founded upon the known physiological fact of the action of the sympathetic nerves in controlling the blood-supply in the blood-vessels.

Further developments, such as the Scotch *douche*, Aix and Vichy *douche*, massage baths, Buxton trough modification, undercurrent *douche*, whirlpool baths, half baths, sitz baths, Plombières *douche*, vaginal *douche*, nasal and ophthalmic irrigation and sprays, peat baths, liver packs, different forms of radiant heat and light baths, and other forms of treatment by electrical currents, all these have been introduced within modern times. They have undoubtedly very considerably increased the usefulness of hydrological treatments, have broadened the field of observation and have emphasized the need for further scientific investigation.

It was not until the end of the seventeenth century that there was any attempt at really scientific observations on the physiological effects of baths and waters, either fresh or mineralized, though the empirics had for centuries made reliable observations and collected data. The effect of waters was so remarkable in some instances as to be attributed to supernatural agency. Scientific investigation was essential, if their use was to be based on accurate knowledge of cause and effect.

The first move in the direction of scientific investigation was made in reference not so much to the action of baths and waters, as to the real nature of disease and especially of fevers and acute pyrexial states. When Virchow showed that elevation of temperature was a pathognomonic symptom of fever, and thermometric measurements carried out, especially at Leipzig, with increasing exactitude in the most varied forms of febrile disease supported this view, a definite step forward had been taken. Later, the best means for reducing the temperature were sought for. Antipyretics

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without the danger of intoxication, was the ideal in view, and after the trial of various drugs, etc., means of obtaining it were found in cold water treatment, with which, as Winternitz remarks, "no other can be compared for its capability of being regulated." This was illustrated by Bartel, in Kiel, and by Jürgensen and others.

It has been said that the first physiological explanations of the effects of water were made by a Frenchman, M. Tanchou, in 1824. We may fairly claim that the first attempt to make exact observations on the use of water treatment was carried out in this country 140 years before that, and that the honour of being the pioneer belongs to Sir John Floyer of Lichfield. He was born in 1649 and died in 1714. He was a graduate of Oxford. It appears from his book, "*Psucrolousia, or the History of Cold Bathing*," published in 1702, that not only did he build a bath house for his experiments, but he used a thermometer to test the temperature of the cold water used, this being, so far as I know, the first recorded use of a thermometer for medical purposes. This is the more remarkable because the air thermometer was invented by Galileo as late as 1612, and it was not until 1701 that Sir Isaac Newton suggested the use of the freezing point of water as zero, and it was not until 1714 that Fahrenheit used a graduated thermometer, the lower point zero and the upper point the temperature of the body; this was changed later to boiling point of water when mercury was substituted for spirit on account of its more equable expansion.

Floyer timed his experiments by means of the minute-glass. He also made experiments with mixtures of salts in water to ascertain if he could produce coldness greater than the "conduit water." He says, "I tried the weight of the several waters by another glass bubble sunk in quicksilver in the part of it"—in other words, he used a hydrometer—"and found the heavier waters cooler than the lighter." He says:—

"I have not been wanting this summer to make some experiments upon such diseased Persons as would be persuaded to use these Baths, but more hereafter will be made when I have prevailed over the prejudices of the common People, who usually despise all cheap and common remedies, which have ordinarily the greatest Effects."

Floyer was no "pulp-pated pill monger,"—to use a quaint phrase which his friend and collaborator, Dr. Bayard applied to a certain apothecary who scorned cold water treatment—but a man who, had he lived in our day, would certainly have been in the forefront of investigators.

Floyer's experiments mark the beginning of research into the action of cold water in the treatment of disease. It was necessary: (1) To prepare a patient for bathing by proper diet, bleeding and purging. (2) Not to bathe when hot or sweating, or to stay in the bath too long. (3) To use cold baths before dining, as they were dangerous after drinking or eating. (4) To repeat the bath in order to get results. (5) To use sweating with cold bathing in certain diseases.

He also held sweating to be unnecessary with cold bathing used to preserve health or invigorate the spirits.

He describes the physiological effects of water applied generally, locally and internally. He notices the effect of cold baths on the heart—

"it strengthens its fibres and invigorates its motion. For though during immersion the pulse stops and the motion of the heart is slower, yet after that for some time that muscle works faster and evacuates by sweat and urine and the menses and the whole body is sensibly hotter."

This was long before Schedel taught the recovery of compensation in failure of the heart by means of cold water affusion. Floyer's book made a lasting impression upon the German hydrotherapist, Professor Fk. Hoffmann.

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In 1724, Smith made observations on water as a dietetic, dissolving and diuretic agent.

In 1799, Dr. Wm. Wright, of Barbadoes, demonstrated the power of cold water to reduce the temperature and expedite the recovery in yellow fever and small-pox.

In 1797-1804, James Currie, following Wright's suggestion and method, proved that the affusion of cold water had a powerful effect in reducing the temperature in typhus fever and in arresting the disease if given at the proper time, which he found to be during the first four days, at the hour when the fever, as measured by the thermometer, was beginning to decline.

So much for records of experiments and observations on hydrotherapy up to the end of the eighteenth century. What records are there of the use of thermal waters (Balneology) for the same period?

Floyer was familiar with the Buxton water, but does not seem to have experimented with it.

Apparently the earliest attempt at accurate observations on the analysis and uses of English mineral waters is that of Dr. Thomas Garnett, who wrote essays on the Harrogate waters in 1791. He was not only an observant physician, but had evidently studied chemistry and even lectured on the subject. His chief authority on chemistry was Boerhaave, of Leyden (1668-1738), whom he frequently quotes.

He made careful analysis of the three waters which were known in his day, viz., the Tewit iron water, discovered in 1570, the sulphur discovered a little later and the Crescent saline discovered in 1783.

In 1792, he wrote: "no accurate analysis of these waters has as yet appeared."

He also made many valuable observations which hold good to the present day. The temperature of the baths was always to be measured by the thermometer and the duration carefully timed. Diet, regimen and exercise were carefully laid down.

I am not acquainted with any early records in the case of Bath and Buxton. The easiest way of following the almost continuous investigations made for the last 100 years, is to take first those on fresh water—which were apparently the first to be made, and are certainly the easier to trace—and afterwards the balneological ones.

Winternitz, of Vienna, stated that when he began his investigations in 1856, a physiological study of the actions of cold water had never been undertaken. This is not strictly true; for in 1824, Dr. Tanchou, of Paris, published a little book entitled "Du froid et ses application dans les maladies," in which he discusses heat and cold, quoting Black and Currie, and gives an excellent description of the reaction to cold.

The first effect he held to be the driving back of the blood and liquids; the second effect the reaction or return to force very graphically described, noting that "La reaction est égal et opposée à l'action."

His practice was to diminish the temperature of the bath at the same time shortening its duration. He made his patients walk after the bath until reaction came into play and then lie down. He applied water generally where inflammation was internal; locally where it was external. Among several cases he records that of a lady suffering from extreme irritability of the nervous system, cured by a series of baths, the temperature of which he gradually reduced from 30° to 15° R.

He records no special investigations beyond those made in treating his patients.

In 1844 Herpin of Geneva published in the *Gazette médicale de Paris* a series of very careful observations on the effects of the baths of the river Arne below Geneva, noting the temperature and depth of the water and the temperature of the air. He describes the *physiological* effects of first entering the water, viz., dyspnoea, præcordial pain, muscular pains, radial pulse feeble, heart beat strong, no acceleration, local lowering of surface temperature of hand 34.4° C. to 21.9° C., the reactions of skin, change of colour; vigorous muscular contraction after immersion.

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Remote effects—sweating less easily provoked, improvement of appetite, increase of muscular force, sleep becomes sound and deep, bowel action regular, diarrhoea resulting only occasionally. As contra-indications he observed: acute illness, heart disease, plethora and high blood-pressure, epilepsy. The best therapeutic effects are seen in uterine affections, irregularity, dysmenorrhœa, chlorosis, spermatorrhœa, rickets and scrofula, digestive troubles, hypochondria, general nervous debility, chronic rheumatism, and in skin conditions such as prurigo, lichen, psoriasis.

About the same time, 1843, Lubanski at the Hydrological Establishment at Pont-à-Mousson was experimenting on wet packings and the influence of cold water drinking on diuresis.

The intimate connexion between hydriatics and heat regulation was recognized first in France and later in Germany, where investigations of normal reactions to internal and external applications of water gave valuable results. For instance, Falck studied the internal use of water, water clysters, and absorption by the skin; Petri, the sweating method of Priesnitz; Preiss, the occipital douche in nervous asthenia; Böcker of Bonn, tissue metabolism under the influence of water; Genth, of Wiesbaden, the excretion of urea, etc., by water drinking. Cold-water treatment of cholera and bath treatment of the insane were also investigated.

In 1865 Senator proved conclusively that in the cold bath the amount of heat given off exceeds the amount produced.

In 1856 Winternitz began, with the help of Professor Oppolzer, his memorable physiological and therapeutic experiments, at Kaltenleutgeben and the Allgemeine Universität Klinik in Vienna. He made full investigations of the effect of cold and of thermal stimuli upon (1) the nervous system, (2) the heart and vascular system, (3) the skin and excretory organs, (4) the temperature of the body, (5) the metabolism of the tissues.

The reactions were tested in the normal subject and in many pathological states. He used Marey's sphygmograph to examine the bearing of the vessels during the application of snow and ice to different parts of the body, especially the behaviour of the radial pulse in the elbow bath, which caused contraction of the artery, and a fall in the temperature of the hand. He thus ascertained the varied behaviour of parts centrally situated; and the application of ice or freezing mixtures between the centre and the diseased periphery became of pronounced value in treating hæmorrhages, aneurysms and local inflammations. Similarly in 1859 he examined the revulsitory action of thermal cutaneous irritation.

By the study of the action of local applications upon the respiratory centres he made precise the application of the *douche fili-forme* of Matthieu, the shower bath, hand bath, etc.

He invented the local box vapour bath; he pointed out that the influence which cold water procedures as stimuli to the nervous system was much more important than the merely physical action of the deprivation of heat; he also thoroughly investigated the effect of methodical cold-water drinking. His researches, extending over fifty years, were the most complete hitherto undertaken, and have guided his successors ever since.

The researches of Winternitz made Vienna the centre for the study of hydriatics, while Kiel was the centre for that of cold-water treatment of enteric fever, and Leipzig for that of pathological thermometry.

One of the founders and past-presidents of the Balneological Society, Samuel Hyde, has summarized the effects of cold and thermal stimuli.¹

A striking example of further investigation of cold-water application during the nineteenth century was in the effects of cooling baths in fevers.

¹ *Balneological Journal*, 1905.

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Giannini, in 1805, had laid down three rules: (1) Very brief immersion in asthenic states; (2) no such baths during general arterial spasm; (3) in sensitive patients, warmth to be applied to the cardiac region during the bath.

Brandt, of Stettin, investigated the use in fever of cooling baths at temperatures below that of the skin, sub-thermal, but never below 65° F., always with friction to the skin, and of not more than fifteen minutes' duration. Currie obtained his remarkable results, as a rule, by cold affusion, not by baths.

The first step in balneological investigation during the nineteenth century was accurate analysis of the various mineral waters. Nothing really reliable or complete was effected until Berzelius of Stockholm (1779-1848), and his assistant Strude about 1820, analysed many of the best known mineral waters. Since then most waters have been carefully analysed and during the present century much further knowledge has been gained concerning their physical and chemical composition and geological origin. Their ionic state and the laws of osmosis have been investigated. The discovery of radium or its emanation in mineral waters has shed much light upon their physiological and therapeutic properties.

In 1893, Liddell experimented in Harrogate on the effects of sulphur water on the excretion of urea and uric acid. Later, Bain investigated the effects of the waters on the secretion and excretion of bile, their solvent action on bicarbonate of soda and their effect on metabolism, and Bain, Edgecombe and Frankling, their effect on blood-pressure and metabolism. David Brown has made thorough investigations of the pharmacological action of sulphur water in normal persons and in gout.¹ Michael Foster has investigated the output of uric acid for several years and concludes that the *crise des baignes* is a reality.

In Buxton, Buckley and Race noted the marked diuretic effect of St. Anne's well as compared with plain water. They have also made an extensive examination of the effect of waters on metabolism.

The power of increasing immunity by the subcutaneous injection of certain mineral waters has been demonstrated, and their anti-anaphylactic effect has been brought to our notice by Billard. There are several spas in which experimental work is still waiting to be done.

Perhaps the most outstanding investigations made in the balneological branch of medical hydrology during the last thirty years are those as to (1) the effect of Nauheim baths upon the heart and the circulation, (2) the effect of various forms of baths upon the blood-pressure, and (3) the influence of intestinal lavage upon various conditions of the bowel causing toxic effects.

The present efficiency of the instruments for measuring blood-pressure, the electro-cardiograph, the polygraph and radiography, have greatly contributed to the value of these investigations.

This Section has not been behindhand in diffusing the most recently acquired knowledge.²

¹ *Proc. Roy. Soc. Med.*, 1911, iv (Sect. Baln.), 45-62.

² 1898. "Discussion on Nauheim Baths in Cardiac Disease."
 Bain's paper on the "Effects of Mineral Waters on Bile and Bile Salts."
 1899. "The Therapeutics of Heat," by W. S. Hedley.
 1903. "Studies in Blood-Pressure Effects," by G. Oliver.
 1905. "Fango Baths," by Cecil Sharpe.
 1908. "Blood-Pressure in Spa Practice," by W. Edgecombe.
 1909. "Intestinal Lavage," by C. W. Buckley.
 1910. "Some Pharmacological Effects of Strong Sulphur Water," by D. Brown.
 1911. "Radium Emanation in Mineral Waters," by T. Pagan Lowe.
 Then through the War comes a lull.
 1919. "Temperature, Environment and Thermal Debility," by C. F. Sonntag.

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Much is still to be done in the study of pure medical hydrology before the scientific foundation is well and truly laid, and its practice conducted on a sound basis.

Many questions still await an answer. Can we obtain all the effects produced by thermal or mineral water baths by the varied use of fresh-water baths? Can we get the same effects by drinking fresh plain water as are produced by the various thermal waters? If not, in what respects do they differ, and what are the limitations of each? I appeal for still further research into these and other hydrological problems.

As Sir Clifford Allbutt wrote in the preface to the "Archives of Medical Hydrology": "It is for Science to extract the living kernel of truth from the perishing fruit of experience."

NOTE.—The New Reception Hospital at Northampton possesses a most complete installation for hydrotherapeutic treatment, showing that this form of treatment is recognized as one of extreme value in mental diseases. I see clearly that another magnificent opportunity will be afforded on these lines for further research in this particular branch of medicine, the fruits of which will, I hope, some day be recorded in the transactions of this Section.