The balneo-gymnastic treatment of chronic diseases of the heart / by Theodor Schott. With a foreword by James M. Anders.

BALNEO-GYMNASTIC TREATMENT OF CHRONIC DISEASES OF THE HEART

PROF. DR. THEODOR SCHOTT
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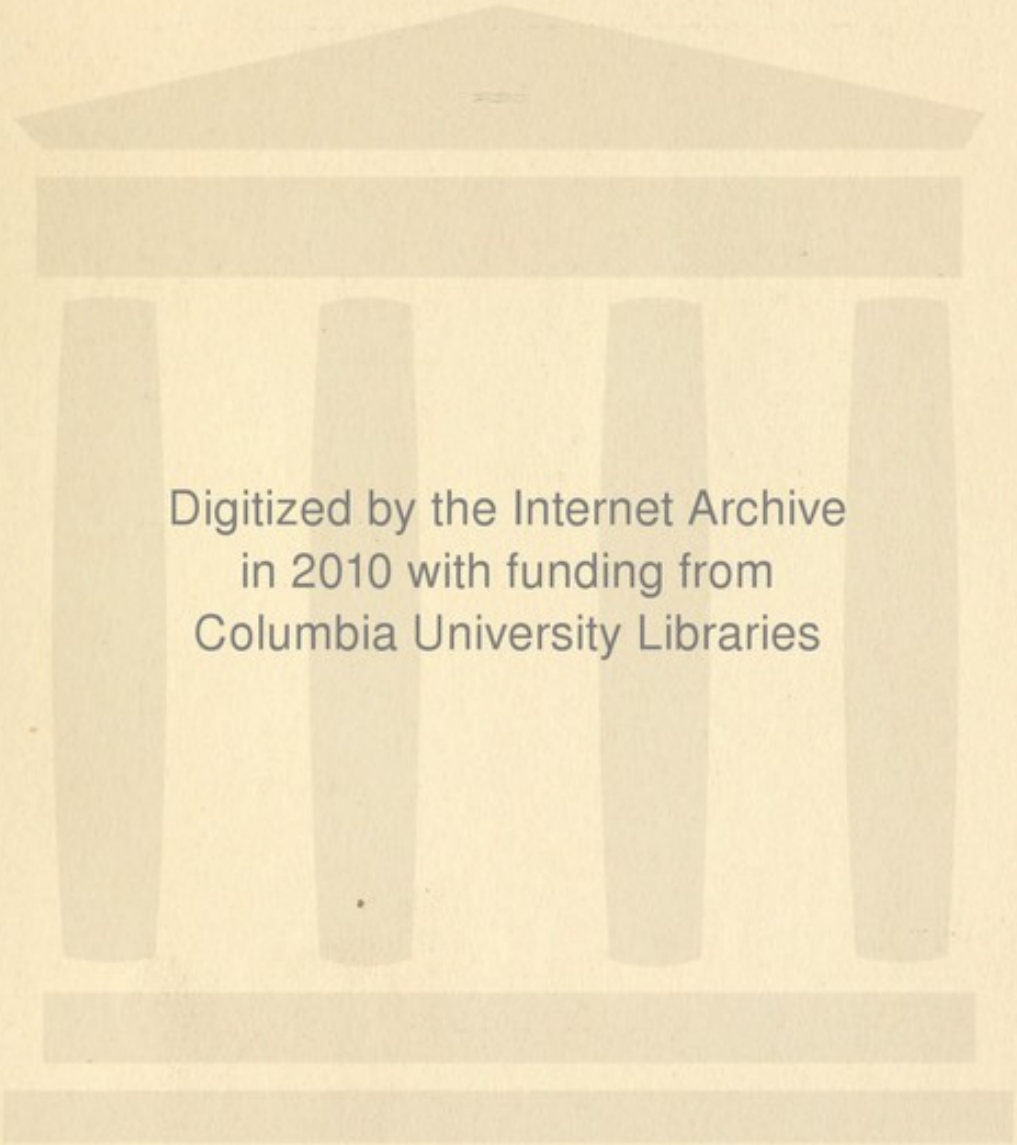

THE BALNEO-GYMNASTIC TREATMENT

OF

CHRONIC DISEASES OF THE HEART

SCHOTT

The Balneo-Gymnastic Treatment

OF

Chronic Diseases of the Heart

BY

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BAD-NAUHEIM, GERMANY

WITH A FOREWORD

BY

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WITH 87 ILLUSTRATIONS

INCLUDING 41 GYMNASTIC POSES

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FOREWORD

The author has brought to this brochure an exceptional degree of care and scholarship, as well as a ripe and most extensive experience covering a service of many years at Bad-Nauheim. The result has been a highly creditable volume on a subject of growing interest and importance to the medical profession. It is especially noteworthy that Professor Schott has set forth in a spirit of fairness and with equal emphasis the conditions and diseases in which the special method he represents is indicated as well as the contraindications to its application. The introductory chapters, especially those on "Prophylaxis" and "Medicinal Treatment," are timely and judiciously conservative, while at the same time they accord due recognition to the newer results in the discussion of the therapy of cardiac complaints.

Physical therapeutics has been a rapidly progressing branch of practical medicine during the past two decades. While the medical profession has been alive to other ideal interests, having for their aim the cure of human ills, the prolongation of life and the betterment of the race in general, it has not bestowed enough attention upon the methods of treatment which are being pursued at the leading health resorts, and this remark applies with especial force to the medical profession of Great Britain and America. In the realm of cardiac therapy, balneologic methods, including dietetics and mechanical measures, are free from certain disadvantages of the older modes of treatment, principally by the use of digitalis, rest and active saline catharsis. Clinicians who have had a large experience in its use agree with Dr. Schott's statement that the persistent administration of digitalis not infrequently produces toxic effects,

and, moreover, its withdrawal is wont to be followed by a recurrence of the distressing features which are manifested by many cardiac diseases.

Unquestionably, the so-called "resistance-movements," which are an essential part of the Schott method, give additional warrant for advocating the measures employed at Bad-Nauheim, since these movements throw into exercise certain groups of muscles, some of which are for the most part inactive under usual conditions, in orderly succession without inducing fatigue. The more complete yielding of suitable cardiac cases to the combined baths and "resistance-exercises" serves to emphasize the potency of the so-called "Nauheim treatment" in stimulating or favorably influencing metabolism, thus tending to retard the otherwise progressive myocardial degeneration.

It is confessedly difficult to carry out the numerous details connected with this balneo-gymnastic treatment, and it can be employed only with the fullest measure of success by a specialist of wide experience located at Bad-Nauheim. The patient also enjoys at that peaceful resort the advantages of being far removed from the cares and responsibilities growing out of the practical affairs of life at home. Professor Schott has, however, described in detail the imitation baths for sufferers who are not in a position to adopt the balneologic methods at the Spa and recommends that one should employ preferably the Nauheim bath salts for this purpose. The directions for instituting the home treatment by means of artificial baths are full and accurate, and will be much appreciated by the profession as a whole. The power of attention of physicians should be especially given to the chapter dealing with the gymnastic treatment in appropriate cases, since these "resistance-exercises," if properly carried out, may everywhere be utilized advantageously.

That the ordinary methods of hydrotherapy are capable of producing results equally satisfactory with those

obtained from the use of the balneologic methods described by Professor Schott may be seriously doubted. Recent investigations in which a comparison is made between the artificial baths and those administered at Bad-Nauheim, tend to confirm the opinion and practical observations of the author, that a difference in favor of the natural baths obtains.

The experimental observations of Professor Schott and his associates have demonstrated that the natural effervescent baths cause vascular dilatation and lowering of the blood-pressure. These researches also add emphasis to his tentative conclusions, as well as furnish an explanation of the functional stimulation of the heart and of the increase in the amplitude of the arterial pressure. The *modus operandi* of the Nauheim baths is still imperfectly understood, but Professor Schott, with excellent show of reason, contends that their virtues are neither exclusively dependent on the temperature nor on the carbon-dioxide present. Moreover, a combination of these two factors fails to explain to his own satisfaction, at least, all of the beneficial effects of which the baths are capable, since he assumes that the mineral constituents play a not unimportant rôle.

Experiments with the method of "resistance-exercises" gave the same result as with the natural effervescent baths, especially noticeable being their direct influence in strenthening the myocardium. These and the foregoing scientific observations relative to the effects of the baths have been amply confirmed by other competent laboratory experimentalists, more particularly the plethysmographic investigations of Strasburger, Meyer and Hirschfeld, so that they afford us a well-established point of view.

The writer has personally observed, during brief sojourns at the Nauheim Springs, striking improvement in the condition of patients suffering from hypertension, due principally to vaso-constriction, and also in cases of dilatation of the heart caused by sudden overstrain. On the other hand,

it is as yet undetermined whether or not the Schott method is capable of arresting or even retarding the further development of sclerotic changes, which are so commonly found to exist in the cardio-vascular system.

In that large group of cases caused principally by an over-strenuous life and characterized clinically by digestive disturbances, neurasthenia and a moderate degree of cardiac dilatation, the balneologic treatment combined with resistance-gymnastics exerts a most salutary influence. It is in chronic valvular diseases, particularly of the mitral segments, that the Schott treatment, has, however, gained pre-eminent favor with the medical profession, in many quarters at least.

It is to be clearly understood that, while the method of treatment under consideration commonly embraces both the Nauheim baths and the resistance-movements, there is a considerable group of cardio-vascular conditions in which either one or the other factor alone is indicated.

In concluding, the writer feels that a careful perusal of Professor Schott's work will subserve a most useful purpose by familiarizing the medical profession of different countries with the true merits of one of the most noted health stations known to the civilized world. It is earnestly hoped that among the lessons conveyed to the reader will be a true appreciation, not only of the *indications* presented by individual cases for the mode of treatment in question, but also of the *contraindications*, so as to deter the annual exodus of "incurables" and improper cases from making the hazardous experiment of an ill-advised expatriation.

JAMES M. ANDERS.

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PREFACE

For several years past many of my medical friends have expressed the wish that I should write a short treatise giving my personal experience in the treatment of chronic diseases of the heart in their various forms; these representations came to me from several quarters, but by far most numerously from my English-speaking colleagues with whom I had been in communication, personally, or through their patients. In compliance with these suggestions I have decided to present in this small brochure an account of the general methods of treatment in use at Bad-Nauheim as well as some clinical observations which bear a direct relation to these methods.

In connection with a short consideration of the medicinal treatment I have described somewhat fully the details of the balneo-gymnastic treatment of chronic diseases of the heart, a method of treatment that was introduced, elaborated and systematized through the efforts of my brother, the late Dr. August Schott, and myself. The general principles of balneotherapy, as well as the rules according to which the various gymnastic procedures are put into practice, have several times been described by us in former publications. The most practical way of showing how the resistance-exercises are carried out in detail is by means of illustrations which permit the technic to be understood at a glance. I have accordingly added photographic reproductions of a great variety of these movements which have been carefully posed for this work by two of my trained operators under my personal direction.

In order to keep the size of the volume within moderate limits, I have quoted only a few observations of other writers. I have also limited myself to mentioning a few

German authors and recording the names of a number of others who have made observations on the subjects under discussion and have published them in the English language.

I desire to express my personal obligation to my friend, Dr. S. Lewis Ziegler, of Philadelphia, for his editorial supervision of the English translation of my book. I also wish to record my deep appreciation of the judicial review of this work presented by Prof. James M. Anders in his courteous Foreword.

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BALNEO-GYMNASTIC TREATMENT OF CHRONIC DISEASES OF THE HEART

CHAPTER I

ANATOMY AND PHYSIOLOGY

Before proceeding to consider the treatment of chronic cardiac disease it may be appropriate to give a short account of modern views regarding the *anatomy* and *physiology* of the heart. The last two decades have brought about a great change of opinion in this respect. *Nervous* influence was formerly regarded as the principal factor on which the movements of the heart depended, but in the closing years of the last century there came a time when the whole action of the heart, its power both of expulsion and of suction, was considered to be purely *muscular* and its functional automatism was attributed to its myogenic activity alone. It was principally the discoveries of Professor His and his pupils, discoveries relating to the progressive stages of the heart's development, which led up to this view. It was found by His that the primitive cardiac tube in the embryo of the chick showed motility before any nervous elements could be discovered in it, and that at a later period of its development the only nerves present were sensory ones, which as they grew proceeded from the sympathetic system and entered the muscles.

Motor nerve fibers could not be discovered in this stage of the development. The ganglia of the heart were also considered to be of a purely sensory nature. The researches of Keith, who found muscle cells in the right auricle at the point of entrance of the inferior vena cava, coincided with the purely muscular theory. This doctrine

was further supported by the discovery of the bundle of His and of Tawara's knot. In this way an absolutely continuous connection between the auricles and ventricles was demonstrated and the recognition of that fact put an end to one of the principal objections upon which the supporters of the theory of nervous action had up to that time relied.

During recent years certain researches, made with the assistance of the electrocardiograph, show that a progressive motion, proceeding from the point of entrance of the inferior vena cava onward, is set up throughout the entire heart, both auricles and ventricles. The purely muscular theory, however, does not explain all the known facts connected with the movements of the heart; for instance, it certainly does not account for the effect produced by psychical influences, and there are many other questions to which it furnishes no answer, such as those relating to the influence exercised on the heart by extracardiac nerves, like the vagus and the recurrent nerve. These unexplained phenomena soon gave rise to doubts as to the correctness of the purely muscular theory, and a further argument against this theory was supplied in an observation made by Kronecker, at a period earlier than the above mentioned discovery made by His. Kronecker, as is well known, found that a lesion of a certain spot in the upper third of the septum cordis caused immediate stoppage of the heart's action. He himself saw in this spot, which he called the coördination center, a convergence of the nervous elements which control the action of the heart. An attempt was indeed made to explain this phenomenon on the basis of purely muscular energy, but the inadequacy of this explanation was soon apparent.

Important assistance in the decision of this question was given by improvements in microscopical technic, improvements which have quite recently made it possible to recognize extremely fine nerve endings in the interior of the

muscular fibrils, so that the old doctrine of the influence of *motor nerves* on the heart's action is thereby re-established. A number of experimental investigations on the hearts of mammals, such as those testing the action of certain salts, also give support to the neurogenic theory. The muscular automatism of the heart is evidently in close connection with the phenomena now under consideration.

The size of the heart and variations in its contour were formerly known only from inspection of it as obtained in a state of post-mortem rigidity at a necropsy, or else from the differences in sound elicited by percussion, but at the present day in addition to auscultation and percussion, both of which are very greatly improved, the observer has at his disposal a number of new methods of investigation, about which something more will presently be said. Although it is often very difficult and may even be impossible to sharply define the limits between normal and abnormal states of the heart, nevertheless these improved methods enable us to recognize pathologic states of the heart with greater frequency and with more certainty than was formerly the case.

CHAPTER II

GENERAL CONSIDERATIONS

Diseases of the heart may be divided into several different groups, namely, *diseased conditions of the muscular substance, valvular lesions* and *disorders of innervation*, to which must be added *abnormalities of the vascular system.* All of these pathologic states may appear as primary diseases, but they are often complications or sequelae of other diseases.

The pathology and symptomatology of individual diseases of the heart will not be discussed in detail here, because in the following pages only those cardiac conditions are to be considered which require medical treatment. Treatment is not necessary for every deviation from the normal standard. Apart from congenital cases, valvular lesions may exist all through life without causing the slightest functional disturbance or leading to any trouble whatsoever. In such instances the discovery of a cardiac abnormality is made by some medical man quite accidentally on the occasion of some intervening illness. This applies especially to nervous diseases of the heart. I am aware of cases of tachycardia—they would now, on the ground of electrocardiographic observations, be regarded as physiologic—and also of arrhythmia occurring in both men and women and existing throughout life without the individuals concerned having occasion to complain of these abnormalities in even the slightest degree.

The explanation of this is simple. As long as the muscular substance of the heart can fulfill its duplex function as a force-pump and a suction-pump in a normal manner, as long as a sufficient quantity of blood is thrown into the arterial system at each systole, and as long as a sufficient

quantity of venous blood flows into the right side of the heart during the diastole, such a heart will behave practically as a normal one.

The course of events is quite similar in abnormalities of the vascular system. The vessels of a large part of the arterial system may become indurated and a considerable area may even become affected with arteriosclerosis, and yet no cardiac disturbances of any kind need make their appearance as long as the muscular substance of the heart remains vigorous and sufficient reserve force is present.

Similarly, as already mentioned, derangements of the nervous system of the heart may, under certain circumstances, pass quite unnoticed. If there is no question of extra systoles or of disorder of those structures which convey motor impulses, a mere irregularity of rhythm depending on the motor nerves of the heart may continue for a lifetime without causing any trouble and may, therefore, fail to attract any attention. If, however, the sensory nerves of the heart are concerned, it will often be found that a very slight disturbing influence may cause most serious results. It goes without saying that the earlier a diseased condition of the heart or an abnormality of its function is recognized, the better is the prospect that treatment will prove beneficial. In this respect, it will be found, as already mentioned, that the newer methods of investigation are of great assistance to us.

Examples of this kind are the notable amplification of the heart sounds by means of phonendoscopy, and the better appreciation of their strength and pitch obtained by the use of other contrivances adjusted to the tube of the stethoscope. In former years percussion was practised only in the form of heavy percussion with a specially designed hammer, by which the extreme limits of the heart were the most that could be outlined by this procedure; but modifications have been gradually introduced, such as light percussion and more particularly percussion with lateral

damping, as well as percussion of the intercostal spaces (A. Schott), percussion combined with palpation (Ebstein), and "Schwellenpercussion" (Goldscheider).[1] It is not difficult, therefore, for an expert in physical diagnosis to outline special portions of the heart by careful percussion.

Graphic methods for the simultaneous recording of the pulse curves given by the radial artery and the jugular vein (Riegel, James MacKenzie) have afforded us (1) an insight into many circumstances illustrating the manner in which various subdivisions of the heart contribute to the general movement, especially the order of succession in which certain events occur, and (2) a better understanding of the functions of the heart in lesions of the mitral and tricuspid valves. The sphygmograph and the cardiograph were at one time overrated as instruments of investigation, and deductions having a wider range than the facts warranted were drawn from their indications; they are, however, indispensable as supplementary to other methods of examination in diagnosing the condition of the heart. Sphygmobolometry has not as yet been sufficiently tested, although its originator, Sahli, of Berne, has quite recently brought out an improved instrument. With respect to the examination of the gases of the blood, some time must elapse before its indications can become trustworthy and capable of application in medical practice. Tachography is as yet considered to be an unreliable method of investigation. Plethysmography, on the other hand, has developed within recent years to such an extent that, as will later be seen, a considerable insight into the conditions of the circulation has been gained by its aid.

The methods by which investigations of blood-pressure are carried out are of very different kinds, and the same remark applies to instruments used for the measurement of

[1] This method consists in very gently percussing over the heart itself, and gradually progressing outward. A different sound is said to be elicited between heart and lung (over the boundary) thus enabling the determination of the exact limits of the heart.

blood-pressure. Almost all of the great nations show a preference for methods or instruments devised by their own people; it is, therefore, not surprising that the results of measurements obtained by means differing so much in themselves are not directly comparable with one another. Originally these measurements were applied solely to systolic or maximum blood-pressure; latterly, however, methods have been so much improved—especially by Recklinghausen and Korotkow—that we are now enabled also to examine the diastolic or minimum blood-pressure in a reliable manner. The difference between systolic and diastolic blood-pressure constitutes the so-called *blood-pressure amplitude*, and it is from this—as will be dwelt upon farther on—that a few conclusions can be drawn in regard to the heart's output and the behavior of the vascular system. Until recently the measurement of the venous blood-pressure was very inexact, and the results were not altogether conclusive. It remains to be seen whether improved instruments, such as we now possess, will meet all the requirements of the case.

Examinations by means of the Roentgen rays are being more and more applied to the purposes of cardiac diagnosis, the desired information being secured either by taking photographic pictures or by viewing the parts through the fluorescent screen. These examinations have done very valuable service in several ways, including the discovery and exact definition of aneurisms or other alterations in the aorta, the recognition of changes in the form of the heart occurring in many cases of valvular disease, and other information of a similar kind. The methods generally practised at the present day are *orthodiagraphy* and *teleoroentgenography;* during the last three or four years kinematographic pictures have also given results worthy of our attention. X-ray apparatus undergoes improvement from year to year, but there are many conditions in cardiac diagnosis to which Roentgen-ray examinations are not yet

applicable on account of certain deficiencies which will be further discussed in another part of this work.

The most recent method of clinical investigation, *electrocardiography*, was at first employed by its originator, Einthoven, for physiologic purposes, but it has been taken advantage of for clinical investigations during the last few years and has brought to light many important facts. By this means it is possible to recognize in the heart very slight derangements in the transmission of motor impulses, derangements so slight as to be imperceptible by the methods which had previously been used. It also supplies information with regard to the position of the heart, as well as with respect to many derangements of the musculature and innervation. Of especial advantage is the fact that by means of electrocardiographic curves we have for the first time with certainty gained an insight into the different forms of arrhythmia, and can with its help distinguish purely nervous types from the much more serious derangements and alterations which take place in the muscular substance of the heart. Nevertheless, the employment of electrocardiography in clinical diagnosis is still beset with many difficulties. For instance, many electrocardiograms admit of such varying interpretations that it is not yet possible in all cases to place much reliance on them in forming an opinion as to the probable success or failure of therapeutic measures.

In addition to these modern aids to diagnosis, the older methods of physical examination, such as palpation, inspection, percussion, auscultation, etc., retain their full value both for diagnosis and for arriving at an estimate of the results of treatment.

CHAPTER III

PROPHYLAXIS

The prevention of disease is and always will remain the chief aim of the physician, and it is therefore most gratifying to find that *prophylactic treatment* gains ground year by year. One of the most important advances that has been made is the increasing recognition of the fact that faulty habits or modes of life may lead to diseases of the heart. For example, we are aware that overexertion of the mind or body (and here it may be remarked that athletic sports carried to excess are a familiar example of this kind), long-continued sorrow and care, protracted night work, or insufficient food may easily endanger the heart. In like manner, overfeeding, especially when bodily exercise is at the same time neglected, too free indulgence in alcohol, coffee and tea, or sexual excesses, may not only cause abnormalities in cardiac action but may even lead to actual diseased conditions of the heart and of the vascular system.

The same remarks apply most emphatically to the use of tobacco, the injurious effect of which on the heart is widely known, as in fact the frequency of the expression "smoker's heart" indicates. The principal topic about which there are differences of opinion is the question whether these injurious effects are only temporary in character or whether the structural changes which have been brought about may remain permanently. The latter of these two alternatives is decidedly to be accepted as the correct condition. Apart from nicotine, the combustion products of tobacco may give rise to premature arteriosclerosis. It is especially the coronary vessels which become affected, as has been proved by experiments quite recently made by Morawitz. In addition to the coronary vessels the cerebral

arteries not infrequently undergo sclerotic changes. The smoking of fresh tobacco leaves is peculiarly injurious, while tobacco chewing and snuff taking both have a detrimental influence on the heart. By explaining the situation and giving sensible advice, the physician may do much good under these circumstances and may thus be the means of saving many persons from cardiac lesions which seem to be threatening them. Psychic treatment is in many cases an excellent prophylaxis.

It is sufficiently well known that almost all the febrile infectious diseases may not only lead to disordered condition of the muscular substance of the heart, but also, by preference, to valvular lesions. At the head of these infectious diseases stands acute rheumatic polyarthritis, to which more than one-half of all the valvular lesions acquired in early and middle life are to be attributed, the heart often becoming affected in the first attack.

There are a great number of medicines by the use of which the course of acute articular rheumatism may be shortened and the pain relieved. Medicines of this character are salicyl and its derivatives, quinin, antipyrin, phenacetin, aspirin and others. Up to the present, however, no one has succeeded in influencing the inflammatory process in the endocardium, and especially in the valves, in such a way as to prevent valvular lesions. Beneke, who was the first to employ mineral baths in the treatment of heart disease, maintained that according to his observations when Nauheim baths were given relapses of acute articular rheumatism might be prevented and recent valvular exudations could be made to undergo absorption, so that neither shrinking nor thickening of the valves would occur; but the proofs of this assertion could hardly be made complete, because functional and organic disorders of the valves may not have been sufficiently differentiated.

In the course of the last decade great advances have been made in our knowledge of the action of antidiphtheritic

serum on the heart. Many suppose that this remedy is more injurious to the muscular substance of the heart than the toxin of diphtheria itself, but the fact is that when the injections of serum are given at a sufficiently early stage and in proper doses the proportion of heart affections following diphtheria is reduced. It is true that cases of collapse of the heart or weakening of its muscular substance have occurred under the use of antitoxin, but they are relatively so few as to be of no account in comparison with the life-saving action of this serum.

It is hardly necessary to mention that the naso-pharyngeal cavity and especially the tonsils are avenues through which pathogenic germs make their way into the human organism, and it is very probable that in many cases the infection of acute rheumatic polyarthritis follows this route. It still remains an open question whether early treatment of these inflammations of the upper air passages can reduce the number of cases of rheumatism of the joints and of the cardiac affections which are the frequent sequelæ of these lesions.

The more promptly a case of syphilis receives medical attention the greater the probability of its treatment being effective. In any case, when there is a suspicion of syphilitic taint Wassermann's test should be applied immediately, and if the result is positive appropriate treatment should be instituted at once. It is beyond question that salvarsan in such early cases has a great influence in reducing or preventing syphilitic affections of the heart. To what extent treatment with salvarsan can produce a like effect in cases of secondary and tertiary syphilis cannot at present be determined. Treatment with mercury alone has up to the present time accomplished this with positiveness to a limited degree only. Should it ever be possible to obtain a real *sterilisatio magna*, as Ehrlich hopes (*i.e.*, a complete elimination of the syphilitic virus) by early treatment with salvarsan or some remedy of a like character—either with

or without the simultaneous use of mercury—syphilitic diseases of the heart and more particularly diseases of the blood-vessels developing on a syphilitic basis would disappear. This applies, for example, to the usually fatal aneurysms of the heart and aorta.

CHAPTER IV

MEDICINAL TREATMENT

As regards the special treatment of chronic diseases of the heart, it is well known that formerly there were for all cardiac lesions only two remedies, rest and digitalis. When these failed the physician was powerless in the presence of increasing heart trouble. At the present day *medicinal* treatment has undergone some extension, and in combination with it *physical* treatment plays one of the principal parts, but before the latter is fully discussed a few remarks may be made on the present position of medicinal treatment.

To this day *digitalis* remains the best of all our therapeutic agents. The studies of Gottlieb and his pupils have greatly advanced our knowledge of the mode of action of the substances contained in digitalis purpurea. These researches in combination with the progress which has been made in chemistry, have had the effect of placing at our disposal a number of pure and efficient preparations of digitalis such as digipuratum, digalen, tincture of digitalis (Golacz and Burger), and the French digitoxin. Some of these products offer the important advantage that they can be administered by either subcutaneous or intravenous injection, whereby their action is developed more rapidly.

Although the improvement in digitalis preparations has rendered less frequent the occurrence of unpleasant symptoms after their use we must, nevertheless, remember that the *cumulative action* is always present in these newer products, and the statement that it is in the power of the physician to wholly eliminate the toxic and cumulative action of these products of digitalis should be decidedly contradicted. By no means infrequently such a toxic action plays an important rôle in the clinical history of a patient. This explains why modern digitalis preparations

cannot under all circumstances take the place of the digitalis herb, or even of the infusion. Thus, it frequently occurs that powders or pills made with the leaves of digitalis purpurea, or even a 1 per cent infusion, may finally produce the desired effect on the functions of the heart and kidneys after other preparations have proved disappointing.

The unpleasant gastric symptoms, which cannot always be excluded, may often be avoided by coating the digitalis pill with keratin. Quite recently gelodurate capsules have been employed in order that the drug may not be absorbed until it reaches the intestines. It has been known for a long time, and is also confirmed by modern graphic methods of research, that digitalis develops its principal activity in disorders of compensation following lesions of the mitral valves, whereas this therapeutic action cannot be relied on with the same certainty in lesions of the aortic valves. It must, moreover, be regretfully admitted that in spite of all the modern scientific investigations the physician must frequently depend on empiric attempts to discover whether or not digitalis is proving efficacious, and if so to what extent.

Tincture of *strophanthus*, originally recommended by Fraser, shows a much less toxic and cumulative action than digitalis, but is much less efficient in disorders of compensation caused by valvular lesions. Its good effects are best seen in *chronic* affections of the muscular substance of the heart, and more particularly in cases of abnormal nervous action. According to my own experience tincture of strophanthus is tolerated by females in fairly large doses, which if the case is carefully watched may not infrequently be increased to 20 or 30 drops three times a day. Quite recently the active principle, *strophanthin*, has been employed in place of the tincture, being given chiefly by injection, either subcutaneous, intramuscular, or more often intravenous; its action is very prompt and energetic, and may without hesitation be compared with that of the

strongest preparation of digitalis. Even in severe disorders of compensation it will often produce rapid improvement, but its powerful toxic action, and more particularly the urgent symptoms of collapse which are frequently observed make strophanthin somewhat unsuitable for general use.

Quite a number of other remedies have been and to some extent still are employed in the treatment of cardiac disorders. Among these are the tincture of *convallaria majalis* and *convallamarin*, which are chiefly used in Russia; the convallaria majalis which grows in Russia appears to yield a more efficient tincture than plants of the same kind raised in other countries. Additional remedies of a similar nature are *spartein*, *adonis vernalis* and *adonidin*, *helleborein*, *arbutin*, *apocynum*, *cannabicum*, etc. Not all of these drugs have come into extensive use, but the physician must nevertheless know something about them, because now and then they may turn the scale in the patient's favor after the cardiac remedies most frequently employed have failed. In some rare instances *ergotin* (or *ernutin*) may also be administered in the form of subcutaneous injections for reducing the size of an aneurysmal sac; as a vasoconstrictor it deserves equal consideration with *atropin*, which has proved itself especially efficient in cases where the inhibiting action of the vagus nerve seems to be more or less paralyzed. As a remedy against cardiac debility it is but seldom used.

In addition to *sulphuric ether* and the preparations of *camphor*, the salts of *caffein* are favorite cardiac stimulants and are frequently prescribed in small doses simultaneously with digitalis, in order to counteract the risk of collapse which digitalis sometimes brings with it. The double salts are mostly employed—namely *sodiosalicylate of caffein* and *sodiobenzoate of caffein*. Like many other drugs sodiosalicylate of caffein in *small* doses acts as a *stimulant*, while in *large* or even in *average* doses it sometimes acts as a depressant and may bring on collapse. Sodiobenzoate of

caffein is to be preferred, because it is a very serviceable stimulant and does not produce collapse so readily as the other salt.

In England and America *strychnin*, administered either by the mouth or subcutaneously, is decidedly preferred in weak and especially in relaxed (atonic) conditions of the muscular substance of the heart. With this alkaloid the heart can undoubtedly be stimulated so as to contract powerfully, but its tonic action appears to have been greatly overestimated. An emphatic caution must be given against long continued administration of this drug, because when taken for a considerable time without intermission it leads to an *abnormally irritable* condition of the heart with all its dangerous after-effects. *Nux vomica* has been more or less thrust into the background by its alkaloid. The salt most favorably employed is *strychnin nitrate*.

Preparations of *iodin* form a special group of remedies used in the treatment of cardiac affections. Their province is chiefly the treatment of chronic diseases of the vascular system. It is true that an existing condition of arteriosclerosis cannot be made to undergo retrogression by means of these drugs; recovery from arteriosclerosis as such is out of the question, but it appears as if the progress of arteriosclerotic changes could be somewhat retarded by the action of iodin. At any rate stenocardiac troubles, or the sensations of oppression which are so harassing, are often found to be relieved by preparations of iodin. Some authorities formerly believed that this result was brought about by a reduction either of the pressure or of the viscosity of the blood, but both of these opinions have proved to be erroneous. It is probable that chemical changes are produced in the blood; changes through which this drug exerts its influence on the circulation. In former years I have called attention to the fact that caution is necessary in prescribing preparations of iodin. It is well known that iodin disintegrates albumen, and when it is administered

the patient's general condition must be most carefully watched by the physician.

Iodid of sodium should always be employed instead of the iodid of potassium, because all potassium salts are cardiac poisons, in some degree. The administration of iodin is moreover greatly facilitated, now that for a number of years we have had at our disposal products in which it is combined with albumen. Of these I shall at present mention only *iodoglidin* and *iodostearin*, with the further remark that *sajodin* and *iodocitin* have also come into great favor as remedies of value. For a very few years *vasotinin*, which is a compound of *urethan with yohimbin*, has been recommended as an antisclerotic remedy in place of preparations of iodin, but according to present experience its influence is doubtful.

Preparations of *thyroidin* are chiefly employed as remedies for reducing or preventing the formation of adipose tissue. There is no doubt but that a decided reduction of fat may be obtained by their use, but the injurious effects which they produce on the whole organism, and especially on the heart and nervous system, are so intense that cardiac collapse, mental disorders and even renal troubles may ensue. Their administration obviously requires very careful medical supervision, and in the majority of cases it will be best to avoid the use of these products. Very small doses of thyroid extract (gr.j, t.i.d.) have, however, been found useful in reducing high blood-pressure.

Preparations of *oöphorin* have been used experimentally for the prevention of the general obesity occurring in females, particularly at the climacteric period, and more especially for the prevention of fatty heart, but the result has been successful in only a small percentage of cases.

Great reliance has been placed on the use of *aromatic spirits of ammonia* as a temporary vaso-motor stimulant, chiefly of the peripheral vascular system. It is indicated in collapse from cardiac weakness, flatulence, nervousness,

and especially to relieve the insomnia which often accompanies cardiac disturbances. It should be well diluted with water before administering.

The substances which have received the name of vasodepressors are known by their mode of action. They produce dilatation of the vessels and in that way cause a fall of the blood-pressure. They are principally the *nitrites*. *Nitroglycerin* is the most important of this group. It is best given in the liquid state, in an alcoholic solution of 1 per cent. Administration in the form of tablets is no doubt much more convenient, but the effect is uncertain because the amount of active substance contained in each tablet often varies greatly. *Erythrol tetranitrate* comes very near to nitroglycerin. Both of these are excellent remedies when the object is to mitigate or remove cardiac spasms and sensations of oppression (cardialgia and shooting pains) in angina pectoris. *Nitrite of amyl*, which is taken by inhalation, has a similar influence on the vascular system, but its action may be so rapid and tumultuous that dangerous conditions may ensue. *Nitrite of soda* has a milder action on the peripheral blood-vessels. The salts of *theobromin*, which are well known as diuretics, have proved useful in many cases of stenocardiac attacks and *theocin* is another preparation of which the same thing may be said. On the other hand, a warning must be given against the use of *antipyrin*, *phenacetin* and *aspirin* in such emergencies, for not only is their action often disappointing, but, in advanced conditions of cardiac degeneration, collapse is occasionally caused by these drugs.

For obtaining vasoconstrictor effects *adrenalin*, *suprarenin* and *pituitrin* have recently been employed. Adrenalin is the most powerful of these and deserves to be preferred to the other two, but intravenous administration of it is not without danger and it is therefore recommended to be administered chiefly by the mouth.

In conclusion, something remains to be said regarding

the action of *morphin* in the treatment of chronic diseases of the heart, a subject about which there has been a great change of opinion in recent years. The slowing of the pulse which morphin produces led to the idea that opium and its derivatives were real cardiac tonics. Carefully conducted observations made with the sphygmograph and the cardiograph and fully confirmed by clinical experience, have, however, shown that the slowing of the pulse is caused directly by a weakening of the ventricular contractions. A drug acting in this way may obviously, under certain circumstances, become absolutely dangerous; but in violent paroxysms of pain, long-continued insomnia, and severe symptoms of oppression morphin is nevertheless indispensable. In such a case the practitioner may make up his mind to give a considerable dose, but not to continue it very long without intermission. The same remark applies to large doses of *narcein*, *codein*, *pantopon*, and *cocain*, although the last mentioned is not in close relation with the preceding.

In the practical use of these sedative drugs, only those most frequently prescribed having been included in the foregoing enumeration, experience has shown that along with their beneficial action they not only have certain disadvantages but may even exercise an injurious influence. Many of them are effective against individual symptoms only, while others possess a therapeutic action that may be accompanied by symptoms detrimental to the patient. The fact that they may produce cumulative and toxic effects has been frequently emphasized in recent literature.

As a result of these many disadvantages efficient methods for the treatment of chronic diseases of the heart have been sought and found in an altogether different field of therapy. The physical methods about to be considered are quite free from toxic properties, they have a tonic action on the heart and vascular system, and at the same time are beneficial to the whole organism. These will be reviewed in detail.

CHAPTER V

THE PHYSICAL TREATMENT OF CHRONIC DISEASES OF THE HEART

This department of practice comprises two subdivisions, *balneologic treatment* and *mechanico-dietetic* treatment. These methods are of modern origin, although it is historically interesting to find that even in the most ancient medical literature bodily exercises and certain dietetic measures were recommended for the relief of obesity and that similar directions occur in the writings of Celsus and Galen; the teachings of Sydenham, Boerhaave, and others were also worthy of attention. On careful consideration, however, it will be perceived that these therapeutic measures had no reference to the heart or the circulation of the blood, but being adapted to the humoral pathology of the time, they rather had in view the elimination of noxious humors from the body and their replacement by salutary ones.

It has already been mentioned that until recently diseases of the heart have always been treated by the same two methods, viz., rest and the internal use of digitalis. It is true, that a more enlightened view was taken by the well-known Dublin physician, Stokes, who was the first to call attention to the fact that in fatty heart appropriate bodily exercise was better for the patient than absolute rest, but his teaching was soon forgotten and the published accounts of the brilliant results Stokes achieved with his patients made no impression on the methods then in vogue. His clinical reports showed that corpulent sufferers from heart disease, who at first were unable to climb, if they took walking exercises and frequently repeated these on mountain excursions of considerable duration, at last re-

turned to their homes with the functional activity of their hearts restored.

His methods were taken up by others, some of whom, such as Quain, had cases of failure, and professional controversies soon arose, therefore, over these questions. The result was that the teachings of Stokes were again abandoned and the older methods of treatment resorted to. Rest was again prescribed for the patients and abstinence from a variety of things was required of them. If, notwithstanding this passive and waiting policy, insufficient compensation was sooner or later manifested, it was treated with digitalis. If the digitalis no longer produced its good effects, or per contra aggravated the symptoms, and if certain substitutes, some of which have been mentioned, had no better success, the practitioner in the presence of the increasing disturbance found himself perplexed and unable to give relief. In this state matters remained for many decades. In fact, skepticism and medical nihilism, which have lasted to the present day, were the natural consequences of this lack of efficient therapeutic measures.

A variety of physical methods of treatment then came almost simultaneously into helpful operation. A fresh stimulus was given to this department of practice by Beneke, who as already mentioned, put an end to the old belief that mineral baths were injurious to sufferers from heart disease. It was at this period that my brother and I announced the successful results which we had been able to obtain by means of treatment consisting of baths and gymnastic exercises, used either separately or in combination. These observations were confirmed in Germany by Juergensen, professor of clinical medicine at Tuebingen, who made his observations at Bad-Nauheim and who first spread abroad the knowledge of our methods. Later on he published his experiences in Nothnagel's Encyclopedia. Then followed the work of Bauer, which appeared in Stinzing-Penzold's Manual, and also the experimental investigation of Hensen,

of the Leipsic clinic. In more recent times it is especially the text-books of Krehl, Romberg, Matthes, Munges and others which contain reports of the results obtained with the balneologic-gymnastic treatment.

Our published communications found their first endorsement in England through the work of Sir Lauder Brunton, Bezly Thorne, Sir William Broadbent, Sir Thomas Grainger Stewart, Robert Saundby, Bowles, Kingscote, Wethered and others. In America the principal publications of a similar kind were those of Anders, Babcock, Billings, Osler, Osborne, Tyson, S. Solis Cohen, John K. Mitchell, Kinnicutt, Camac, Bishop, Baldwin and others. Almost at the same time Zander published observations which he had made in the course of his mechanico-gymnastic treatment of heart diseases by means of ingeniously constructed apparatus. A few years later Oertel announced his method of treatment, the so-called "*Terrainkur*" which consisted chiefly of graduated hill or mountain climbing. This, however, interested the medical profession for a short time only.

CHAPTER VI

BALNEOTHERAPY AND THE NAUHEIM SPRINGS

Before proceeding to discuss the balneotherapy of heart diseases I shall give an analysis of the springs used for the Nauheim baths.

There is no intention of introducing in this place a full analysis of the Nauheim springs which patients drink and only a brief mention of the following particulars will be made. The two saline springs, Kurbrunnen, containing 1.8 per cent of salts, and Karlsbrunnen, containing 0.8 per cent of salts, are prescribed in disorders of the stomach and intestinal canal, especially in constipation, and also often in combination with the bath treatment for the relief of congestion of the liver. The alkaline Ludwigsbrunnen, containing chlorides, lithium and bicarbonate of sodium, serves for the correction of the arthritic diathesis. The two sources, Schwalheim spring and Löwenquelle, are ferruginous waters which, on account of the iron and manganese present in them, are well adapted for the correction of the anemic conditions so often associated with cardiac disease.

Bad-Nauheim was originally regarded as merely a place where warm brine baths could be had, a form of baths which gained a reputation for being useful in the treatment of rheumatism. A chemical analysis of the carbonic acid gas in the brine baths and in the effervescent flowing baths was made by my brother and myself. This analysis of the Nauheim effervescing baths, together with a study of the therapeutic effects of the baths, enabled us to show that they supplied a variety of remedial principles which were peculiarly adapted to the treatment of chronic diseases of the heart. Our analyses and inferences were afterward

confirmed and extended by other observers. With the arrangements in use at that time it was only possible to obtain the water from the small bath tubs. Since then arrangements have been perfected to such a degree, that much more satisfactory analyses can be made. Accurate chemical tests yield the following results:

Analyses of the Mineral Springs at Bad-Nauheim.

Constituents in 1000 grams of water	Bathing Springs		
	Sprudel No. VII. (Large Sprudel.)	**Sprudel No. XII.** (Friedrich Wilhelm Sprudel.)	**Sprudel No. XIV.** (Ernst-Ludwig Sprudel.)
Sodium chloride ($NaCl$)	19,5402	27,1525	22,7090
Sodium bromide ($NaBr$)	0,0090	0,0122	0,0170
Potassium chloride (KCl)	0,5953	0,8381	0,6436
Lithium chloride ($LiCl$)	0,0560	0,0626	0,0405
Ammonium chloride (NH_4Cl)	0,0508	0,0575	0,0753
Calcium chloride ($CaCl_2$)	1,3643	2,7619	2,4493
Magnesium chloride ($MgCl_2$)	0,3948	0,5281	0,4663
Sodium sulphate (Na_2SO_4)	.....	.....	.....
Potassium Sulphate (K_2SO_4)	0,0652	0,0818	0,0787
Sodium bicarbonate ($Na_2CO_3CO_2$)	.....	.....	.....
Calcium bicarbonate ($CaCO_3CO_2$)	2,4894	1,7953	1,6019
Strontium bicarbonate ($SrCO_3CO_2$)	0,0302	0,0500	0,0456
Magnesium bicarbonate($MgCO_3CO_2$)	.....	.....	.....
Ferrous bicarbonate ($FeCO_3CO_2$)	0,0218	0,0289	0,0309
Bicarbonate of manganese ($MnCO_3CO_2$)	0,0063	0,0052	0,0041
Sodium bi-phosphate (Na_2HPO_4)	0,0004	0,0004	0,0005
Sodium bi-arseniate (Na_2HAsO_4)	0,0009	0,0007	0,0008
Silicic acid (SiO_2)	0,0164	0,0194	0,0173
Total of solid constituents	24,6410	33,3946	28,1808
Carbonic acid entirely free (CO_2)	3,9634	3,3118	2,9630
Sum of all constituents	28,6044	37,6064	31,1438
Entirely free carbonic acid at 0° C. & barometric pressure of 760 mm. in ccm.	2021,3	1689,0	1511,1
Entirely free carbonic acid at the temperature of the springs and mean barometric pressure of Bad-Nauheim, 748.9 mm. in ccm	2277,2	1931,0	1715,3
Temperature	29,9° C.	34,4° C.	32,2° C.
Specific gravity at 15° C.	1,0184	1,0255	1,0222

Simultaneously with the bathing spring there issues from the earth (mingled with the brine as foam) a plentiful supply of medicinal Sprudel gas, the exact quantity of which could not be gauged in its entirety up to the present time. The above analyses were carried out in the years 1903, 1904 and 1906 by the Grand-Ducal Chemical Laboratory for the Commerce of Darmstadt (Director: Professor Dr. W. Sonne).

Since the above mentioned analysis was made the method of procuring the water for the purpose of examination has again been materially perfected. To-day we succeed in withdrawing directly from the main conduit the water to be examined, and in reducing the escape of CO_2 to a minimum; we are thus enabled to determine its percentage with greater precision.

Privy Councillor Eser, Ph.D., President of the Board of Directors of the Baths of Nauheim, who is well known in the domain of the examination of waters, has in recent years made a thorough analysis to determine the exact amount of CO_2 contained in our Nauheim mineral springs the results of which tests he intends to present in a future publication. He has kindly placed some average figures at my disposal, for which courtesy I desire to express my sincere thanks.

Eser drew the water directly from the main supply pipe under mean barometric pressure and found the contents per liter of the separate springs to be as follows:

	Spring No VII.	Spring No. XIV	Spring No. XII
CO_2 free and in solution	3.434 gr.	3.768 gr.	4.451 gr.
CO_2 active (*i.e.*, free and loosely bound according to Schott)	3.841 gr.	4.191 gr.	4.907 gr.
CO_2 Total	4.248 gr.	4.615 gr.	5.362 gr.

By means of suitable ventilating contrivances care is taken that all superfluous cabonic acid shall be removed

before the water enters the bathroom in order to sufficiently protect the patient from the inhalation of carbonic acid gas.

Regarding the amount of carbonic acid in the effervescing (Sprudel) and effervescing-flowing (Strom-Sprudel) baths, compare the analysis on page 24.

The water used for the Nauheim warm baths (Thermal) comes to the surface at temperatures similar to those at which ordinary baths are generally taken, 86°, 90° and 94° F. Their saline constitution is that of a moderately strong brine bath, and as the Nauheim mother-liquor which is added to the bath-water contains a quite extraordinary amount of calcium chloride, the saline constituents of an individual bath can by the addition of this mother-liquor be raised to any strength desired. The Nauheim effervescing springs are the only ones, among those hitherto discovered, which come naturally from a great depth directly to the surface with the temperature of a warm bath and accompanied with a most abundant supply of carbonic acid gas. They are, moreover, used for bathing purposes at the very place where they emerge from the earth, so that in the bath they contain far more carbonic acid gas than can possibly be the case either with springs of low temperature which have to be heated, or with those which have to be brought in long pipes from distant springs to the bathing establishment.

The water of all the Nauheim springs, used for bathing purposes, comes from this great depth and is thrown into the air by the powerful expansive force of its own carbonic acid gas.

The forms and gradations in which the baths may be used are as follows:

1. **Brine Baths.**—A portion of the water flowing from the spring is led into the so-called "*Gradierwerke*," or graduation works, where it is allowed to make its way slowly through a filter-bed of thorny brush. In this process the water

loses the whole of its carbonic acid gas, and during its descent the principal part of the salts of iron and calcium settle on the thorns. What comes through is the water used for a plain brine bath.

2. **Thermal Baths.**—The water delivered from the ascending mains flows into large open basins from which it is led into the bath rooms. In these open basins it loses a great part of its free carbonic acid—so much indeed that the dissolved bicarbonates are converted into monocarbonates, and salts of calcium and iron which are precipitated give the water a reddish-yellow color. While the water remains in these open basins its temperature is to some extent influenced by the temperature of the outside air prevailing at the time. On an average such a bath contains about 500 *cubic centimeters* of free carbonic acid gas in a liter of water.

3. **Thermal-Sprudel Effervescing Baths.**—The water delivered from the upright mains passes into basins which are almost completely closed, only a narrow aperture being left by which a small portion of the carbonic acid may escape into the air. The water of such a bath may be either transparent and colorless or at the most will be only slightly tinged. It contains about 1000 *cubic centimeters* of free carbonic acid gas to the liter.

4. **Sprudel Effervescing Baths.**—The water flows from the upright main of the springs through branch pipes carried underground directly into the bath tubs, where it arrives in a clear and bright condition, retaining its natural temperature and so large a proportion of its free carbonic acid that on an average from 1200 to 1500 *cubic centimeters* of this gas are present in a liter.

5. **Strom-Sprudel or Flowing Effervescing Baths.**—These are quite the strongest baths of this description that are known to us. They originate as follows: deep in the earth's crust carbonic acid gas is forced into warm mineral water under very great pressure, and when this water makes

its way to the surface through the expansive power of the gas, and through that alone, the water of the several springs is thrown up in a jet to a height of 16 to 20 feet from one, and of 56 to 60 feet from the other. The bath-water is therefore under high pressure, which, according to the spring yielding it, amounts to half an atmosphere, or to two-thirds of an atmosphere, or to one and one-half atmospheres. When the bath tub has been filled, the water is allowed to flow constantly in and out of the tub during the whole time that the patient is immersed. This high pressure produces a succession of gaseous waves which exercise a powerful mechanical effect on the surface of the skin, a veritable bombardment of the skin by bubbles of gas, an effect which is intensified by the circumstance that in such a bath of effervescing water in motion each liter of water contains more than 2000 *cubic centimeters* of free carbonic acid in the nascent state. Care must be taken to cover the bath with a cloth in order to protect the patient from inhaling an undue quantity of carbon-dioxide, or the patient should be instructed to lean his head over the side of the tub while inhaling; it is also advisable that the bath room should be well ventilated and abundantly supplied with fresh air.

The brine baths, the warm baths and the effervescing warm baths can all be given in the form of flowing baths, and in like manner the water of all the springs can be employed as douche baths. By taking advantage of these various combinations it is possible to administer baths in a great diversity of forms with a correspondingly extensive range of successive gradations, thus permitting baths to be adapted to the different requirements of each individual patient. These gradations enable us to apply balneologic methods and principles with a degree of precision that is very necessary in the treatment of patients afflicted with heart disease.

The authors of some recently published works appear to regard the *temperature of the water* as the essential factor

in balneologic treatment, while others consider that the *carbonic acid* is the only efficient agent, but practical experience has shown us that it is not possible to obtain the desired results in cases of heart disease by bathing either in fresh water maintained at a variety of selected temperatures, or in water containing only carbonic acid without any saline addition. Some space will, therefore, now be devoted to a consideration of the manner in which these baths produce their effects, as well as to the subject of balneologic methods and principles in general.

The influence of temperature shows itself in the following way: when a bath is at a temperature approaching that of the human body, say from 93° to 95° F., the pressure of the water on the skin and the suppression of the cutaneous perspiration have principally to be taken into account. The increased external pressure causes a reduction of the intraabdominal pressure and a relaxation of the muscles. What part is played by the diminution in the external abstraction of heat is not yet sufficiently explained. The differences between the conductivity of the air and that of the water have not yet been fully investigated with respect to their influence on the abstraction of heat from the surface of the body. It is also questionable how far a somewhat quickened respiration acts directly on the circulation of the blood, because very often the respirations instead of being deeper are found to become more superficial. The principal effect of such baths, therefore, seems to be that the blood moves more freely in the vascular system. So far as I have been able to discover, no decided action on the heart can be recognized, either by direct observations made on the heart itself, or by investigations with the sphygmograph, or by measurements of the blood-pressure.

Quite different, however, is the case when the thermal stimulation lies either *over* or *under* the point of indifference. A *cold bath* produces a rapid and, according to the temperature, a more or less powerful loss of heat from the

skin to the water of the bath, that is to say a waste of energy. The stimulation of cold leads to contraction of the whole peripheral vascular system and to accumulation or stasis of the blood in the internal organs. The blood-pressure rises and the heart has to fight against an increased blood-pressure; in other words, cardiac fatigue and relaxation takes place and, as no sufficient compensation on the part of the internal organs follows, there results finally a weakness of the heart which leads secondarily to lowering of the blood-pressure.

A *hot bath*, on the other hand, causes thermal stasis and dilatation of the peripheral vessels. The small rise of temperature in the interior of the body probably plays only a subsidiary part, but such baths excite the activity of the heart very powerfully. The number of heart beats increases, respiration becomes quicker and more superficial, and the blood-pressure, which may vary according to the duration and temperature of the bath, cannot achieve any adjustment. A heart excited like this is more easily fatigued, with the result that the regulating mechanisms of the body—which we possess in the vaso-motor activity and reserve power of the heart—are finally insufficient. Such baths lead ultimately to cardiac weakness with all its resulting symptoms.

With baths that are only a little above or below the point of indifference the described effect manifests itself according to the temperature but in a diminished intensity. By the use of luke-warm baths the vaso-dilator influence comes more into action; with the cooler bath the vaso-constrictor effect prevails. Here the regulatory mechanism of the vascular system and respiration are generally sufficient to effectively equalize these varying influences.

In balneologic therapy there must further be taken into account the *salts* which are dissolved in the water. These are principally *sodium chloride* and the more powerfully acting *calcium chloride*. It is probably quite certain that

these salts are not absorbed by the unbroken skin. It has been observed that a strong salt-water bath increases the delicacy of taste perception, that is to say, it renders certain sensory nerves more acutely sensitive; it is also a pre-eminently important fact that concentrated salt-baths increase the blood-pressure, as was determined by A. Schott through experiments on animals, by measurements of the blood-pressure in the carotid. These observations can be explained only by an action on the sensory nerves of the skin, in consequence of the salt solution penetrating to the peripheral nerve endings in the integument and stimulating them. In other words, the saline solution must act through imbibition. In favor of this statement is the further circumstance that a salt-water bath, such as this, exerts a much more powerful rubefacient action and sometimes weakens and fatigues the whole body more than a fresh-water bath of the same temperature and duration.

A question which was and still is much discussed in balneotherapy is that of the action of gaseous solutions, principally those of *carbon-dioxide*. There is a great difference between allowing the carbon-dioxide to act on the human organism in the form of the simple *dry carbonic acid gas* and in the form of *carbonic acid baths*. It has long been known that gaseous substances can pass through the intact skin; this was proved with regard to carbonic acid baths in an indisputable manner by H. Winternitz, in Halle, some years ago. It is also quite clear that they produce a change in the conditions of tension in the body and an action on the nerves of the integument. A dry carbon-dioxide bath like this causes first, by stimulation of the nerves of the skin, a powerful feeling of warmth in the skin and subsequent reddening, but this redness disappears quickly. By repeated application of such dry carbonic acid baths their influence becomes rapidly and distinctly impaired. According to our investigations this influence is hardly perceptible after they have been employed three or four times. It is

open to doubt whether we have to deal here with a simple accumulation of carbon-dioxide in the interior of the body or only with a peripheral *stimulating* action, either of a *thermal* or *mechanical* nature, which very rapidly subsides again. Goldscheider has tried to explain the sensation of warmth caused by the local application of carbonic acid gas as due solely to the action of a thermal stimulant. It is, however, by no means proven that we have here only a stimulation of those nerves which cause the sensation of warmth. All the other chemical and mechanical actions may also play their parts.

Carbonic acid in water acts otherwise and this is the case in a simple fresh-water bath containing carbonic acid gas and still more so in a salt-water bath containing the same gas. Here the simple physical law holds good, that the cooler and quieter the water and the higher the pressure under which the gas exists in the fluid, the more free carbon-dioxide will remain in the water of the bath. With plain waters containing carbon-dioxide the full carbonic acid gas is the only thing to be considered; in mineral water baths containing salts we find the *carbon-dioxide wholly or partially united* to the salts. In the case of the carbon-dioxide which is wholly united a free gas action does not, of course, take place; where it is only partially united it is open to question whether and in what manner it becomes active.

There remains for our balneologic purposes only the free active carbon-dioxide, the activity of which we can definitely estimate. Here a distinction must be made between free carbonic acid suspended in water and that escaping from the water into the outside air. The amount of the latter, as has already been stated, is distinctly dependent on the rapidity with which the water pours into the bath, on the temperature of the water, and very much on the pressure under which the gas was absorbed by the water. The higher this pressure was originally, the greater will be the amount of carbonic acid gas which will remain suspended in the water

in spite of a considerable loss into the air. It follows, as will be seen later, that *in this respect there is a distinct difference between natural and artificial salt-water baths containing carbon-dioxide.*

Free carbonic acid *escaping into the air* is useless for the bath. It is, however, otherwise with the bubbles of gas which on their way to the surface attach themselves directly to the surface of the body and in places remain adherent. They cover the body more or less thickly with a layer of gas. This layer of carbon-dioxide, in my opinion, produces its action on the peripheral vascular and nervous system, not directly as does that suspended in water, but indirectly. It acts by protecting the surface of the body from loss of heat. If one examines one of the smaller or larger bubbles with a magnifying lens one can see that between the bubble and the surface of the body there is always a considerable layer of water. It is just this watery layer which, in the baths under discussion, becomes rapidly and efficiently warmed. From this also comes the sensation of sudden cold when the bather moves about and thereby removes this watery layer of slightly higher temperature. If the patient remains quiet in the bath the warmer layer of water spreads the individual gas bubbles more and more over the skin so that, while a portion of the gas bubbles escape into the air, new ones are always attaching themselves to the skin. This warm covering, which the gas envelope surrounding the skin supplies, is one of the chief factors which impart the sensation of greater warmth to the skin, especially in a cool bath rich in carbon-dioxide and which, therefore, makes it possible to resort to cooler temperatures for these baths. To what extent the mechanical action exerted by the carbonic acid bubbles, as they rise to the surface, plays a part in influencing the nerves and vessels of the skin is difficult to determine.

Several years ago Senator and Frankenhäuser propounded a theory according to which the therapeutic action

of carbonic acid in baths occurs through a so-called thermal contrast. This contrasted action, according to these authors, is due to the fact that the power of absorbing and of giving up warmth is different with carbonic acid gas and with water. They assumed that a thermal stimulation on the part of the carbon-dioxide, because of its gaseous form, comes into action simultaneously with a cold-producing stimulation on the part of the water. Apart from the fact that other gases in baths, such as oxygen or atmospheric air, do not exhibit this action, the above analysis of the behavior of the carbon-dioxide bubbles on the surface of the body alone disproves this theory. There are probably few adherents to this doctrine at the present time.

Free carbonic acid suspended in water deserves special consideration. For example, if one removes—while taking care to avoid any powerful mechanical action—the carbon-dioxide bubbles from the surface of the skin by stroking it very lightly, thus preventing the diminution of heat-loss to the outside caused by the visible bubbles, nothing is left but the action of the free carbonic acid gas suspended in water. The gaseous molecules which, according to H. Winternitz (Halle), have been proved to penetrate the integument as far as the internal organs, exercise a stimulating action upon the peripheral nerve-endings, thereby calling forth an intense sensation of warmth. This latter is caused not only by stimulation of the nerves which give rise to the thermal sensation; since the simultaneous appearance of intense reddening of the skin is distinctly in favor of a vaso-motor influence on the whole of the peripheral vascular system. Endeavors have been made to explain this symptom purely through some action on the capillaries and smallest arterioles of the skin. This explanation is insufficient, as will be shown further on. The observations which have been made on the heart itself are also against it.

With but few exceptions the clinical results obtained from natural salt-water baths containing carbon-dioxide have received and still receive general endorsement in the medical world, as the current literature will show. But it is a very different matter when we turn our attention to experimental researches mainly concerned with the mode of action of the baths, which have been and are still being pursued with a view to ascertain in what way the action of the balneotherapeutic measures adopted is brought about. In this connection, the following questions obtrude themselves: (1) How much does the operation of these measures influence the heart itself, and how much the vascular system? (2) Which factors play the principal part therein, the *temperature* or the *chemical constituents?* (3) What share in producing the effects is due to the *salts*, and what share is due to the *gases?*

Even in the earliest researches of my brother and myself, we added to our clinical observations some theoretic considerations touching the manner in which we conceived the action of the baths to be brought about, and in support of our views took sphygmographic tracings and investigated the blood-pressure, the hemoglobin, etc. We came to the conclusion that the baths operate by imparting tone to the heart and to the entire circulatory apparatus, in consequence of which the whole organism is strengthened. On the basis of our investigations we attributed to the muscular apparatus of the heart the chief share in accomplishing these results. The investigations and observations that were made soon after by others, also pointed in the same direction. But at a later period still other researches were set on foot, which were more concerned with the vasomotor influences bearing upon the circulation, and these researches so dominated the field, that it began to look as if the vascular system played a more important part than the heart itself in thus influencing the circulation.

Other experimental researches had the object of as-

certaining what influence the separate constituents of the waters exercised in producing the effects of the baths. As our observations had been made on the warm saline springs of Nauheim, rich in carbonic acid (and in order to provide a partial substitute for these we devised a method of preparing the baths artificially), the next step to be taken was obviously to test (a) how far the influence on the circulatory apparatus was due to the temperature, (b) how far to the mineral constituents, *i.e.*, the salts, and especially (c) how much was due to the carbonic acid gas. It was precisely in reference to these questions that there arose among different inquirers a marked diversity of opinion, which has become more and more accentuated during the course of the last decade. Some, for example, asserted that the temperature was almost the only factor by means of which the baths exerted their influence; others were of the opinion that the salts were to be regarded as non-essential and that only the carbonic acid gas produced any effect; and so on.

The question now arose as to how much light the newer methods of investigation might throw upon the influence of those factors which prove efficacious in the bath. As many of the opinions in question were based upon results obtained in the course of investigations conducted with artificial saline baths charged with carbonic acid gas, it became necessary to try what difference, if any, was to be found between the effects produced by these *artificial* baths and the *natural* effervescing saline baths. With this object in view it was deemed most appropriate that the investigations should be conducted at Bad-Nauheim.

It was particularly the able and diligent researches instituted by Otfried Müller and his collaborators, that seemed to deviate the most from the observations and results that I had recorded before him. His experiments dealt with observations made with *fresh-water baths* and *artificial Nauheim baths* which he had prepared with sodium

bicarbonate and hydrochloric acid, according to the methods formerly laid down by us and which I still use at the present day.

In order that I may not be misunderstood, I should like on this occasion to state definitely that, clinically, highly gratifying results may be obtained in cases of heart disease by the use of such baths, but their action is *decidedly not identical* with that of the natural waters. On this point I also dwelt in the year 1907, in an article published in the Boston Medical and Surgical Journal. But even in reference to the mode of operation of the artificial baths, the statements of J. Strasburger differed essentially from those of O. Müller. It, therefore, seemed all the more requisite to institute fresh inquiries. Some of these I undertook last year at Bad-Nauheim with my assistant, Dr. Degenhardt, while others were carried on by Dr. J. Strasburger, the present Director of the Policlinic and Therapeutic Institute of Frankfort-on-the-Main, with his two assistants, Dr. Max Meyer and Dr. S. Isaac. The investigations which were carried out by my assistant involved measurements of the blood-pressure in the case both of *healthy persons* and of those with *cardiac lesions*. A somewhat detailed account of these observations will here be given, while a fuller elaboration will be supplied by Dr. Degenhardt at some time in the near future. The experiments of Dr. J. Strasburger and his assistants were carried out with the spirometer-volume-indicator (Strasburger's improvement of the plethysmograph) and O. Frank's reflecting or optical sphygmograph.

CHAPTER VII

INVESTIGATIONS OF THE BLOOD-PRESSURE IN HEALTHY PERSONS

As regards the condition of the blood-pressure in the plain-water bath, it has already been established by former observers, especially by O. Müller and by J. Strasburger, that in the cool plain-water bath the blood-pressure generally stands above the initial value. O. Müller says this is invariably the case. Strasburger maintains that secondary diminutions occur, bringing it down as far as, or even lower than the initial value, but he agrees that in the cool plain-water bath the average of the blood-pressure is raised.

The following investigations of the blood-pressure, whether of healthy or of sick persons, were conducted by continuously observing and recording the *maximal* and *minimal blood-pressure*, the *rate of the pulse* and of *the respiration* for the space of 15 minutes *before* the bath, then *during* the bath and again for 15 minutes *after* it. All necessary precautions were observed. In order to eliminate as far as possible every psychic influence, provision was made to secure the greatest quiet in the surroundings of the patient under observation. It was almost always arranged that my assistant only, and the same bath-attendant, should be present, although in particular cases I joined them. The temperature of the room was kept between 68° and 72° F. (20° and 22° C.), in order to avoid any sense of chilliness or overheating. Care was also taken, from a hygienic point of view, to secure ample renewal of the air, so that the respiration should not be interfered with by any closeness of the room. After undressing, the person to be examined was covered with warm woolen blankets,

and after the Riva-Rocci tonometer with Recklinghausen's broad cuff had been applied the patient stepped into the bath and the observations were begun.

As I have already explained, the measurements of the *systolic* and *diastolic blood-pressure*, of the *pulse rate*, and of the *respiration* had already been taken in turn for some little time, because by this procedure a more exact control is rendered possible than when only a single measurement is determined to start with. When the period of time for the bath had elapsed the water was run off, in order to avoid exertion on the part of the person under examination, and always maintaining the reclining position, he was carefully dried, and again covered with warm blankets, after which the observations were continued. The *systolic* or *maximal* blood-pressure was ascertained by palpation, the *diastolic* or *minimal* blood-pressure was ascertained by Korotkow's method, because the latter perfectly meets the scientific requirements. Here both the *maximum of tone* and *complete disappearance of tone* were taken into account.

In reading the manometer, the level of the mercury and the eye of the observer were kept at the same height. All measurements were conducted by the same assistant, for by this arrangement uniformity of observation is best guaranteed irrespective of the psychic quiet necessary for the person under examination. During this observation, which lasted from three-quarters of an hour to an hour, the investigations were made continuously, and by this means the figures obtained possess a much more certain value than when observations are instituted at longer intervals. The experiments on the same individual were, of course, always made at the same time of day, and that was during the course of the morning. The morning meal which preceded the bath was likewise invariably the same.

The healthy subjects, on whom a somewhat lengthy series of observations were made, were a painter, B. S., aged 31, a painter, A. B., aged 39, and a servant-boy, U., aged 19. In

all of these men, who had never had any illness, physical examination showed that their organs were absolutely sound.

The results of our investigations on the above-named healthy individuals with the natural thermo-saline carbonic acid baths are here reproduced in various tracings. This tracing (Fig. 1) represents the operation of a Nauheim effer-

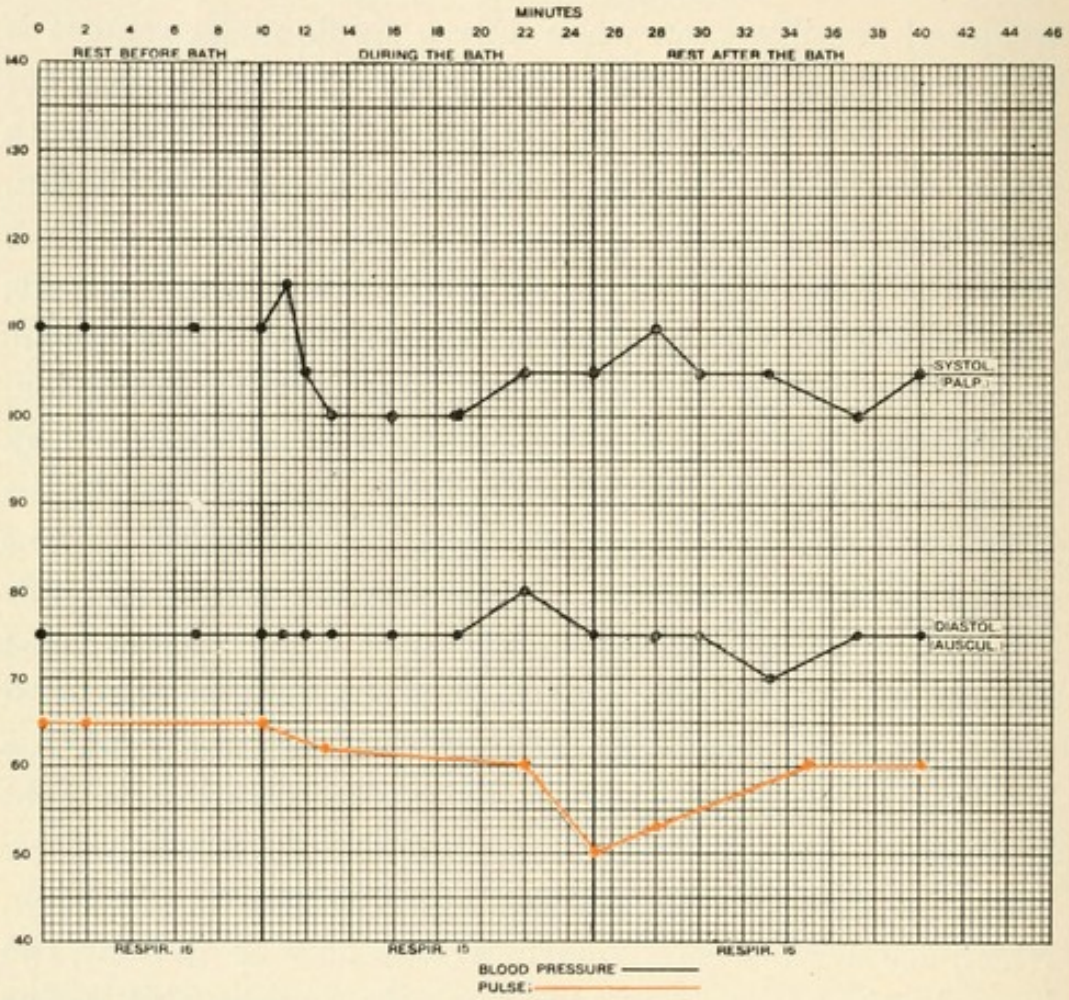

FIG. 1.—Effervescing (Sprudel) bath of Spring No. VII, 80.6° F. (27° C.), 15 minutes.

vescing bath of Spring No. VII, at 27° C. and of 15 minutes' duration. It shows that notwithstanding the low temperature, upon a rise of pressure at the beginning there ensues a fall, passing below the initial level to such an extent as is probably never met with in the plain-water bath of the same temperature. Similar characteristics appear in a series of tracings, which we have obtained with cool ef-

fervescing baths. The striking feature is that after the increase of blood-pressure at the beginning (and the cooler the bath the greater is this increase) the subsequent diminution goes below the initial level. This is shown, for example, in the following tracing (Fig. 2).

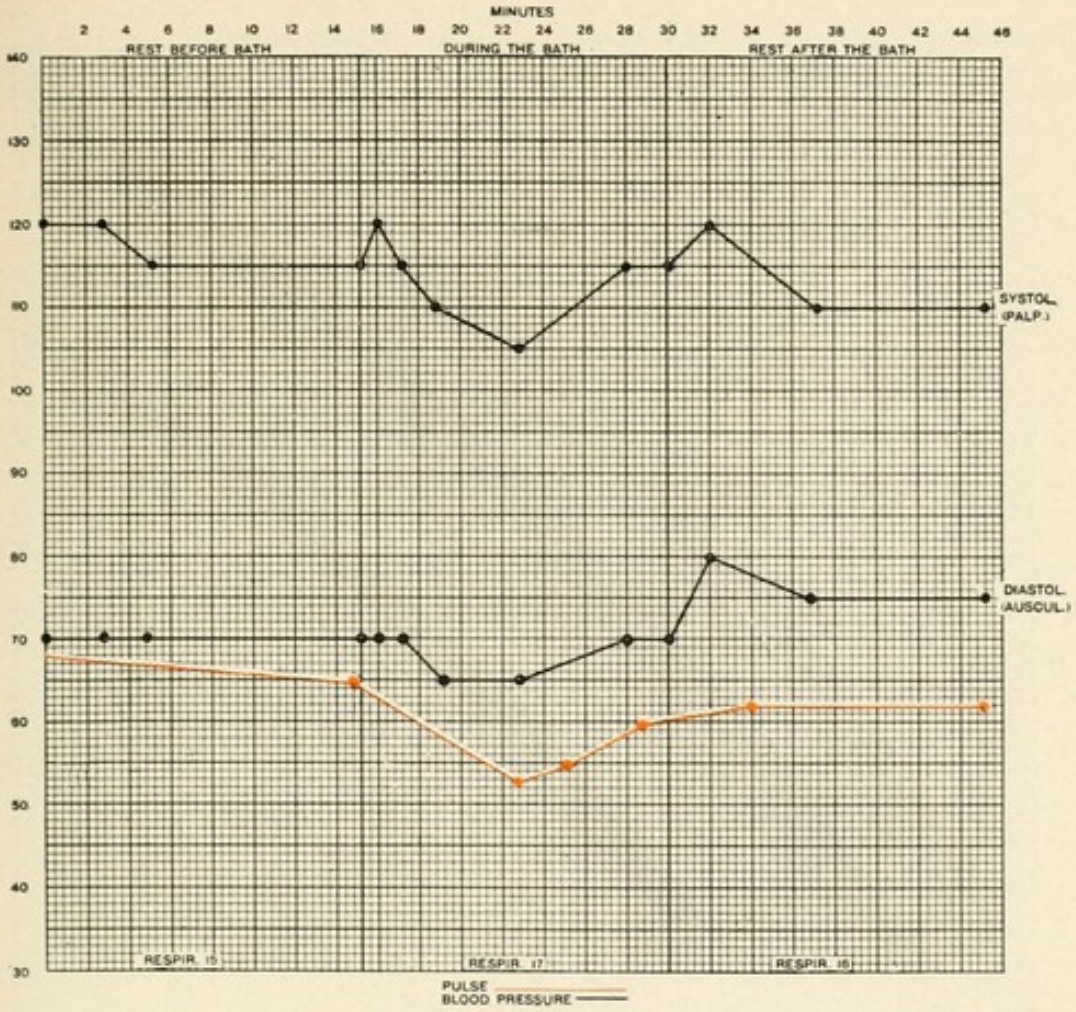

FIG. 2.—Effervescing (Sprudel) bath of Spring No. VII, 80.6° F. (27° C.), 15 minutes.

In contrast with the averages obtained in the cool plain-water bath the pressure during the natural effervescing bath in only four out of thirteen instances remained above the initial value.

If we administer natural effervescing baths having a temperature above the point of indifference, but without being decidedly hot, a marked diminution of pressure is maintained from the beginning to the end of the immersion.

This requires no explanation, for even the simple bath at these warm temperatures, as we all know, lowers the blood-pressure. But that the diminution of pressure with the natural effervescing bath of this temperature is, through the action of the CO_2 in dilating the vessels, still more

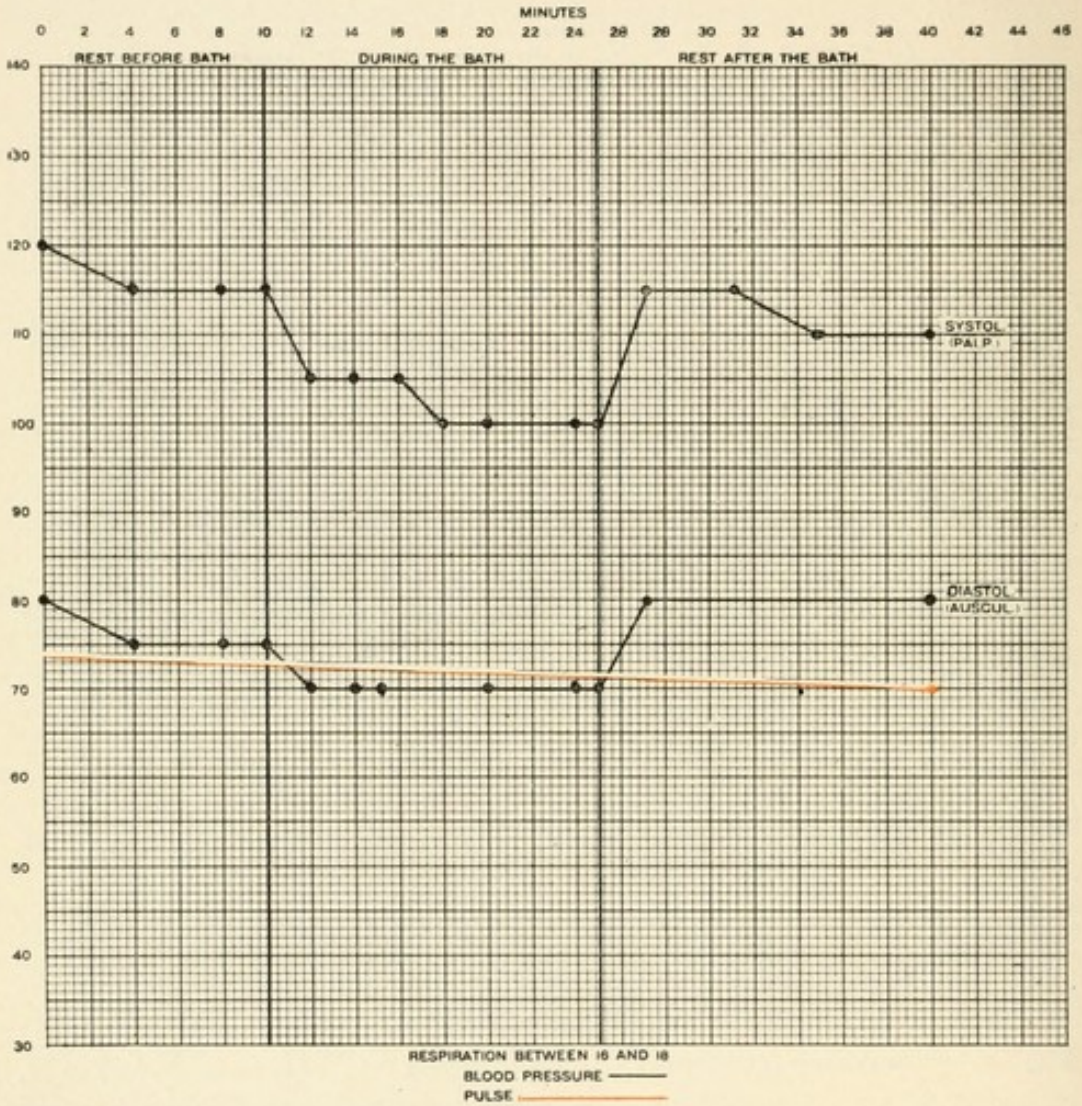

FIG. 3.—Effervescing (Sprudel) bath of Spring No. VII, 96.8° F. (36° C.), 15 minutes.

strongly marked than in the simple bath, appears clearly from the tracing of Fig. 3. Here we find a notable fall of 15 mm. Hg.

It is a remarkable fact, evolved from our experiments with natural effervescing baths at temperatures below the point of indifference, that such effervescing baths, which, if they operated by temperature alone would cause an

increase of pressure, far from doing so, bring about, through their content in mineral constitutents and especially by the carbonic acid gas which attains its full efficacy in the natural bath, a *diminution of pressure* in a very large percentage of cases. From these observations on healthy persons it follows that the natural effervescing baths possess a *powerful dilating action* upon the blood-vessels, such as is not to be found either in the plain-water bath or in the artificial CO_2 bath at corresponding temperatures.

CHAPTER VIII

MEASUREMENTS OF THE BLOOD-PRESSURE IN CASES OF HEART DISEASE

(*a*) Operation of the natural thermo-saline baths containing carbonic acid on patients with low blood-pressure. (*Hypotonia.*)

Most interesting information is afforded by an investigation of the systolic and diastolic blood-pressure in cases of heart disease. In healthy persons the pressure was frequently reduced by the effervescing Sprudel bath because of free vascular dilatation. In affections of the heart we may assume that the same dilating action is exercised on the vessels where no arteriosclerotic process is present and the vascular walls are still elastic. In accordance with this, a blood-pressure that is already lowered by a weakened heart, ought to sink still lower in the effervescing Thermal bath at the fairly cool temperatures of 86° to 90.5° F. (30° to 32. 5° C.). Now, precisely the opposite takes place, as is shown in our tracings, for the low blood-pressure rises and generally remains for some time at the higher level that it has attained.

This circumstance indicates the presence of some other factor, which has over-compensated the lowering of pressure that might have been expected to follow on vascular dilatation. This factor can only be *the heart itself*. Now, I have pointed out in my different works how the stronger activity of the heart, produced by the baths, can be clearly detected in the heart itself by the help of *inspection*, *palpation*, *percussion* and *auscultation*. These observations have been confirmed by many writers, not only in Germany, but also in England and America, so that I need hardly mention this point. I would only call attention to the fact

that, in relative insufficiency of the heart-muscle, murmurs often disappear; that, as a consequence of a stronger and slower action of the heart weak sounds become louder; that tachycardia or arrhythmia may disappear; and so on. Moreover, the general condition of the patient indicates that the heart has really become stronger.

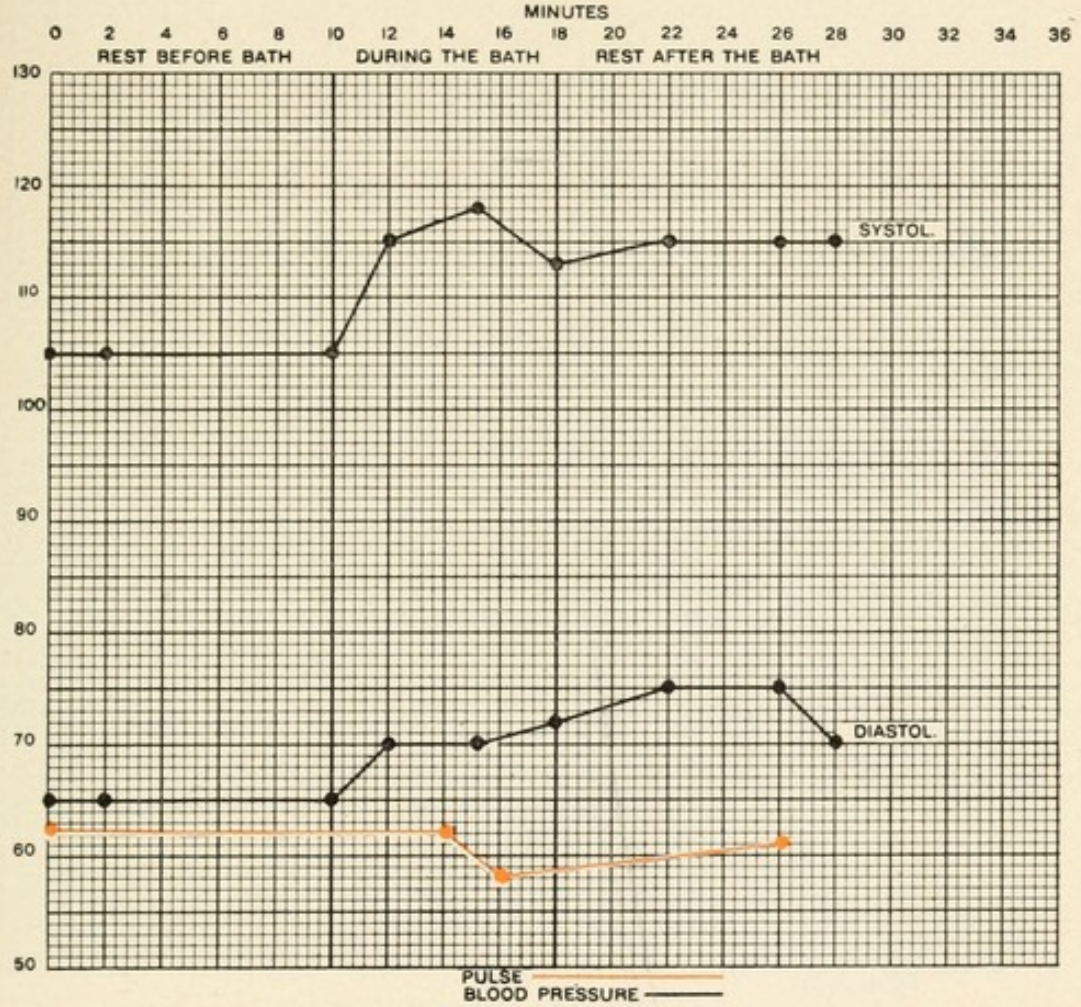

FIG. 4.—Mr. S., merchant, 19 years. Weakened heart; both ventricles dilated. Effervescing (Sprudel) bath of Spring No. VII, 86° F. (30° C.), 8 minutes.

This increase of strength in the heart's action receives an unexceptional confirmation in the range of the amplitude of the blood-pressure which now becomes observable, for in our experiments this amplitude was notably raised with hardly an exception, and indeed the blood-pressure in the different patients showed the same condition, whether it

be in cases of weakness of the heart-muscle of a purely functional kind, or weakness of the muscle originating in a valvular defect, as, for example, in the case of C. M. (Fig. 6). From the fact that in our cases the mean blood-

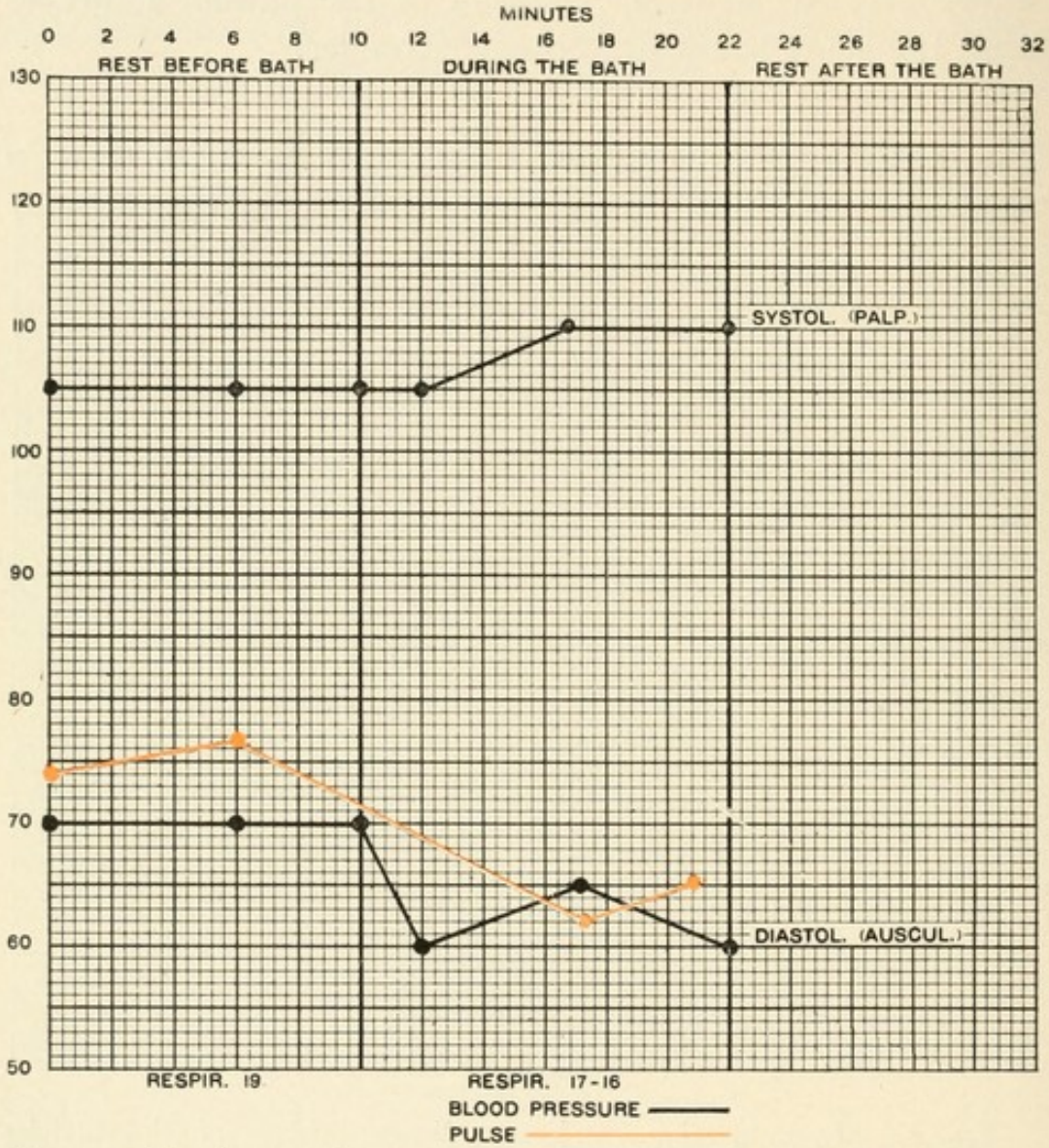

FIG. 5.—Mr. A., merchant, 38 years. Weakened heart. Effervescing (Thermal) bath of Spring VII, 90.5° F. (32.5° C.), 12 minutes.

pressure *remained the same*, or about the same, we must conclude, that the range of amplitude cannot have been influenced by changes in the elasticity or tone of the vessels. It accordingly results from the *increase of amplitude* that the output of the heart has been raised by the natural gaseous saline bath, and this agrees, too, with our former

observations on the influence of the effervescing baths in imparting tone to the heart. With hardly an exception there was simultaneously observed a moderate slowing of the respiration, and especially a distinct reduction in the frequency of the pulse.

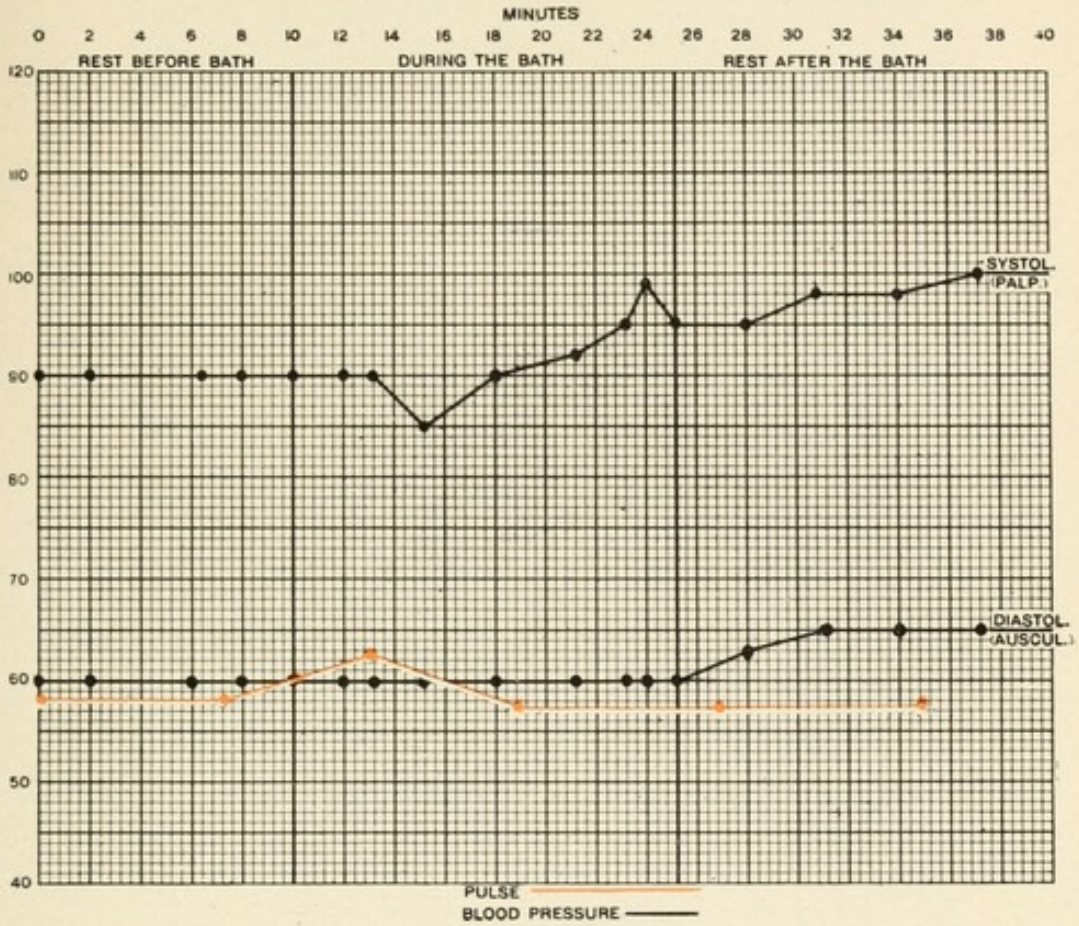

FIG. 6.—Mr. C. M., manufacturer, 53 years. Mitral insufficiency. Effervescing (Thermal-Sprudel) bath of Spring No. VII, 88.7° F. (31.5° C.), 15 minutes.

(*b*) **Operation of the natural Nauheim baths on patients with high blood-pressure.** (*Hypertonia.*)

In some of my former writings I have pointed out how, with the help of the Nauheim baths correctly and methodically employed, an abnormally high blood-pressure may be, and actually is, brought down.

This tracing (Fig. 7) shows how during an effervescing (Thermal) bath of Spring No. VII at 34° C. the high blood-pressure of 200 mm. Hg. went back to 190 mm. Hg.

In Dr. W.'s case, effervescing bath No. VII at 87° F. (30.5° C.), the blood-pressure, which had previously been 175

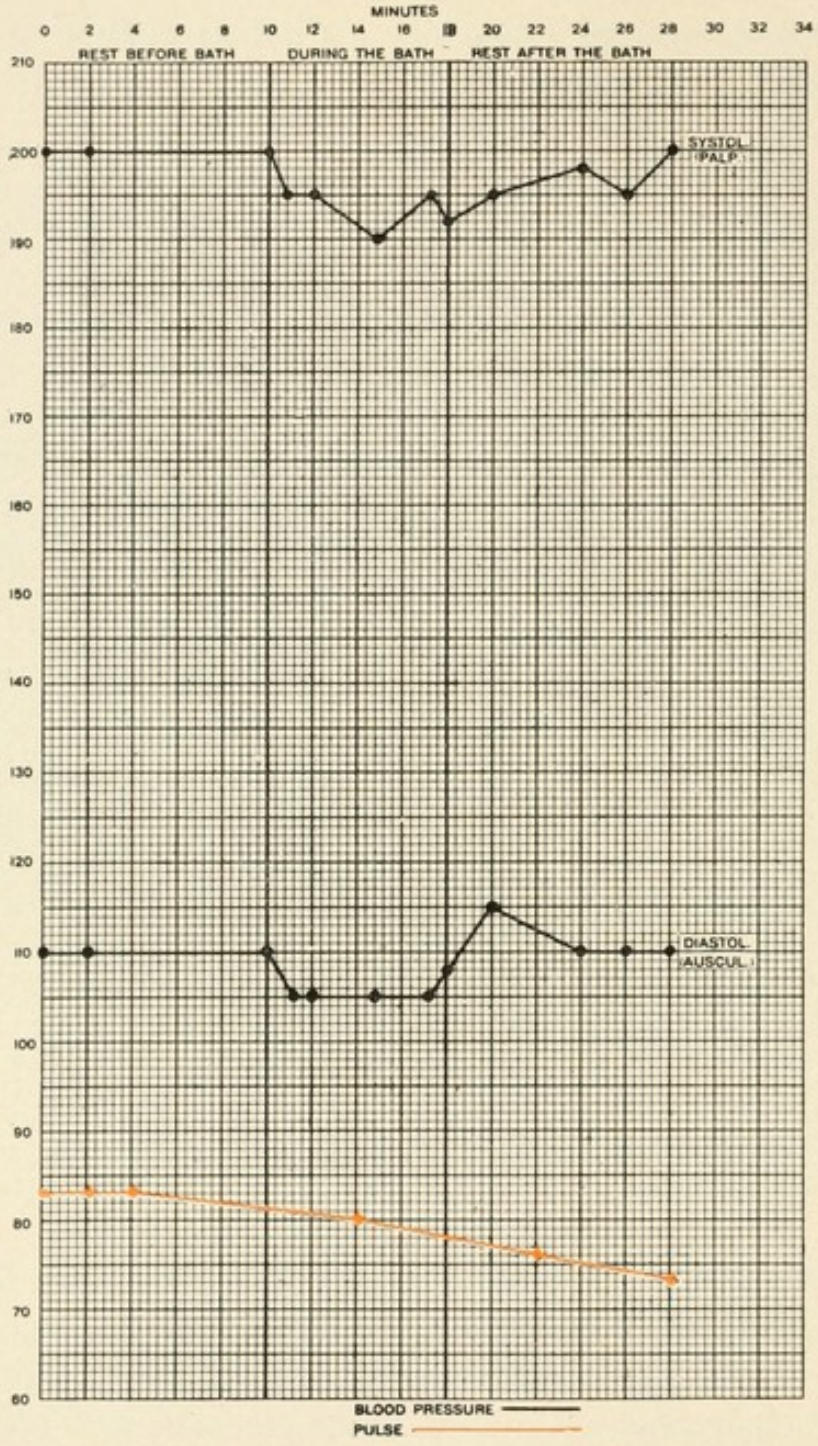

FIG. 7.—Mr. S. O., merchant, 63 years. Arteriosclerosis, myocarditis, nephritis. Effervescing (Thermal) bath of Spring No. VII, 93.2° F. (34° C.), 8 minutes.

mm. Hg. while at rest, rose within the first minute in the bath to 186 mm. Hg., but under the strong influence of

the bath on the heart and vascular system, went back during and following the bath to 165 mm. Hg. This marked

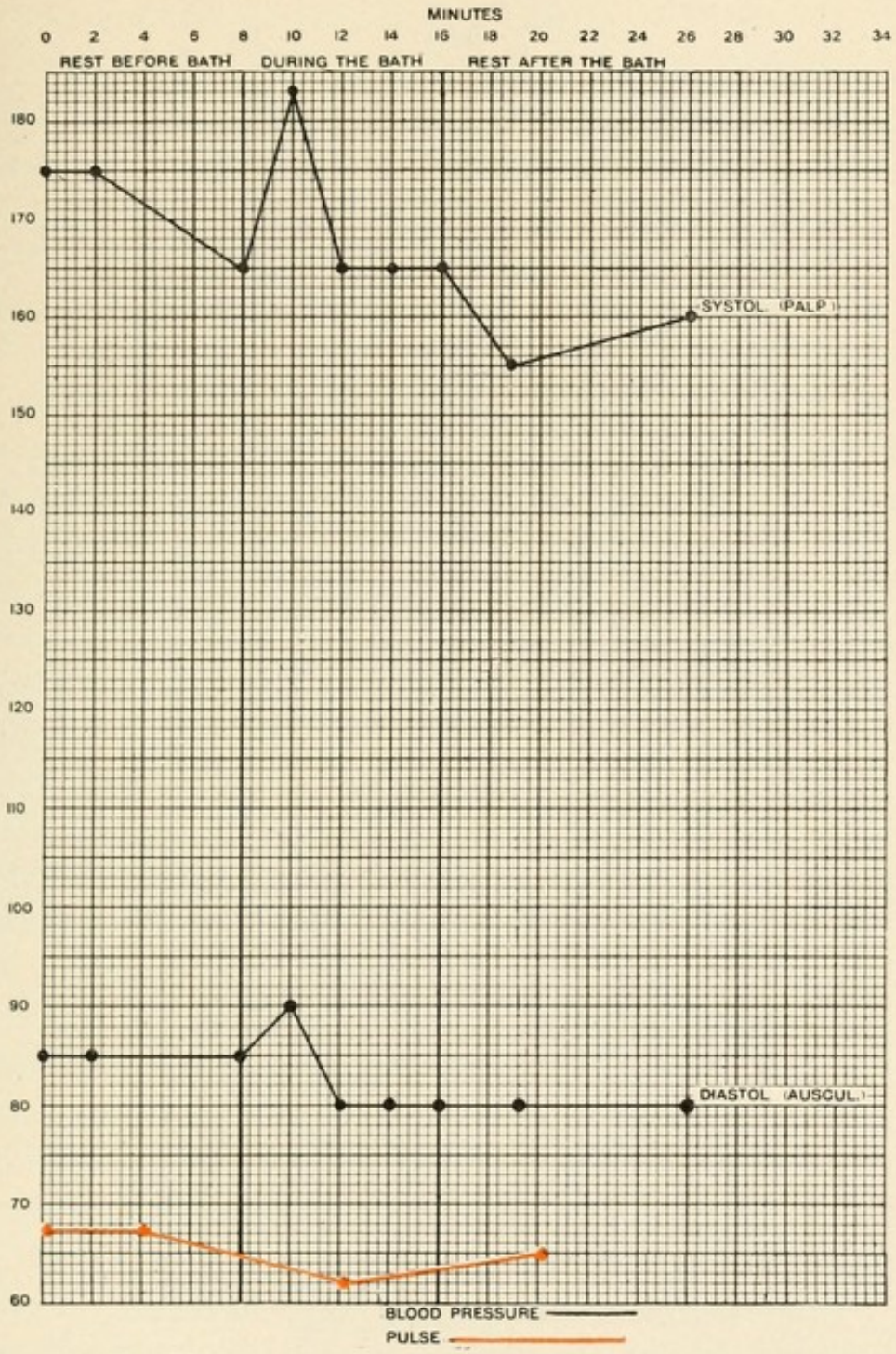

FIG. 8.—Dr. W., physician, 56 years. Arteriosclerosis, aortic stenosis, myocarditis. Effervescing (Sprudel) bath of Spring No. VII, 87° F. (30° C.), 8 minutes.

initial ascent in such cases of high blood-pressure is not a matter of indifference in its bearing on the heart and blood-

vessels. It is easy to see that the patient's condition may become aggravated thereby, and so, for the beginning of the

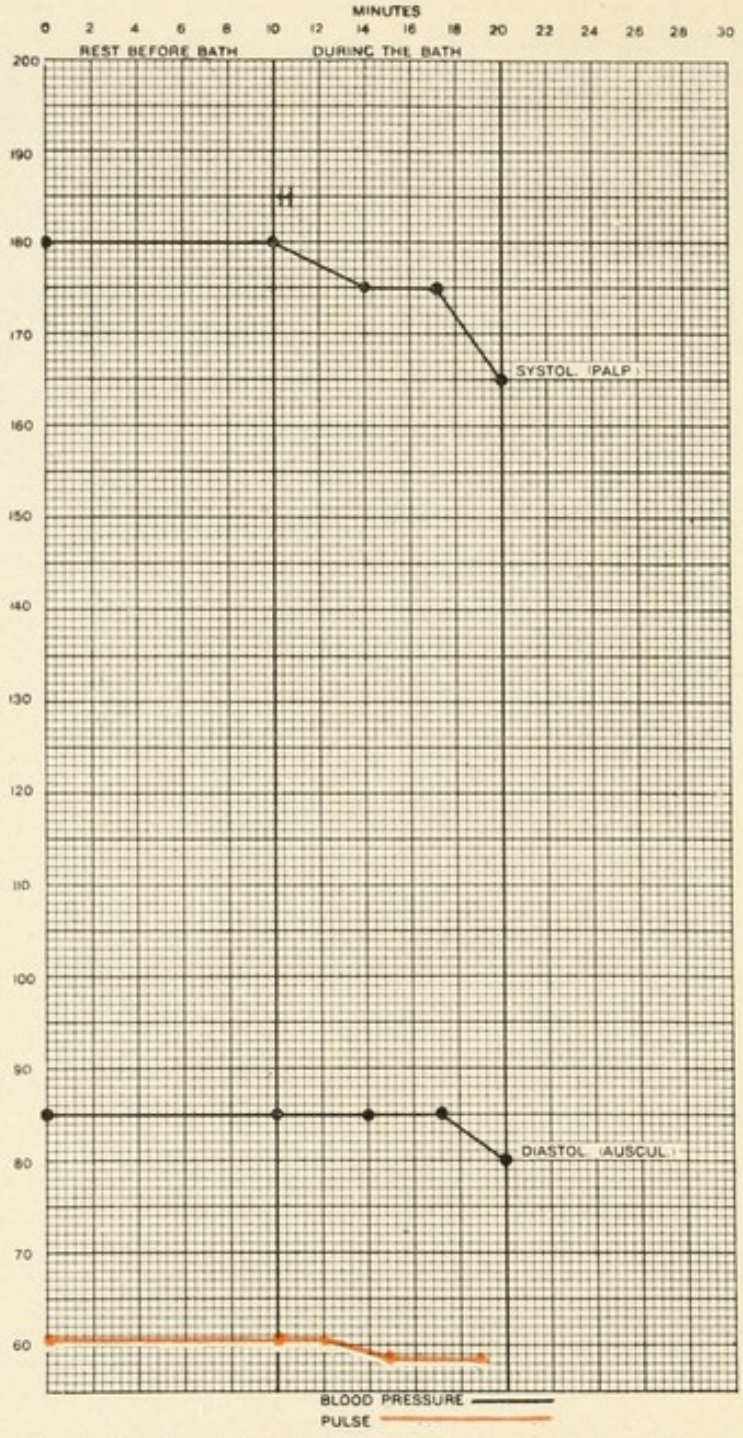

FIG. 9.—Dr. W., physician, 56 years. Arteriosclerosis, aortic stenosis, myocarditis. Effervescing (Sprudel) bath of Spring No. XIV, 88.7° F. (31.5° C.), 10 minutes.

treatment, too cool a temperature must always be avoided and warmer baths at first employed. These natural effer-

vescing baths develop such a powerful action, that, as in the case of all energetic remedies, an exact knowledge of their mode of application is necessary.

The tracing (Fig. 9) taken on the same patient, which reproduces the action of a warmer effervescing bath of Spring No. XIV, at 89° F. (31.5° C.) and 10 minutes duration, does not show this initial elevation. The blood-pressure, which was 180 mm. Hg. when the patient was resting before the bath, went down within the first few minutes to 175 mm. and finally fell, in 10 minutes time, to 165 mm. Hg.

Now, while the systolic blood-pressure subsides, we find in most of the cases belonging to this category, chiefly cases of arteriosclerosis and nephritis, that as a matter of course the amplitude becomes smaller. As is well known, there is in these cases of high blood-pressure a very large amplitude, *i.e.*, a very great interval between the systolic and the diastolic pressure; consequently, a very great increase of pressure at every single beat of the heart. This very high amplitude at a high blood-pressure is caused by the fact that the further distensibility of the vascular system is very minute at this level of pressure, because the conditions of elasticity in the arterial system are not the same as those of a rubber tube, in which a uniformly increasing load always conditions an equal increase of distention. The distensibility of the arteries which is greater with a small load, decreases rapidly at a higher pressure, in consequence of which every addition to the contents of the already tense artery causes an extraordinary rise of pressure.

The same output of the heart, which produces a moderate rise of pressure when the arterial tension is slight, calls forth a much greater rise of pressure (amplitude) when the tension is greater. Now, if during the bath, the mean blood-pressure falls, the vessels again become susceptible of distention and the same increment of pressure as before now shows a smaller amplitude. The diminution of the amplitude is the automatic (purely physical) consequence

of the falling blood-pressure. Whether alterations in the output of the heart play any part in this cannot be gathered

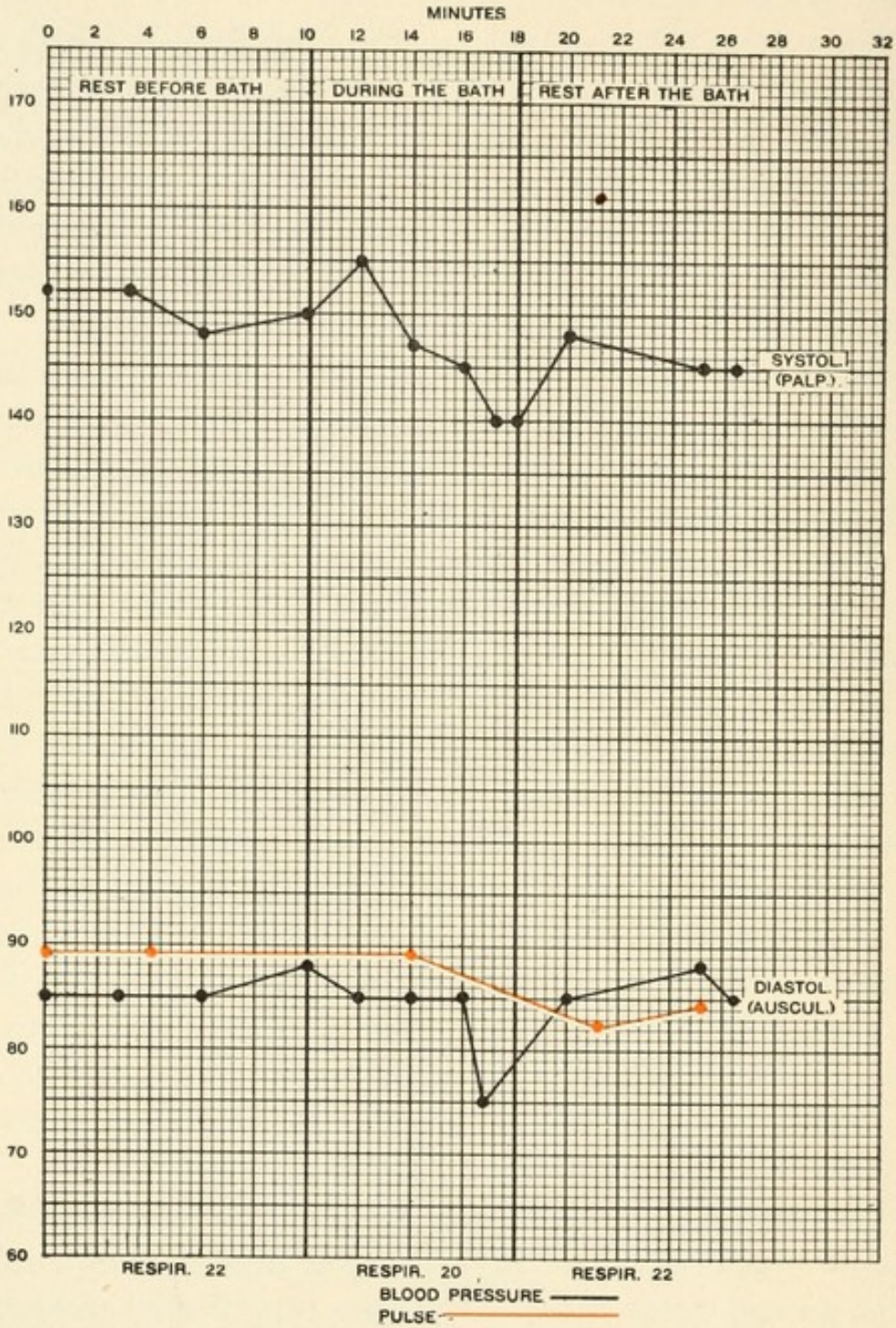

FIG. 10.—Mr. P., merchant, 51 years. Arteriosclerosis, myocarditis, angina pectoris, dilatation of both ventricles. Effervescing (Sprudel) bath of Spring No. VII, 87° F. (30.5° C.), 8 minutes.

from the amplitude in these cases, although the results of our clinical observations should throw some light upon the

subject. Aside from the above tracings, the one shown in Fig. 10 will clearly illustrate the conditions described.

We should bear in mind that blood-pressure reduced in this manner generally remains for a long time at a reduced level. Of course, the clinical picture also changes in connection with the change of the blood-pressure. This will presently be dealt with more in detail.

Action of Resistance-exercises.—The application of our method of resistance-exercises will be fully described later on.

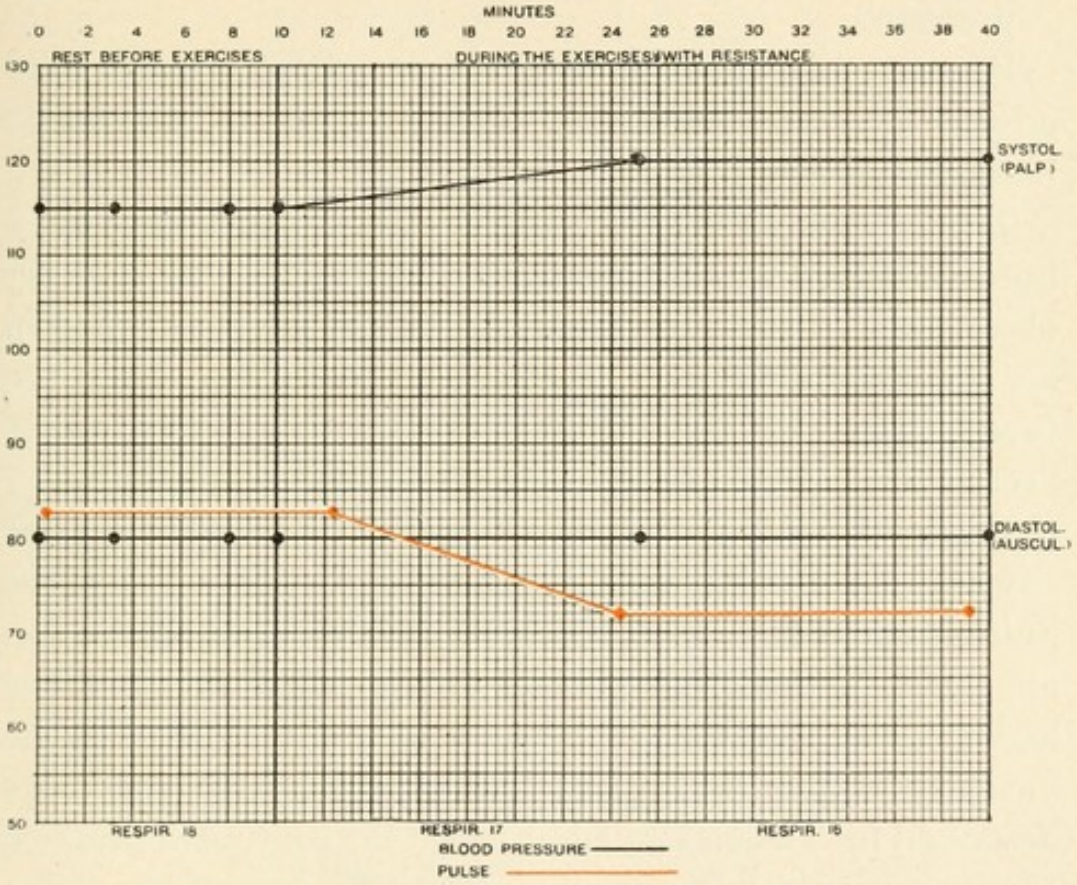

FIG. 11.—Mr. C., merchant, 26 years. Weakened heart, dilatation of left side of heart. Thirty minutes exercises with resistance.

While the influence of the bath starts from the sensitive and cutaneous nerves, the stimulus of the muscles that are thrown into movement travels by other paths to the brain and thence through the vagus to the heart, calling forth the retarding action through this channel. Slowing of the pulse rate and improvement in the respiration are effected

by the exercises. It is, therefore, easy to understand how the tracings of the blood-pressure will be influenced by the resistance-exercises in the same manner as by the effervescing baths. This is shown by the following tracings.

(*a*) **Action of the resistance-exercises on low blood-pressure.**

From these tracings (Fig. 11) it is manifest that the *blood-pressure, previously low, has risen* through the influence of the resistance-exercises.

(*b*) **Action of the resistance-exercises on high blood-pressure.**

Here, as these tracings show (Fig. 12), the *exercises* have *affected* a *reduction* of a *blood-pressure* that had previously been abnormally high.

The influence of the resistance-exercises, which have often been described by me, has been confirmed by many other observers. A study of these effects has been recorded in an elaborate article by Tiedemann and Lund. They too found that, with the aid of suitable (manual) resistance-exercises, weakened hearts were strengthened in such a way that disturbances of compensation were removed. In their cases it was shown also that dyspnea was relieved, that the pulse became fuller and stronger, and that the edema disappeared; further, that in cases of high blood-pressure, the high pressure became lower by removal of resistance in the vascular system. Moreover, it appears, from the cases described by Tiedemann and Lund, that continued practice of the movements above described had the effect of exercising and strengthening the heart, in entire agreement with the facts previously established by our own observations.

I shall submit here the reproductions of two roentgenograms that show the condition of the heart before the exercises (Fig. 13) and also a reproduction of the result on the same heart of exercises given with mild resistance, for the period of half an hour (Fig. 14).

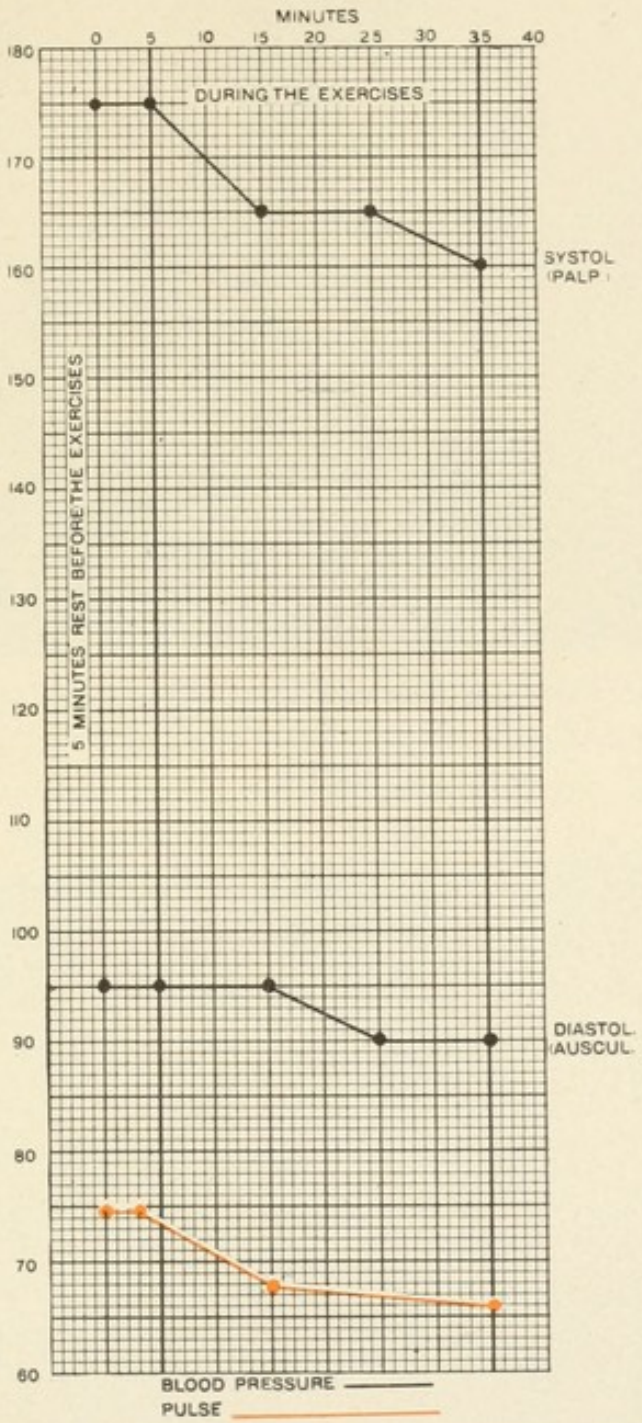

FIG. 12.—Dr. W., physician, 56 years. Arteriosclerosis, aortic stenosis, myocarditis. After 30 minutes of exercises with resistance (3 séances of 10 minutes each).

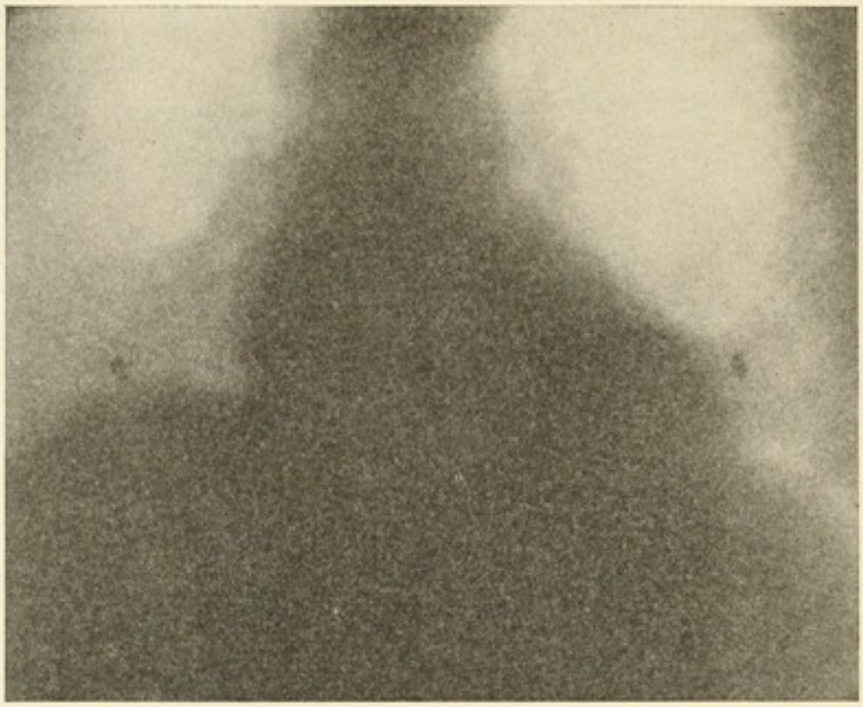

FIG. 13.—Before the resistance-exercises. (X-ray photograph of heart.)

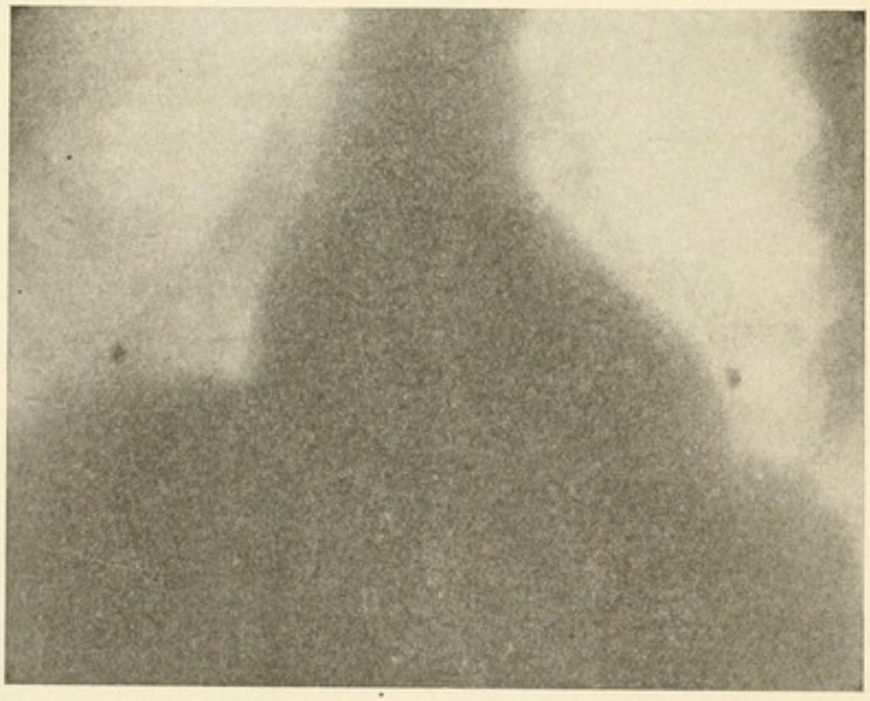

FIG. 14.—After a half-hour's exercise, with mild resistance. (X-ray photograph of heart.)

CHAPTER IX

PLETHYSMOGRAPHIC INVESTIGATIONS

A valuable supplement to my investigations of the blood-pressure, which are more directed to the center, that is, to the heart, is now contributed by the experiments which Strasburger with his assistant, Max Meyer, had instituted with the help of plethysmography. By this means we obtain information on the variations in the volume of the peripheral vessels under the most varied balneotherapeutic influences. The experiments were carried out last autumn in Bad-Nauheim with natural effervescing baths, after the necessary preliminary trials had been made in the Therapeutic Institute of Frankfort-on-the-Main. More detailed communications will be supplied by these gentlemen on a future occasion. I have to thank them for placing at my disposal for this treatise, some of the results of their studies on which the following remarks are based.

The results of these plethysmographic investigations lead to conclusions differing essentially from the views which O. Müller believed he had established through his experiments with artificial gaseous saline baths. According to him, the action of such baths on the volume of the peripheral vascular system is caused almost exclusively by the temperature, while to the carbonic acid in the bath is ascribed but a very slight influence on the behavior of the vessels. In opposition to this, Arthur Hirschfeld has already shown by his plethysmographic experiments, which were likewise made with artificial gaseous baths, that contrary to O. Müller's results, the artificial carbonic acid bath does not, like the fresh-water bath of the same (cool) temperature, cause a constriction of the vessels, but a moderate dilatation. These differences are occasioned, as

appears from Hirschfeld's investigations, by a set of arrangements in O. Müller's experiments which are not quite free from objection. More clearly still does this vascular dilatation appear from the more recent plethysmographic investigations by Strasburger and Meyer, to which I have just referred.

Based upon tracings taken from a considerable series of experiments now placed at my disposal, the comparison between a Nauheim effervescing bath and a fresh-water bath of like temperature yields the following results. After a short primary contraction, there follows on the stimulus of the salts and carbonic acid a vascular dilatation, which increases at first quickly, then gradually, until it attains considerable dimensions, so that the tracing at the close is found to be considerably higher than the level at which it started and at which it had remained constant for a considerable period before the bath. This tracing is entirely different from the tracings obtained by O. Müller from artificial baths, with which he regularly found *contraction* of the *vessels* while in these Nauheim experiments *dilatation* was always observed.

O. Müller's different results are perhaps accounted for by the circumstance that he made his experiments with the artificial gaseous saline bath, and that possibly the specific action of these baths in causing vascular dilatation is not so great, so that the momentary stimulation of the cold preponderates and causes a vascular contraction. This could, however, also be accounted for in the following way: It has already been emphasized by another inquirer (E. Weber) that the height of the plethysmographic tracing may be interfered with by the activity of the respiration, since by deeper breathing the flow of blood from the veins is promoted, in consequence of which the volume of the extremities from which the blood flows must sink. Now it is well known that from the artificial bath a larger proportion of the carbonic acid escapes into the air.

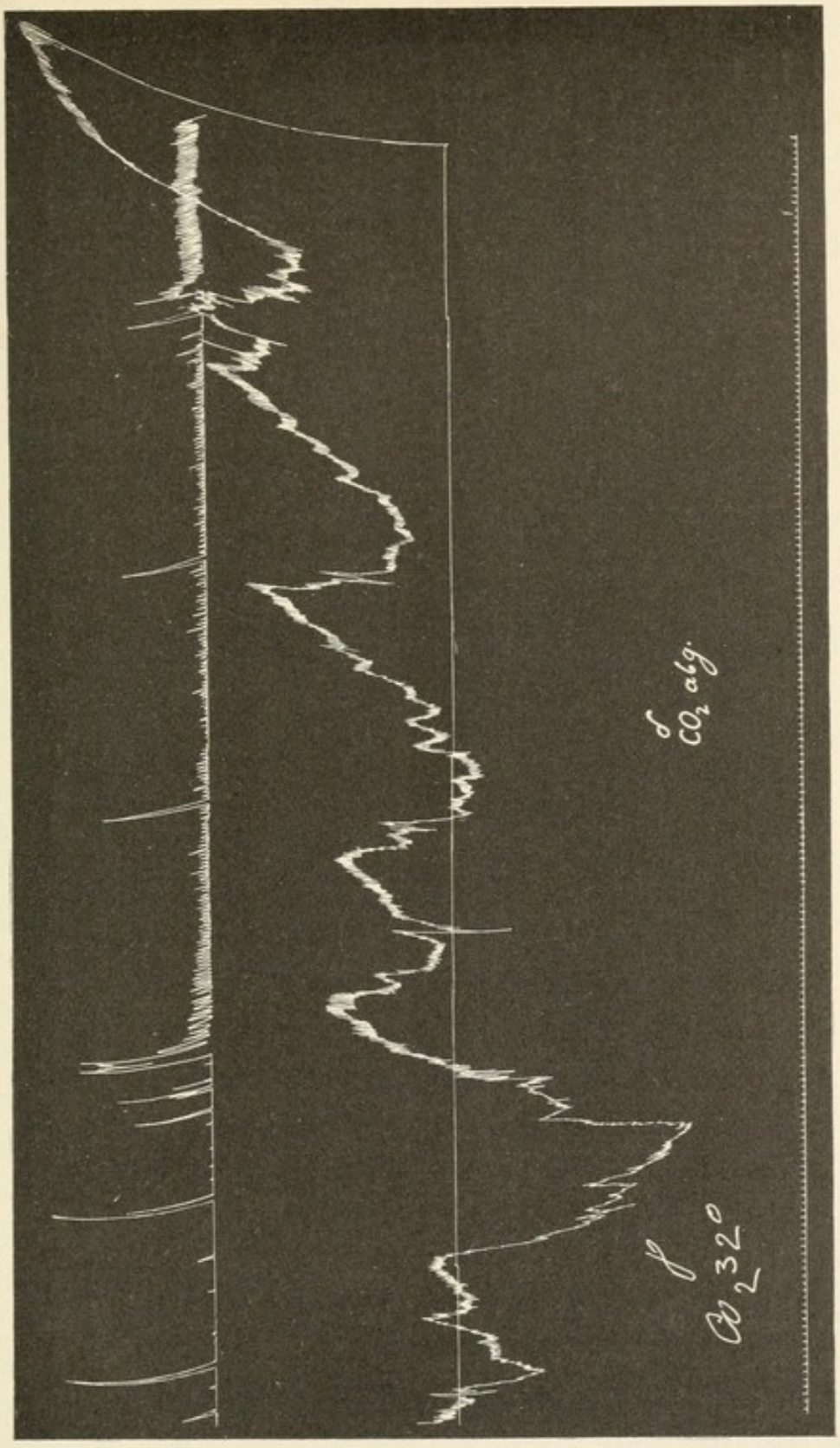

FIG. 15.—Plethysmographic tracings showing vascular dilatation after an effervescing (Sprudel) bath.

In consequence of this much more carbonic acid is inhaled and the breathing is deepened which may lead to a fall in the plethysmographic tracing. That this circumstance may play a considerable part will be shown by the following tracing (Fig. 16).

In this experiment cool Sprudel-water was let into the bath tub, which was already half filled with hot fresh-water. By this means the escape of the carbonic acid was favored. From the upper part of the tracing, representing the respiration, we see how singularly deep and irregular this became, which must point to the conclusion that there was a condition of dyspnea present. We see at the same time that the plethysmographic tracing has fallen notably and exhibits pretty well-marked oscillations, but does not return to its former position. It is quite conceivable, nevertheless, that a relative dilatation of the vessels took place; but, in consequence of the marked increase in the outflow of blood this no longer appears in the tracing.

The powerful action of the natural Sprudel baths in dilating the vessels, as contrasted with the fresh-water baths of like temperature and also the artificial carbonic acid baths, is rendered evident by further tracings obtained by Strasburger and Meyer.

A reliable auxiliary device for studying the alterations in the vascular system, and especially in attempting to elucidate the influence exercised by vaso-motor agencies on the peripheral circulating apparatus, consists in the determination of the lapse of time between the pulse in the central arteries and that in the peripheral arteries. The stronger the tension in an arterial current, the swifter is the propulsion of the blood-wave in the vessel; the less tense the current, the slower is the wave of propulsion. Remission of the tension, especially if this be well pronounced, is a sign of vascular dilatation. If we know the length of the tract and find alterations in the time taken by the wave therein, we may recognize whether the vessel has become wider or

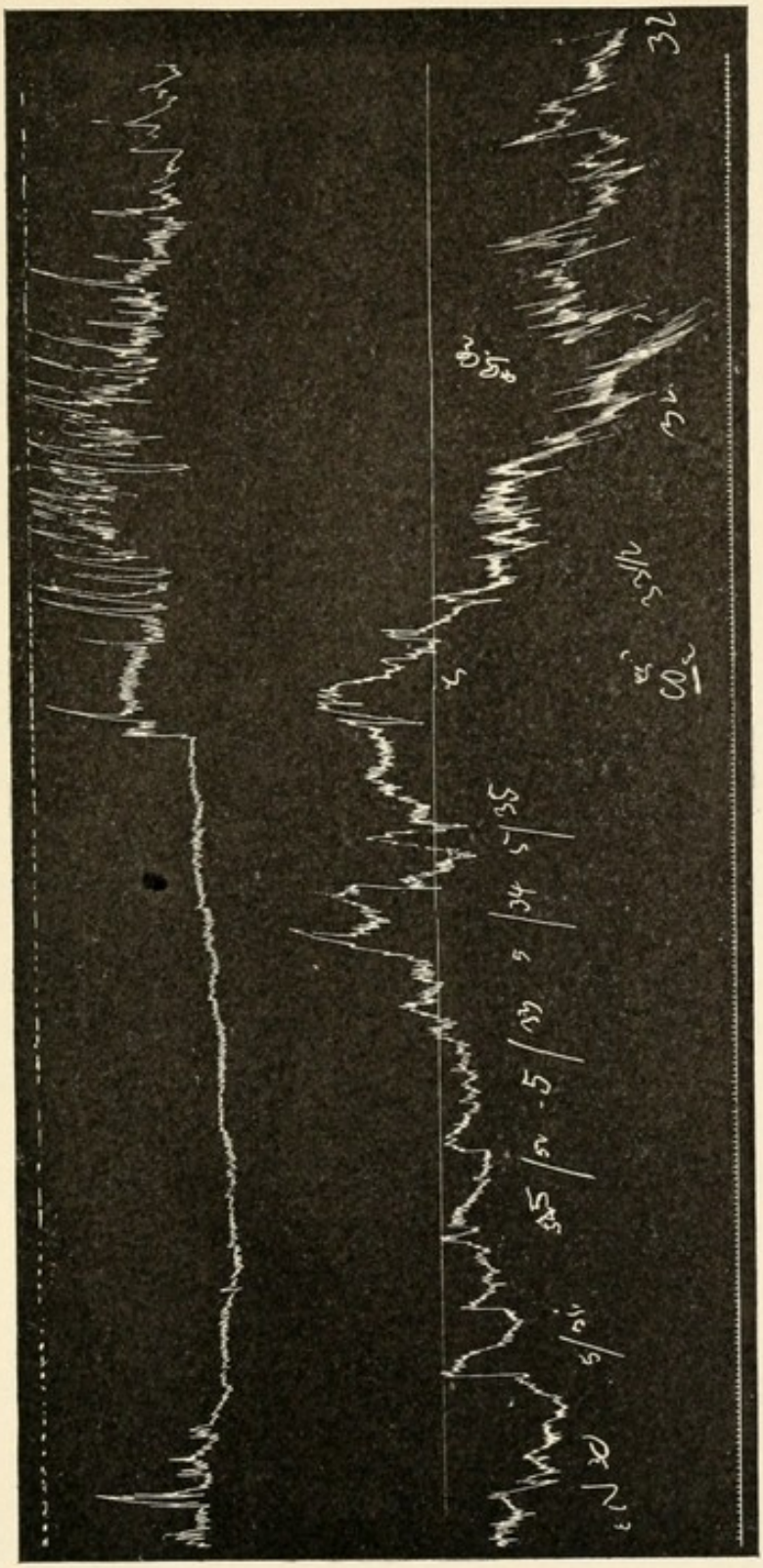

FIG. 16.—Plethysmographic tracings showing how inhalations of CO_2 caused deep breathing and a fall in the pulse tracing.

narrower. An excellent instrument, doubtless by far the most perfect that we now possess for this purpose, is O. Frank's optical registration sphygmograph. More will be said about the advantages of this instrument at another time. This apparatus enables us, when the drum is put in rapid motion, to measure with ease minute differences of less than one one-hundredth part of a second in the time occupied by a pulse wave. The differences in the experiments here exhibited were measured, some between the subclavian and radial artery, and some between the carotid and the radial.

In order to facilitate comparison and measurement the photographic reproductions of the pulse waves were so arranged that the two pulses were recorded on the same film, the one directly above the other.

As may be seen, the radial pulse normally begins to ascend somewhat later than that of the subclavian or the carotid. If these differences between the central and the peripheral vessels undergo a change, as can be ascertained by measurement taken on the basal points of the tracings, we are enabled by this difference of time to judge of the tonus of the vessels. This only applies to cases where decided changes in the blood output are not present. When there is a contraction of the vessel, the pulse sets in earlier; with dilatation of the vessel it occurs later. The tracings, together with their figures, afford exact information regarding these differences of time.

CHAPTER X

RETARDATION OF THE PULSE

While, as previously stated, O. Müller and Veiel, using artificial gaseous saline baths at indifferent or somewhat lower temperatures, and comparing these with fresh-water baths of the same temperature and duration, found an *acceleration* of the *pulse*, and so a *vascular contraction*, the

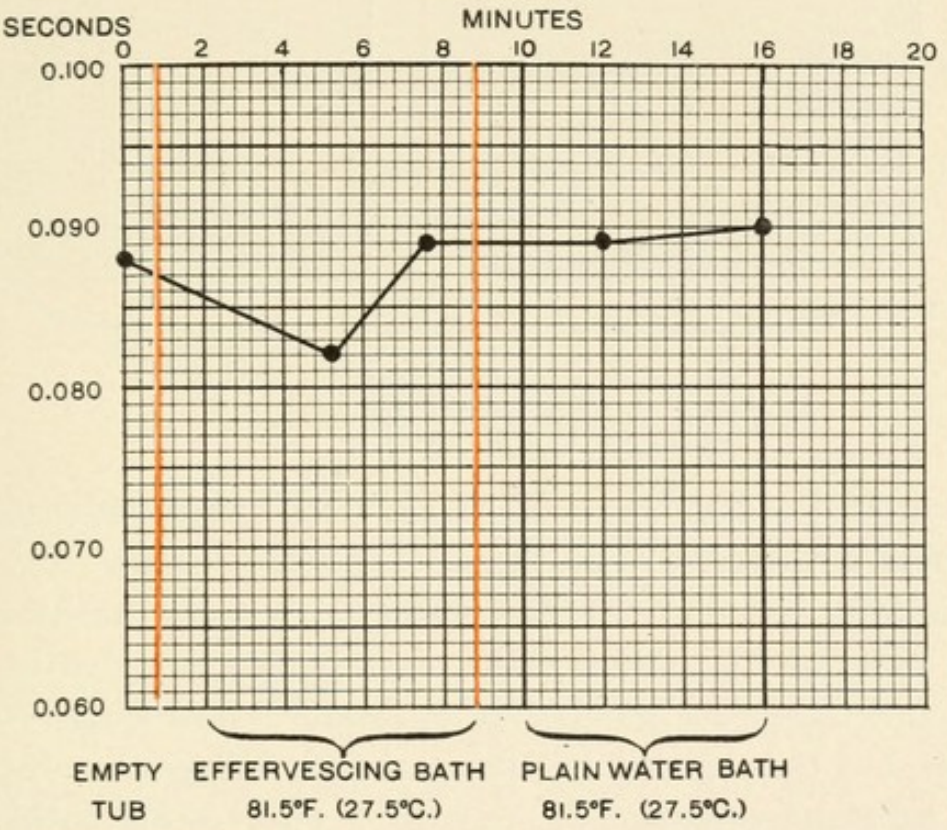

FIG. 17.

experiments of J. Strasburger and his assistant Isaac, who compared the natural Nauheim effervescing baths with fresh-water baths of the same temperature, show in contrast with O. Müller's results, a distinct *retardation* of the

pulse. It is to be noted that the temperatures were here chosen, so as to correspond with those in Müller's experiments. Thus, by these observations the powerful *vaso-dilator action* of the effervescing baths, even *below the indifferent temperature*, is established.

If we now collect the results of these three series of investigations and compare them with earlier investigations, it follows that natural thermo-saline CO_2 baths develop

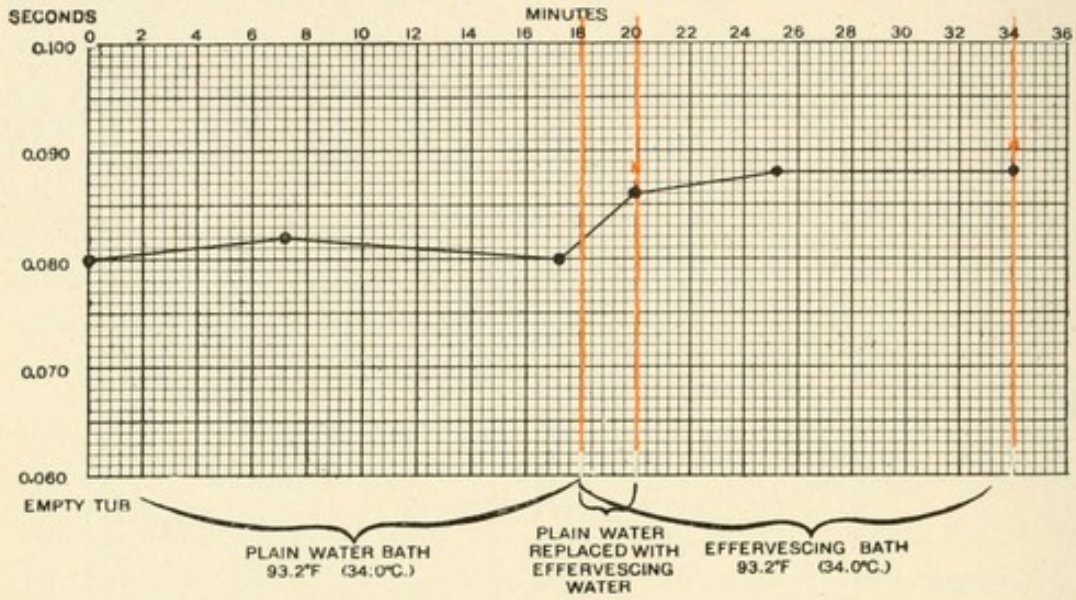

FIG. 18.

a powerful action upon the heart itself, and furthermore possess a powerful vaso-motor influence. They are so essentially distinct from the ordinary plain-water baths, and the artificial CO_2 saline baths, that it may confidently be concluded that the decisive factor *cannot be their temperature alone*, but that an eminent share of their influence is due to the substances present in the natural effervescing baths.

As already mentioned, my brother and I were the first to suggest the preparation of artificial saline CO_2 baths, and to report upon their employment. Hilger's statement that in such artificial baths the CO_2 wholly escapes in a short time is certainly not correct. Appropriately prepared, such baths can be shown to contain free carbonic acid even after the lapse of 20 or 30 minutes. And yet essential differences exist between the natural and the artificially prepared CO_2

baths. The investigations of Beerwald and Von der Heide, for example, have established the following important facts, first, that in the natural baths CO_2 is much more uniformly distributed through the water; second, that from the artificial bath much more CO_2 escapes into the air.[1] Whereas in an artificial bath at 32° C. the air at 5 cm. above the surface was found to contain 7.5 per cent of carbonic acid, in the natural bath of the same temperature air taken at the

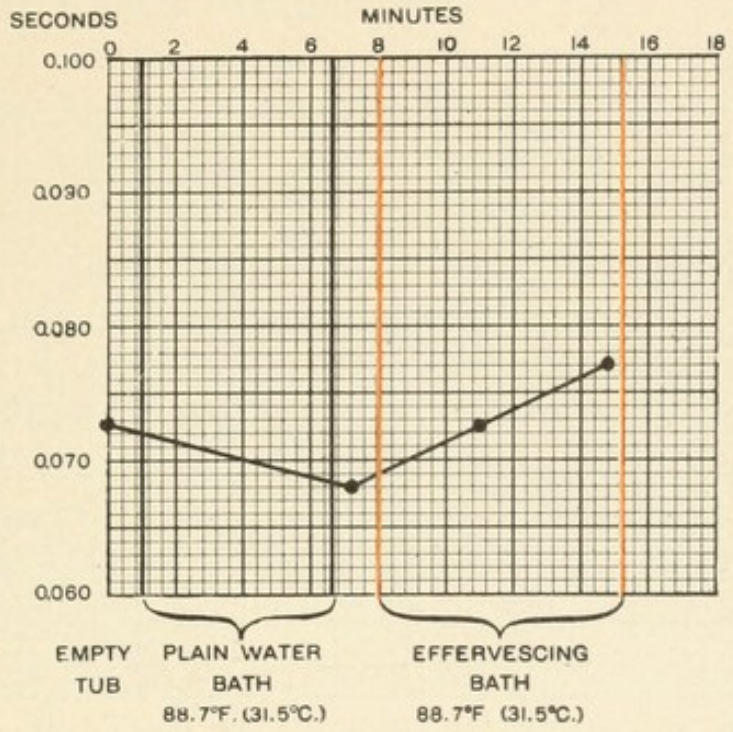

FIG. 19.

same height and after the same interval showed but 0.20 pert cent of CO_2. This circumstance, as follows from the plethysmographic investigations already mentioned, is not without significance as regards the respiration and, therefore, the conditions affecting both the lesser and the greater circulation.

It has already been mentioned that by the employment of artificial baths gratifying results may be obtained. And in

[1] According to the latest investigations of Von der Heide, it may be possible to find larger quantities of carbonic acid gas in the water by newer methods of preparing artificial baths, but even then, very essential differences would remain between the natural and the artificial baths, as regards the behavior of the CO_2.

this sense many publications have appeared, confirming the statement of my brother and myself not only in Germany but also in England and America. Yet the artificial baths must not be used without discrimination. If they are so used, unfavorable results may easily follow and of such there are to be found in the literature numerous reports, by a close study of which the causes of the unfavorable effects and the

PLATE G. 5-5 TO

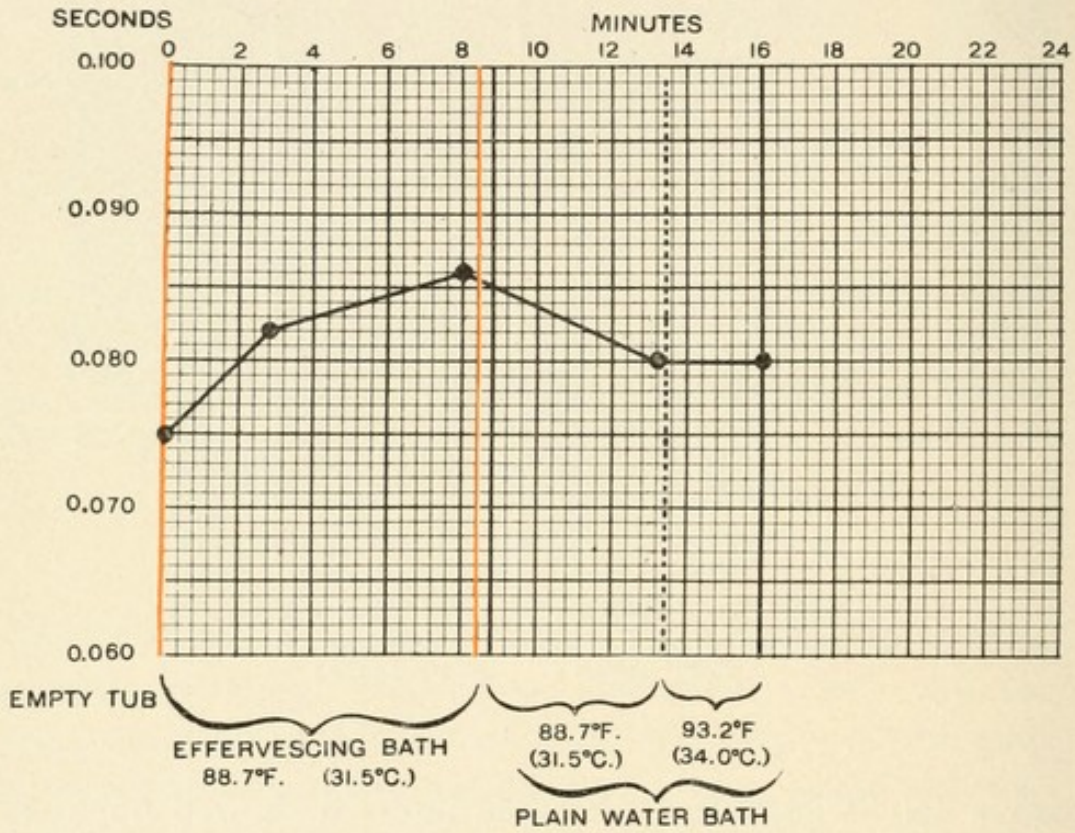

FIG. 20.

various errors in the administration of the baths may readily be detected. The correct apportionment of the separate ingredients of the bath, and likewise the exact regulation of the temperature and duration of the bath must be carefully controlled. Then again, the unfavorable influence exercised upon the respiration by the more rapid escape of the CO_2 gas demands certain precautions on the part of the physician. In my previous writings I have

repeatedly dwelt upon the importance of these points, and I have formulated a procedure for the employment of both the natural and the artificial baths.

As regards the operation of the natural CO_2 thermo-saline baths in healthy persons, their influence on the heart itself, like that of digitalis, is not very great, in consequence of which the preponderance of the vascular component becomes clearly manifest, and (as this signifies vascular dilatation) the blood-pressure falls.

In cases of heart disease, this vaso-motor influence also occurs, as the very flushing of the skin indicates, and we have every reason to assume that in these cases the dilatation of the vessels is just as pronounced as in those whose hearts are sound. For, if we exclude the arteriosclerotic, it is not the vessels that are unsound, but the heart itself. Why then should the vessels react differently in these cases.[1] If in such cases the blood-pressure, reduced by weakness of the heart, does not (as happens with a normal heart) fall still farther, but on the contrary rises, this must occur in consequence of the strengthening of the heart's action through the influence of the bath. This is also beautifully exemplified in our observations *by the increase in the amplitude*, and above all by the clinical features, in which the action of these baths in imparting tone to the heart is clearly recognized.

When we view these differences in the reactions of healthy and diseased hearts in this light, many of the contradictions existing between the statements of different authors, some of whom found a reduction, others a rise in the blood-pressure, disappear. It is true that in conditions of cardiac weakness the rise in the blood-pressure is generally an indication that the heart reacts well and that the bath has agreed with the patient. The fact also that a

[1] O. Müller states that with the administration of certain remedies and with the local application of ice, he has found that different vascular reactions occur in the diseased heart than occur in the healthy one. According to the reasons cited above these results need further investigation.

weakened heart reacts more intensely to CO_2 baths than a normal one, shows the differences in amplitude already mentioned. This increase of amplitude had already been found in healthy persons when experiments were made with the CO_2 baths. In my experiments on healthy persons this increased amplitude did not show itself clearly; this probably depends upon the relatively shorter duration of the baths. While the shorter duration suffices to call forth an increase of amplitude in a weakened heart, nevertheless, in healthy persons a more pronounced stimulus is evidently necessary to produce the same phenomenon.

In affections of the heart attended with high blood-pressure the action on the heart as well as on the vascular system becomes clearly manifest. In such patients it is well known that we mostly have to deal with arteriosclerosis accompanied or not by changes in the valvular apparatus (chiefly aortic) and with anomalies of the kidneys. The heart, which has to struggle with so high a pressure, readily becomes distressed, and such arteriosclerotic subjects are easily put out of breath. The accumulation of carbonic acid in the blood and the consequent stimulating action on the respiratory center are further agencies contributing to raise the blood-pressure. In the clinical picture of these hypertonic cases the influence of the natural effervescing baths is mostly shown as follows: the breathing becomes quieter and deeper, the circulation in the kidneys improves to such a degree that the albuminuria is greatly reduced or may even completely disappear, while a diminution in hyaline casts, amounting sometimes to a complete disappearance, is often observed. Thus the concurrence of all these factors, as shown by the tracings, Fig. 7 to Fig. 10, *had the effect of lowering an abnormally high blood-pressure* which had previosuly existed.

Some hypertonic cases, of course, require cautious and rational treatment. Dr. W. (who has already been mentioned in connection with the demonstration of the trac-

ings, Fig. 8 and Fig. 9) had previously only transiently reduced his heightened blood-pressure by venesection performed at his own home on two different occasions. He came to me, having previously been ordered in Nauheim to have cool effervescing baths in the form of half-baths. These cool half-baths, which naturally had the effect of cooling the upper part of the body, had with certain other injurious influences the further result that the blood-pressure, instead of declining, increased considerably. By careful management of the baths the abnormally high blood-pressure decreased during the bath itself, as the tracings show. Continued treatment combining both baths and systematic resistance-exercises, caused the blood-pressure, which on his first visit was uncommonly high even for such cases, namely, 225 mm. Hg., to subside gradually in the most surprising manner to 150 mm. Hg., where it has since remained.

On account of limited space I will select, from a considerable number of cases, only two more which reproduce the average figures for the variations of blood-pressure that were observed during the course of treatment.

In the case of a merchant, R., 53 years of age, with aortic insufficiency and arterial sclerosis, the blood-pressure fell from 220 to 180 mm. Hg. during the course of systematic treatment with baths and resistance-exercises.

In a merchant, P., 51 years of age, suffering from myocarditis with angina pectoris, Adams-Stokes' phenomenon and albuminuria, the pressure fell from 200 to 150 mm. Hg.

These investigations teach us further that the blood-pressure as such is not, as, for instance, Huchard believed, *taken alone* a measure of the applicability of carbonic acid baths and that the opinion of O. Müller is not justified, that a pressure of over 180 mm. Hg. is a contraindication

to such baths.[1] The contraindications must be gathered from a comprehensive clinical survey of the patients, as I have pointed out in more detail in previous publications.

The facts now described, established as they are by the aid of our newest and most approved methods of investigation, form the most perfect confutation of the views which James MacKenzie, in his treatise on diseases of the heart, expressed in regard to the action of the Nauheim baths in the treatment of chronic heart-disease. MacKenzie's opinion, so far as appears from his book, is founded on some few imperfect measurements of the blood-pressure made on invalids, and some few determinations of the pulse tested on himself and on a healthy friend. MacKenzie's work on the pulse, the introduction of the polygraph into clinical diagnosis, and the important facts derived from these investigations and applied to the diagnosis of affections of the heart, are generally known. We also know from Otto Frank's physiologic investigations, which rest on a mathematical basis, that all the sphygmographs hitherto invented, whether they be those of Marey, Landois, Riegel, Dudgeon and many others, or the polygraphs of Jaquet, MacKenzie, etc., are imperfect instruments so far as concerns the representation of the *forms* of the pulse. The inertia inherent in the apparatus, that is to say, the inertia in the bulk of the instrument, causes these instruments to yield results which are not free from objection.

Now in the optically registering sphygmograph of O. Frank these faults are eliminated. And again, with regard to the registration of time in the tracings, this apparatus, by virtue of its incomparably greater delicacy, has an advantage over other instruments, since we attain results with facility which are unattainable with other apparatus. The trials made with Frank's instrument, in

[1] As appears from an article published during the last year, O. Müller seems no longer to entertain this opinion.

comparing the periods between two arterial tracings, have yielded perfectly clear results, with which the plethysmographic experiments completely agree. They show that the natural effervescing baths exert a more powerful vasomotor (vaso-dilator) action than has hitherto been observed either with plain-water baths or with artificial effervescing baths of the same temperature and duration. Furthermore, Frank's apparatus gives an extraordinarily true representation of the forms of the pulse, and the following diagrams of the pulse show in a manner free from all objections the powerful action of the natural effervescing baths on the form of the pulse (Fig. 21 to Fig. 24).

Concerning the action on the heart itself, in addition to the direct observations on the heart, the investigations of the systolic and diastolic blood-pressure and of the amplitude of the pulse have afforded us more detailed information. MacKenzie writes on this question in his book above mentioned: "I found that 10 to 20 years ago, when the notion was prevalent that to have a good heart you must have a strong pulse, these baths had a remarkable effect in strengthening the pulse, raising the arterial pressure 20, 30 and 40 mm. Hg. But nowadays the fashion being to soften a strong pulse, these waters are discovered to have a remarkable effect in lowering the arterial pressure. So remarkable are these waters that it is claimed that they can increase the pressure when it is low, and lower the pressure when it is high." *By our experiments it is incontestably proved that a low blood-pressure can be raised and an abnormally high pressure lowered by a methodical treatment with natural effervescing baths. In other words, the normal physiologic balance is restored.* This I have already described in detail in several publications and my statements have received confirmation from a considerable number of writers at home and abroad. The very numerous works that have appeared, particularly in the English language, I take it for granted are well known. In Ger-

many it is shown in the treatises of Matthes, Romberg and others. Krehl too, for example, in his handbook on "Affections of the Heart-Muscle," of which the second edition appeared a few months ago in Nothnagel's Encyclopedia, emphasizes the injustice of MacKenzie's opinion on this question.

The method of the resistance-exercises, as introduced into practice by my brother and myself, and their results have

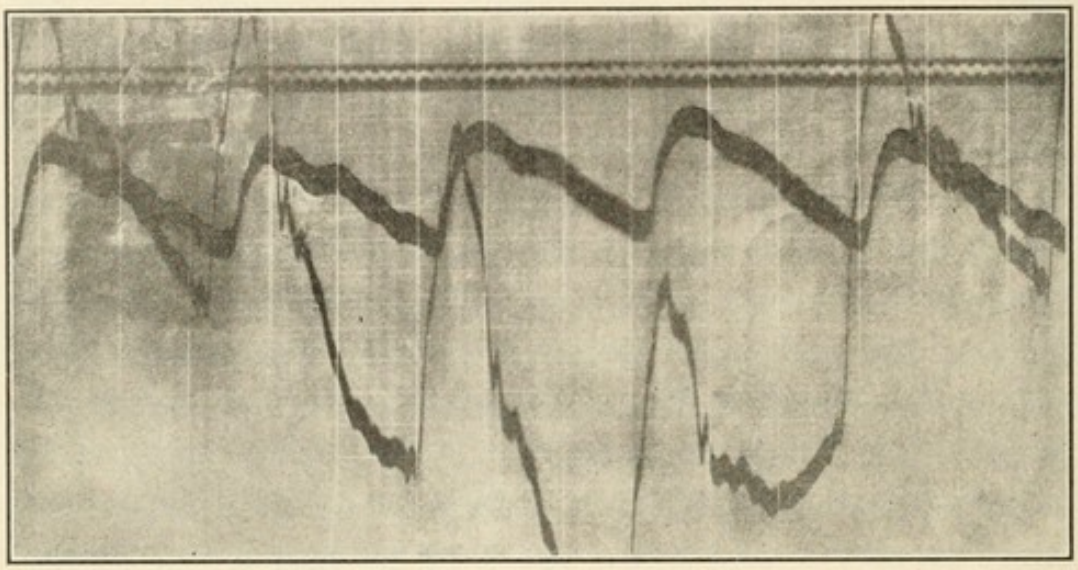

FIG. 21.—Resting in the empty bath tub before the bath.

often been described by us and by many others. Thus, for example, the investigations of Tiedemann and Lund, published a few years ago, show what a powerful effect such manual exercises have in the treatment of cardiac disturbances of compensation.

Tiedemann and Lund also found that with the help of suitable exercises it is possible to so ameliorate the functions of the heart that shortness of breath and sleeplessness are removed and the functions of the kidneys are so influenced that by a more copious diuresis edema disappears. In contradiction to all these earlier experiences Mackenzie, in the treatise already alluded to, expresses himself as follows: "I have made a careful inquiry into the effects of passive resistance-movements and voluntary contractions of the

muscles and could find no appreciable effect upon the heart. In certain people, especially in those of a slightly neurotic habit, the slowing of the pulse at the end of the séance was sometimes very marked, but I found I could produce exactly the same result by employing, with equal solemnity, indifferent acts, such as stroking the finger-nails and the shin-bones."(?) How this view of Mackenzie's is estimated

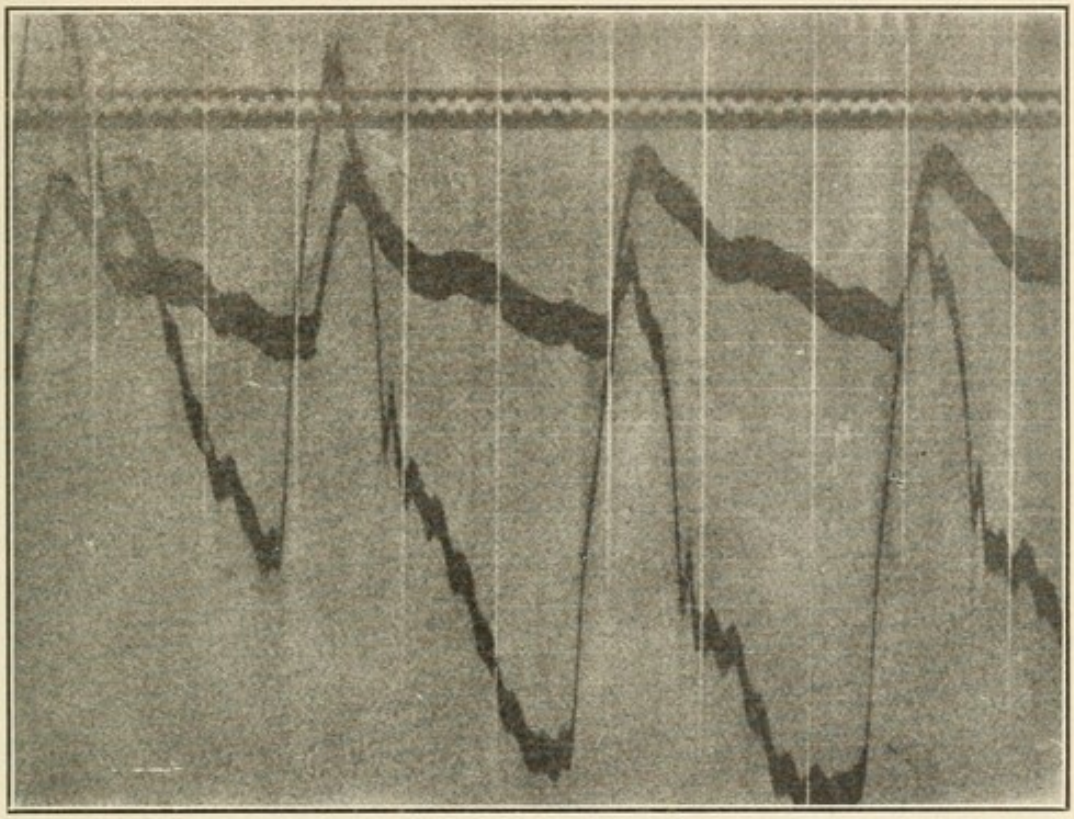

FIG. 22.—Effervescing bath of Spring No. XII, 85.1° F. (29.5° C.).

appears, *inter alia*, in the recorded opinion of Krehl in the handbook before mentioned, when he writes: "I really cannot concur with Mackenzie's judgment on the indifference of the measures adopted, because at the hands of those experienced in the application of these exercises I have seen successful results, hardly attainable by others." In addition to the established clinical observations my investigations on the blood-pressure, which have already been stated and illustrated by tracings, supply a further contribution to the establishment of the powerful therapeutic influence

of the resistance-exercises upon the entire circulatory apparatus.

In relation, therefore, to the balneologic as well as to the gymnastic treatment, the results of the more recent experiments here discussed coincide with the clinical observations already published.

In recent times *oxygen baths* have been brought into use. This gas, however, exerts a *much feebler* influence on the heart and also on the peripheral vascular and nervous

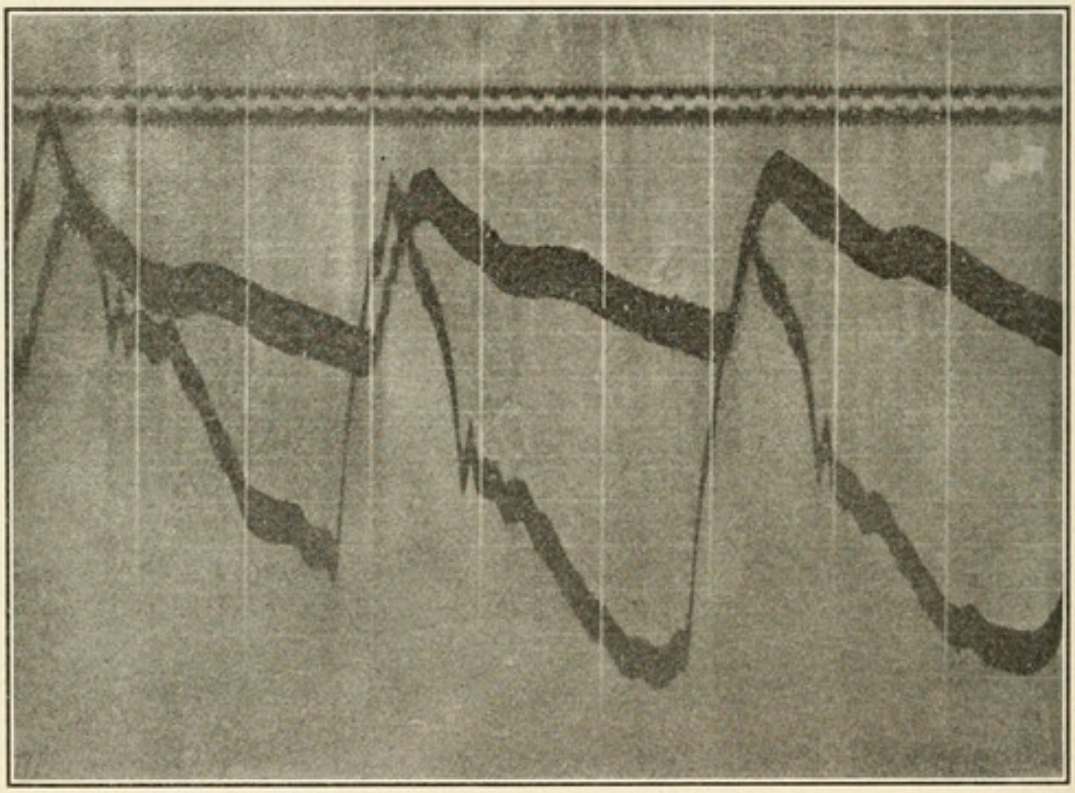

FIG. 23.—Effervescing water of 85.1° F. (29.5° C.) replaced by effervescing water of 93.2 F. (34° C.).

systems than does carbon-dioxide. Its action in lowering the blood-pressure, on which many authors appear to place a very special value, is one of no permanence. Certainly more convincing results are necessary in order to determine whether and to what degree these oxygen-containing baths are active.

The same observation applies to *electrotherapy* in its various forms. Galvanic and faradic currents, electrical

baths and electrical massage of the whole body, or individual parts thereof, may be used with good results where nervous disturbances, such as neurasthenia, hysteria, Graves' disease, etc., are the underlying cause. But with heart diseases electrical therapy has up till now gained no wide application. It is more than doubtful whether it is possible to cure arteriosclerosis by means of high tension alternating currents or even actively to control the extension of the sclerotic process.

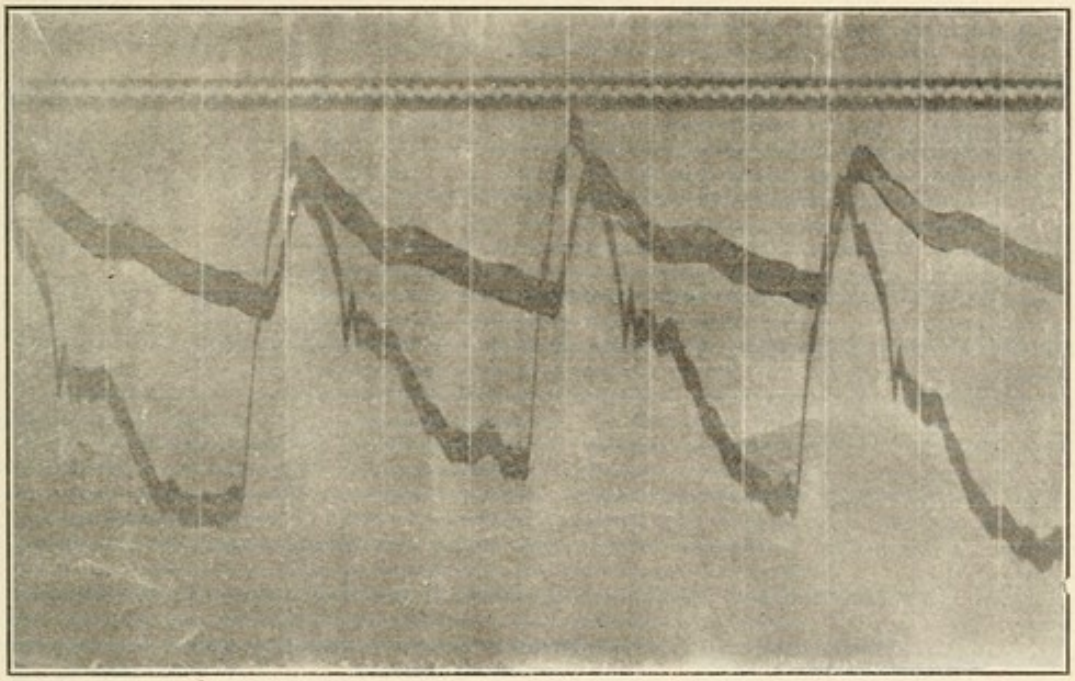

FIG. 24—Effervescing bath of Spring No. XII, 93.2° F. (34° C.) replaced by plain water of 93.2° F. (34° C.).

Since several natural waters contain *radium* the influence of radio-activity on the heart and circulation must also be mentioned. Regarding the amounts which were found in the Nauheim baths and drinking waters by Elster and Geitel, I published a paper sometime ago, but the influence of radio-activity on the heart and circulation remains to be mentioned. In such waters it is principally the emanations and their decomposition products which have to be considered. Investigations have been carried out according to quite different methods so far as can be judged from previous

publications; they cannot be readily compared with one another, neither have they led to uniform conclusions. For example, in one place we read that the blood-pressure remains unchanged by the action of radium; in other instances a fall in blood-pressure has been recorded. Further observations are necessary in order to determine whether and to what extent a vaso-motor influence can be proved to be well-founded. The action of radium on the heart itself has received the least discussion of all. The circumstance that so far, even with the strongest radium waters, a distinct action on the heart and circulation has not been observed, gives rise to considerable doubt. And, as is well known, it is just those baths possessing only a moderate radio-activity which exert the most powerful action on the heart.

In the above review I have merely discussed the most important actions of such bath constituents as especially concerns the subject under consideration. The efficacy of the Nauheim baths may be explained by the presence of the following factors:

1. *The easy gradation of the baths*, which makes it possible, commencing with weak saline baths, to increase the concentration of the solid constituents by means of the powerful acting mother-liquor containing 30 to 40 per cent of calcium chloride.

2. *The natural temperatures*, namely, 86° to 93° F., to which we are accustomed in our daily life for bathing purposes.

3. The possibility of *beginning with* a *weak* impregnation of *carbon-dioxide and* of *gradually increasing* this to the highest amount for this temperature. While in the quiescent Thermal effervescing baths and in the more active Sprudel effervescing baths the water directly in contact with the skin is warmed by it, thereby losing a portion of its carbon-dioxide, the effervescing flowing-bath (Strom-Sprudel), as already mentioned, constantly brings in contact with

the surface of the skin a fresh supply of carbonic acid gas in the nascent state, thus through imbibition of the solid constituents as well as by the rapid penetration of the mobile carbon-dioxide molecule, producing a powerful tonic action on the skin.

4. *The mechanical effect of running water* exerted by the effervescing flowing-bath (Strom-Sprudel) is also an important factor.

It has not yet been definitely ascertained whether in the natural mineral baths *the action of the salt ions* should be taken into consideration.

To our methods of treating chronic heart disease the use of the gymnastic therapy, already mentioned, must be added. With regard to the special methods evolved for the application of these heart gymnastics a more detailed statement will later be made, and also a description of the technic to be adopted in conjunction with the balneologic treatment.

CHAPTER XI

METHODS OF BALNEOLOGIC TREATMENT

Here, as is often the case in medicine, merely general rules can be formulated. It stands to reason that a careful physical examination of the patient must be made, since only in this way can a strictly personal treatment be outlined. This should never be disregarded because these baths exert a most decided action in all systemic diseases, but especially in affections of the heart. According to the method of application favorable results may follow, just as readily as, conversely, unfavorable effects may be produced. It has frequently been emphasized by us that even here a constant control by the physician is essential. The symptoms in heart affections may undergo sudden changes and especially during balneologic therapy; it is, therefore, advisable to frequently examine the heart *before*, *during* and *after* the bath. The methods which have proved most successful in my hands are largely the following:

It is best, more especially with severe cases, to commence with a simple salt-water bath. Since the water at Nauheim contains between 2 and 3 per cent of sodium chloride and as much calcium chloride per thousand, it may be necessary to dilute this still more. The duration at first should not exceed 8 to 10 minutes, in severe cases not over 5. The temperature should commence at 93° to 95° F. and should be reduced but slightly during the first week. One must be specially careful with anemic and weak patients and with those who are easily chilled. On the other hand, however, even in patients with weak rheumatic hearts one should not exceed a temperature of 95° F., since a tonic action on the heart will not be gained. It is, therefore,

preferable to administer cooler baths and to make them of shorter duration. In the first half to 1 minute the patient, while remaining quiescent, may experience a feeling of chilliness; then, however, a sensation of full comfort should occur, partly owing to the warming action of the bath on the skin and partly from habituation. If, however, after a minute's quiescence this does not result, but rather the slight feeling of cold persists, then the bath must be slowly and carefully warmed to a temperature which is just sufficient for the purpose. In the majority of cases, as the cure advances, cooler and cooler temperatures are tolerated and may be used with benefit.

One should avoid, if possible, a second or recurring chill while in the bath. By this we understand that a patient who had become chilled on entering the bath had later regained his warmth and shortly thereafter had commenced to feel chilled again after he had remained quiet for some time. Such a bath was too prolonged in relation to its temperature. The temperature should either be rapidly raised, or the patient should leave the bath at once. During the following days warmer baths should be given.

Many patients, especially those who suffer readily from dyspnea, cannot tolerate complete baths at first. They find the pressure over the cardiac region very troublesome. It is best to recommend that such persons should not be immersed in the water deeper than to the level of the nipples. Gradually they also become accustomed to the full bath. Partial baths may easily produce ill effects and should, therefore, be avoided. Patients suffering from heart disease should bathe neither on an empty stomach nor on a full one. Most suitable of all is the forenoon about 1 to 2 hours after breakfast, or if this cannot be arranged, then the late afternoon, from 3 to 4 hours after the mid-day meal.

If the baths are well tolerated the stronger concentrations may gradually be employed. First the concentration of

the salts should be increased, especially that of the calcium chloride. At Nauheim we obtain this by the use of the mother-liquor derived from the spring, which contains 30 to 40 per cent of calcium chloride. After these follow the baths containing carbonic acid in a quiescent state and later those rich in free carbonic acid gas; for these we employ at Nauheim, in rotation, the already-mentioned Thermal, Thermal effervescing and Sprudel effervescing baths as well as the effervescing flowing or Strom-Sprudel of the individual springs, with their different temperatures and their varying concentrations of salts and carbon-dioxide.

Patients with heart disease without exception require *days of rest* on which the bath is suspended; in certain instances, especially with severe cases, a *pause day* is necessary even after the first day, usually, however, after the second day. Later three or four baths may be given on successive days. Simultaneously, an extension in the duration of the bath also takes place; it is, however, seldom advisable, particularly in severe cardiac lesions, to prolong them beyond 18 or 20 minutes. After each bath the patient should be wrapped in hot towelling and rubbed down vigorously so that the skin becomes red and warm. He should then resume his clothing and immediately seek his room where he should *rest in bed for at least one hour* under a suitable covering, in order that the body may be rested and maintain an equable warmth. During this *rest period* the mind should be kept quiet and all reading avoided. In the further course we should endeavor to obtain a continuous but, nevertheless, prudent *stimulating action* of the baths. The baths should be given always slightly *cooler*, always for *longer* periods and *at more frequent intervals*. An exact supervision by the physician in regard to this should be constantly exercised. *The result of to-day's bath is the criterion for to-morrow's orders.*

Owing to their strong content in salt and carbonic acid

the Nauheim baths can gradually be taken fairly cold and can be safely borne by patients with cardiac affections. In this way there is a possibility of hardening such sufferers, little by little, in order to make them resistant toward cold and particularly toward muscular rheumatism, which is naturally of great importance for heart patients.

During menstruation the baths should be discontinued as an abnormally large loss of blood may be caused by such powerful baths and this must be especially avoided in cases of heart disease.

The *summer months* are the most suitable for balneotherapy. In mild cases from 3 *to* 6 *weeks* are sufficient, to which may be added with advantage an *after-cure* in a moderately high mountainous district, not over 1000 to 1200 meters (3000 to 4000 feet). In severe cases, on the other hand, the treatment should extend over several months and it is then advisable to divide the cure into two parts and to separate them by a short residence in a mountainous region. To form an exact estimate of the number of baths at the beginning of treatment is not possible, since, apart from the severity of the case, patients react quite differently to the baths. It can be readily understood, therefore, why it is quite out of the question to formulate such a scheme. During the winter many patients with heart disease require residence in a southern climate in order to remain in the open air to the fullest extent.

It is now possible for those suffering from heart diseases, who are not in a position to take the cure by means of the natural baths, to imitate these baths at home, to a certain extent. My brother and I have laid down exact directions to this effect. One should employ for this purpose preferably the natural Nauheim bath salts, or if these are not available at the moment make use of the most important of their saline constituents, namely, *sodium chloride* and *calcium chloride*, in the correct proportions, 2 per cent of the former and 1 part per 1000 of the latter. These

quantities may be increased when stronger baths are indicated. The carbonic acid is best obtained from sodium bicarbonate and hydrochloric acid; both are used in the form in which they exist in commerce. The chemical equivalents indicate in what proportions these ingredients are to be added to the bath. With the strong solution of hydrochloric acid (equivalent to 42.8 per cent) equal quantities of hydrochloric acid and sodium bicarbonate should be employed. With the dilute hydrochloric acid a correspondingly larger quantity of this solution is necessary. The sodium bicarbonate, commencing with 100 gm. and gradually increasing to 500, 1000 or even to 1500 gm., as the baths progress, should be dissolved in the bath-water simultaneously with the other salts (sodium chloride and calcium chloride) which must also be increased in proper proportions for these stronger baths. An *excess* of bicarbonate of sodium is always advisable for the protection of the bath tub. After the temperature of the water has been properly regulated an amount of hydrochloric acid equivalent to the quantity of sodium bicarbonate already dissolved in the bath is *poured directly on the surface* of the water from a small-mouthed bottle and *distributed well over it.* One should avoid any additional agitation of the bath-water as otherwise the carbon-dioxide will readily escape into the air. The layer of carbonic acid gas which forms on the surface of the water during its preparation should be driven off with a towel before the bath is used so that the patient will not breathe it. In this way the carbonic acid gas will continue to be evolved for a considerable time, probably a half-hour or more.

Instead of hydrochloric acid one may employ a milder acid as, for example, formic, citric or tartaric acid, since these are less liable to attack the sides of the tub; of course they must also be added in amounts corresponding to their respective equivalents (about 2 parts of acid to 1 part of sodium bicarbonate).

By the use of such baths as these, many errors have become apparent. For instance, it is held by some that a plain salt-water bath or what is still more common a plain carbonated bath is sufficient for the treatment of chronic heart disease. If we desire to obtain an increasing tonic action, so far as may be possible with such artificial baths, then we must even here increase in a systematic manner the dosage of the ingredients, salt, calcium chloride, sodium bicarbonate and hydrochloric acid, and adjust the temperature and duration of these baths to the condition of the patient at the time being.

The employment of the ingredients in definite and fixed doses, as they are prepared and sent out by certain factories (known as "acid cakes"), has led to the evolution of carbon-dioxide in improper proportions and above all to the quantity of the gas increasing by leaps and bounds. These are positively dangerous. A considerable number of patients have had, as I have been able to convince myself, imperfect or untoward results from the fact that the baths formed with such prepared doses, owing to their faulty adjustment, were suitable neither for the case as such, nor for the temporary condition of the sufferer.

It is self-evident that even in the employment of artificial baths a constant supervision by the physician is essential if satisfactory results are to be obtained. And often a good result is only to be secured when it is practicable to remove the patient from business and family worries into pure air and new surroundings. Suitable nourishment, to the consideration of which we shall return elsewhere, also plays an important part in these cases. If properly used, favorable results can be obtained with artificial Nauheim baths in a certain proportion of cases. Naturally, the number of cases to be benefited must necessarily be limited by the circumstance that the strongest of these baths, the effervescing and the effervescing flowing-baths cannot be imitated artificially.

CHAPTER XII

METHODS OF GYMNASTIC TREATMENT

By means of regulated gymnastic exercises, such as those introduced in treatment by my brother and myself, effects can be obtained similar to those of balneotherapy. The bath produces its action by way of the sensory nerve tracts, the gymnastics, as already mentioned, through other nerve tracts. The essential characteristics of the gymnastics are as follows: The movements employed must always be carried out slowly and with such degree of power as the momentary condition of the patient will permit. In order to procure this simultaneous retardation and increase in strength, resistance is necessary, which is supplied by a second person, the "gymnast" or operator; this is the simple passive *resistance-gymnastics*. Or, the resistance is produced by the patient himself through the simultaneous contraction of antagonistic muscles; this form we have called *gymnastic exercises with self-resistance*. Regarding the employment of gymnastics, the following general regulations may be stated (A. Schott: Berliner Klinische Wochenschrift, 1885):

(1) The movements should alternate with one another in such a manner that, according to their arrangement, new groups of muscles are continually being brought into activity. After the movements have taken place over the whole of the skeletal musculature they can eventually be repeated in several cycles if the patient still feels sufficiently fresh. In this way a one-sided fatigue is most effectively prevented.

(2) This general activity of the skeletal muscles can be

attained by means of a very simple geometrical arrangement of the movements. Usually we employ the following scheme:

(*A*) Movements of the extended arms in three vertical directions, one after another.

(*a*) Sagittal, toward the front from the position of downward extension, upward to near the temples and from there again downward.

(*b*) Frontal, laterally upward to the temples and backward.

(*c*) Horizontal, brought together and apart again in a horizontal direction.

(*d*) The fully extended arms are rotated on their axes outward and inward to the farthest extent, which includes pronation and supination.

(*B*) While with the free articulation of the shoulder-joint a selection of the directions of movements was necessary, the movements for the elbow-joint and wrist are determined by nature. Flexion and extension, with radial and ulnar abduction; the rotations have already been carried out under (*A*).

(*C*) Movements of the body, bending forward from as far back as the patient can bend and the reverse, side movements from the extreme left to the extreme right and vice versa, as well as rotation of the vertebral column on its axis, in both directions.

(*D*) The extended leg should be raised under resistance, straight forward and upward and again lowered against resistance; then again to the right and to the left and raised and lowered toward the back.

(*E*) The directions of movement for the knee- and ankle-joint are also determined by nature.

It is not necessary to carry out all of the movements on each occasion.

(3) One can train up men to act as gymnastic operators in a very short time if they have sufficient conscientiousness

and intelligence. Of course, they must previously have gained a certain amount of anatomic and physiologic knowledge. It is of advantage in many cases to teach a member of the patient's family so that the sufferer can always have someone at hand.

The *gymnastic operator* must learn:

(*a*) *The application of resistance;* according to the relation of his strength to that of the patient he should apply the resistance at a higher or lower position, in the latter case with the advantage of greater leverage in his favor. The resistance should always be applied on the advancing side, as, for example, on the anterior side of the forearm when the two arms are being approached together horizontally and on the dorsal side when they are being horizontally separated again by the opposite movement. Similarly, on the upper and lower leg he has to exert pressure at one time on the front, at others on the outer, inner or posterior side of the limb, according to the momentary direction of the movement. The resistances for the bending of the body are applied in front over the manubrium sterni, or at the back over the lumbar vertebræ; those for extension of the back on the neck and on the xiphoid process. To check the rotation of the body the operator stands at the side and places the right hand in front of the advancing shoulder and the left hand behind the retreating shoulder, and so on.

The operator should exert pressure on one side only *and never grasp the limb* because he may thus quite easily, and unconsciously, prevent the movements instead of assisting their accomplishment against resistance.

(*b*) The operator must, in fact, commence with the intention of moving the limb which is undergoing exercise in a direction opposite to that in which it is being directed but he must always *allow the patient to have the upper hand.* From my own experience I can recommend only these so-called eccentric movements for patients suffering from heart disease.

(*c*) The resistance must be so calculated that the movement may succeed in a slow and regular manner but should never be so powerful as to stop the movement completely during its progress or to allow it to progress only by fits and starts. The hand of the operator should always exert approximately the same even pressure on the patient's limb while it follows the limb through the movement.

(4) While the previous regulations for the use of curative gymnastics are applicable in a general sense the following must be added as the most important for the treatment of heart diseases. The patient should be exhorted to *overcome the resistance so slowly that his breathing will remain absolutely quiescent* or, as I usually express it, so that he shall have enough breath left in order to speak with ease at all times. The operator himself must observe the patient's mouth and nostrils carefully; any trace of commencing dyspnea is an indication for pausing until the breathing has become distinctly quiet again.

If necessary, a single movement may be divided up into several sections, between which the limb may rest while supported in the hand of the gymnast; following each single movement there should be a pause of 1 to 3 minutes' duration, and the patient may sit down to avoid the slightest tiring. *At the end of the séance the patient should rest quietly on a couch for about* 15 *minutes.* I have placed at the end of this book numerous illustrations of the most important exercises from which may be observed the positions and movements of the patient and of the operator as well.

Bed-ridden patients can, of course, carry out only a few of these exercises in the supine position. In other cases standing is difficult, so that those exercises only are possible which can be practised while in the sitting posture.

Whereas at the beginning the greatest possible care is necessary, as the treatment progresses more powerful resistance can always be withstood with ever shortening

pauses, as the heart itself becomes more vigorous from the exercises.

With young persons who are in process of rapid growth and in whom the chest has not at the same time developed sufficiently and likewise in persons with kyphosis and advanced scoliosis the heart often remains weak, and most frequently of all the respiration is imperfect. It is of advantage to employ in these cases breathing gymnastics with deeper inspiration and expiration. So long as the bones and rib cartilages are still soft and elastic it is possible to produce an expansion of the chest by means of such gymnastics and to obtain an improvement in the respiration and in the pulmonary circulation and as a result an invigoration of the heart also.

In cases of disturbance of the peripheral circulation or where edema has already occurred, *massage* may be employed with good results. This consists best of all in centripetal stroking of the extremities, in the form of "*effleurage*" and "*pétrissage*" in order to facilitate the return of the blood to the heart and also the absorption of the edematous fluid. In cases in which there is increased rapidity of the heart's action "*tapotement*," which is usually carried out on the body, together with the employment of an ice-bag, produces a rapidly sedative effect; this action, however, does not usually last very long. The same remark applies to vibratory massage, which is often employed nowadays instead of manual massage. The action of this vibration massage is also insufficient and of short duration, even when it is carried out in conjunction with high frequency currents. This has been frequently confirmed from other quarters as, for example, in a work recently published by Plate and Bornstein.

We have also recommended the *application of heat* in cases of weakness of the cardiac muscle, in which the heart requires a more rapid stimulation. Best of all is the use of hot water, in a rubber bag, at a temperature between

140° and 160° F. which should be lightly applied to the region of the heart.

The mechanical treatment of heart diseases in the form of gymnastics and massage has been specially cultivated in Sweden. The fact that these methods, discovered and developed in an empiric manner, have clung to hard and fast rules, has confined their use to that country alone until the work of Wide and others caused them to be slowly taken up by other nations.

The Swedish movements first obtained general dissemination through their talented advocate, Zander, who along with manual treatment, employed also very cleverly constructed apparatus which forms a distinct acquisition to our curative stores. Much that has already been described as to the action of resistance-gymnastics applies also to the machine gymnastics of Zander. These apparatus are intended to make the patient independent both of the gymnastic operator and also of his own physical condition. As to the latter statement opinions are divergent. A constant supervision is very necessary with machine gymnastics, as much on account of the regulation of the resistance as also to note the condition of the patient during and after the movements. But even with an exact control by the physician it is impossible to equalize the imperfections which exist in the nature of the machine. If the resistance is at first made too great the patient must endeavor to overcome this resistance during the whole period of the movement. An exact individualization or even an increase or diminution during a single movement cannot be attained; *the machine does not adapt itself to the case.* A resistance whch at one time was correct may become far too great on the repetition of the movement owing to the rapidly changing condition of the diseased heart. Machine gymnastics may, therefore, be a source of danger to the patient, and in fact over-straining is not uncommonly observed after their use. At the same time, Zander's machines are unquestionably a great

advance on the many one-sided apparatus such as the ergostat and several others.

Some years ago by the employment of a wheel mounted eccentrically, as well as by weights moving on inclined planes, Herz improved the apparatus of Zander; his apparatus was also considerably used. The expensiveness and need of management for Zander's and for Herz's apparatus, and the circumstance that for their use the patients are limited to place and time, stand in the way of their general employment.

Oertel, who at one time gave a great impetus to the treatment of heart diseases, combined with his mechanical treatment a dietetic therapy which consisted principally in a limitation of the quantities of fluid. We shall discuss here merely his mechanical method of treatment. Oertel employed in his method the movements of walking and climbing and hoped that this increased muscular activity would produce an invigoration of the heart and a removal of the circulatory disturbances. For these climbing exercises, Oertel selected mountainous regions, "*Terrainkurorte*" as he called them, which were suitable for his purpose by reason of their ascending paths. So long as it is a matter of treating young and muscularly strong persons, of a rugged physique, good results can certainly be obtained by this method. But, with definite heart disease, however, whether of an organic or functional nature, climbing is an uncontrollable form of gymnastics which cannot be administered in definite dosage and which cannot be used at the beginning but only at the end of the treatment, when the heart has become so far invigorated through other methods of treatment that it can undertake such extra exertion as hill-climbing requires, without any actual danger.

CHAPTER XIII

BALNEOLOGIC AND GYMNASTIC TREATMENT COMBINED

A considerable time has elapsed since the observation was first made that baths containing salt and carbonic acid gas produced a slowing of the pulse, but no especial value was at first attached to this fact. My brother and I found, however, that by carefully conducted bath treatments, either given alone or in conjunction with resistance-gymnastics and finally culminating in hill-climbing, rapid improvement was frequently obtained in diseases of the heart, and even that complete cures were sometimes brought about, according to the status of the case. The manner of action of these methods of treatment, which are so different from one another, may be explained in the following way: For both the baths and the gymnastics the same harmonious principle determines their activity, namely, that of careful stimulation of the heart to more powerful activity; that is to say, a tonic action on the weakened heart muscle. In most cases (see also A. Schott) this is dependent on an insufficient power, relative or absolute, of the heart musculature to overcome the normal blood-pressure by means of its propulsive and suction actions. This inadequacy of the cardiac musculature; the so-called insufficiency of the heart-muscle, leads to imperfect expulsion of the blood from the cavities of the heart, thereby producing cardiac dilatation and the series of symptoms connected with it which we have described as disturbances of compensation.

Every cardiac dilatation does not necessarily carry with it the danger of loss of compensation. We must rather distinguish clearly between two different forms of dilatation, as

was first suggested by A. Schott, namely, (1) *stasis dilatation*, which arises when the muscular power becomes insufficient to expel the necessary amount of blood from the heart, and (2) *compensatory dilatation*, which serves as an adjustment of the impediment in the valve, particularly where valvular lesions are present. The first type of dilatation alone demands treatment. It is especially indicated where we wish to increase the diminished amount of work performed by the heart and to stimulate the heart-muscle to eliminate the excess of blood by means of powerful systolic contractions, because stasis dilatation, whether produced by insufficient power of muscular contractions alone, or in combination with some valvular defect, means a stasis of blood in the heart itself. The heart makes frequent but insufficient contractions and after every systole a certain amount of blood remains behind in the cardiac chambers. In addition to this, the blood-pressure existing in the aorta cannot be overcome by the cardiac contractions. We have previously described how, by means of baths and gymnastics, which have a similar action, the heart may be stimulated to give a much more vigorous and powerful systole.

It has been proved by experiments on animals that the pressure in the aorta and the whole arterial system increases very considerably through the action of these baths; but the powerfully stimulated heart has at the same time become capable of overcoming this rise of pressure in the vascular system. Owing to complete emptying, the heart is freed during the time of the ensuing diastole from the constant excessive pressure which previously affected its internal surface and excited the heart to powerless and continued contractions. The increasing arterial pressure produces fresh inhibitory impulses which, by way of the pneumogastric, affect the heart and thus the heart may beat more slowly and more powerfully.

This action can be recognized after both the baths and

the gymnastics. It has been previously stated what amount of influence the temperature and ingredients of the baths have on the peripheral vascular system and, through the stimulation of the sensory nerves of the skin, on the heart. This action, as is known, arises by conduction of the stimulation to the sensory centers of the brain and reflexly from these through the pneumogastric to the heart. Now by means of gymnastics we obtain an exactly similar action on the heart, except that the stimulus of the muscles which are put into action passes through other paths to the respective brain centers and in turn is conducted from these to the heart. The difference is that *with the bath the stimulus is much weaker, but lasts longer,* whereas *with gymnastics it is much more energetic, but of shorter duration,* at least in the beginning of the treatment.

From different sources it has been sought to explain the action of the baths and gymnastics, simply through the withdrawal of the blood from the internal organs to the skin and muscles, by which the heart becomes relieved and spared in its activity. This theory is, in my opinion, insufficient to explain the energetic and often rapidly occurring action of the baths and gymnastics. The same may be said regarding the theory that the increased psychic attention aroused by resistance-gymnastics, and especially by exercises with self-resistance, produces in itself an action on the heart and on the whole circulatory apparatus. It is, of course, possible that this may be a single factor in the total action, but it can be nothing more.

CHAPTER XIV

CLINICAL RESULTS

We shall now consider the results which are obtained clinically from balneologic and gymnastic treatment. We have seen how properly regulated baths and systematically arranged gymnastics stimulate the heart to more powerful activity. Through their influence, even in healthy persons, a stimulation of the nervous and muscular systems of the heart and blood-vessels can be observed and this takes place to a greater extent in patients who are suffering from heart disease.

As a result of the stronger systole and the more prolonged diastole there occurs in cases of tachycardia a slowing of the pulse but in cases of bradycardia there is often an increase in frequency. The pulse becomes fuller, arrhythmia sometimes disappears completely and the blood-pressure rises. The improvement in the circulation is also shown by the diminished frequency of the respiration. The increased propulsive and suction action of the heart produces a more energetic circulation through the lungs and in consequence of this a better exchange of gas in the pulmonary alveoli; in other words, there results an improved absorption of oxygen and increased elimination of carbon-dioxide.

From a series of experiments extending over a long period I was able to draw the conclusion that in anemic patients suffering from heart disease, the percentage of hemoglobin in the blood was substantially increased during treatment by baths and gymnastics. The more vigorous circulation and the improved condition of the blood produce a diminution in the pulmonary stasis; the rapid shallow breathing present in such cases becomes deeper and slower, and dys-

pnea, if it be present, quickly disappears. The more richly oxygenated blood proves of value to the whole organism but especially to the heart itself, since the blood in the coronary arteries is now more rich in oxygen, and the heart in this manner receives better nourishment. A weakened or even an atrophied heart gains in muscular power and this stronger musculature can empty the cavities of the heart more completely and thus free itself from the great amount of blood which has been stagnant in these cavities. We can determine this by means of percussion, owing to the gradual diminution and ultimate complete disappearance of the dilatation due to the stasis. By auscultation we may often recognize the improved vigor of the heart from the following symptoms: A murmur, due to a valvular defect and which was previously faint or completely inaudible again becomes distinctly heard owing to the more powerful contractions, while a murmur caused by relative insufficiency of the heart frequently changes into an impure or mixed type and finally into a normal sound.

In other parts of the organism the improved circulation is recognizable by the decrease in the stasis of the whole vascular system. A livid or an anemic appearance of the countenance gradually improves and the normal color of the face and lips returns. Stasis of the liver diminishes, as can be determined both by palpation and percussion. The functions of the kidneys are benefited and, corresponding with the increased amount of urine, there occurs often a diminution or disappearance of the albumen as well as in given cases of the hyaline casts. The improved circulation in the abdomen allows of better assimilation as well as a powerful augmentation of the nutritive material entering the blood; the appetite increases and from this results an invigoration of the nervous system especially, but also of the whole organism. Improved sleep acts as a sedative to the nerves, and this applies to the sensory as well as to the motor nerves of the heart.

A heart damaged by *valvular defects* must naturally perform a much greater work than a normal one. It is rendered capable of this extra work by an increase in its musculature, especially that of the ventricles. So long as such hypertrophic compensation exists and no disturbances occur, a valvular defect may, as has been mentioned already, run its course without the patient experiencing any untoward symptoms. Of course, loss of compensation may very readily take place in such a heart. This may be produced by an intercurrent illness, by mental and bodily overwork, by excesses of different kinds, as well as by disturbances of the peripheral vascular system. The disturbances of compensation which occur from mitral insufficiency and mitral stenosis are especially those in which digitalis displays most effectively its beneficial influence, although, in not a small percentage of cases it will either fail to do this or will manifest its cumulative and toxic action. In defects of the aortic valves digitalis often fails to improve the condition, a fact that is well known.

In mitral or aortic valvular defects, even when congenital, the tonic effects of baths and gymnastics are distinctly apparent and, in a series of researches, I was able to describe the technic of treatment and the manner in which the action takes place, and from this to demonstrate that the invigoration of the whole body goes hand in hand with the invigoration of the heart.

In recent times, as may be seen from the works of several authors, medicinal and physical measures for the treatment of compensatory disturbances in mitral lesions have been studied from the standpoint of a comparison in their relative activity. I shall here briefly give the description of a specially characteristic example selected from a large number of cases. The pulse curves show the changes in the vascular system during the progress of the treatment.

The case is that of a male, aged 52, who had suffered for many years from a mitral insufficiency and now showed a

considerable degree of myocarditis complicated with emphysema. The first pulse-tracing (Fig. 25) shows the imperfect filling of the arteries due to the arrhythmia which was present. Pulse-rate, 104. Blood-pressure, 82 mm. Hg. Within

FIG. 25.—Imperfect filling of arteries due to arrhythmia. Mitral insufficiency, myocarditis, emphysema. Pulse-rate, 104. Blood-pressure, 82 mm. Hg.

the first week, in fact directly after his arrival, he had two severe attacks of embolism of the lungs; he suffered also from congestion of the liver, edema of the legs, etc. The second tracing (Fig. 26) shows some improvement. Pulse-

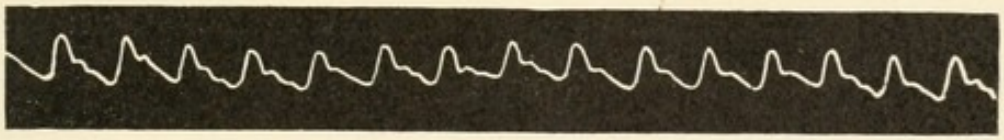

FIG. 26.—Same case after embolism of lungs, congestion of liver and edema of legs. Pulse improved to 96, arrhythmia gone, blood-pressure increased to 90 mm. Hg.

rate, 96. Blood-pressure 90 mm. Hg. Here we find not only a diminished frequency of the pulse but also a disappearance of the arrhythmia and an augmentation of the blood-pressure to 90 mm. Hg., as measured by Gärtner's

FIG. 27.—Continued improvement; pulse reduced to 78, blood-pressure increased to 105 mm. Hg.

tonometer. The third tracing (Fig. 27) demonstrates marked changes for the better. This shows the condition after using the effervescing bath of Spring No. XIV. The pulse-rate had diminished to 78 per minute, the

blood-pressure by the tonometer had risen to 105 mm. Hg. (equivalent to 125 mm. Hg., Riva-Rocci). It may be mentioned at the same time that the invigoration of the circulation was also perceptible in the heart itself. The edema in time disappeared completely and the enlargement of the liver diminished.

Such cases as these come in large numbers to Nauheim every year and I have had the opportunity of observing many of these for several seasons in succession and have thereby convinced myself that the improvement has remained permanent. If, however, from some adverse circumstance fresh disturbances of compensation occur, these can again be relieved by the same treatment without the use of drugs, and a more enduring compensation can be restored.

A statement confirming this occurs in a treatise by Sir Lauder Brunton, a well known English specialist on heart disease. From a lecture which he delivered to the North-East London Post-Graduate College, on the "Clinical Measurement of Diastolic Blood-Pressure and Cardiac Strength"(see British Medical Journal, November 5, 1910), I excerpt the following passage referring to a patient who at that time was sent to me:

"Of late years a method of treating cardiac disease has come into practice and consists in baths, massage and resistance-exercises. It is now 20 years since I first examined into this treatment. An old friend of mine who was an Army Surgeon in India came home with a very bad mitral regurgitation. He took a house in Norwood and came up to me once or twice a week for advice. I did the best I could for him by means of drugs, but he did not improve in spite of all my endeavors, and at the end of the summer I told him he must go across to Nauheim. He accordingly went. I followed him to see the method of treatment and to see how he was getting on. He came back very greatly improved and before the winter set in he was

able to return to India to serve out 3 years and retire with a pension from that time on. This was a test case because I had done my best to cure my friend but the Nauheim treatment succeeded where drugs had failed."

Numerous cases like the above come for treatment year after year. Thus I have had the opportunity of demonstrating the following very characteristic case to several of my colleagues: Miss P., an English lady, somewhat over 30 years of age, came to me at Nauheim on May 5, 1909. Her previous history was as follows:

The patient was unaware whether heart disease was hereditary in her family or not. Between the age of 7 and 14 years she had suffered repeated attacks of articular rheumatism, the most severe attack occurring in her twelfth year; at that time the presence of heart disease was determined. In her fifteenth year menstruation began and it was from this time that the patient dated the aggravation of her illness. She was easily tired by short walks; even at that time the climbing of stairs was difficult and readily produced trouble in breathing. At the eighteenth year pronounced dyspnea commenced, at first more particularly at the menstrual periods. Gradually, climbing became more and more difficult and finally it was only with great effort that she could walk on level surfaces. The dyspnea became at last so severe that the patient for 3 years had hardly been out of her bath chair. Along with certain dietetic regulations and prolonged rest, which were advised, the treatment consisted largely in the administration of digitalis. Other drugs were also given at intervals, as, for example, strophanthus and strychnin, which, however, were almost wholly inactive so that a return was always made to digitalis, in the form of the tincture as well as the powder and the pills.

Until two years previous the patient felt that her condition was still bearable. During the warm summer season she was able to walk short distances on a level surface but was unable to go up an incline. During the last two winters

she was compelled to remain in her room. From that time walking even on a level surface became so difficult that during the last year she was hardly ever out of her bed or the bath chair. In this condition the patient arrived at Bad-Nauheim.

Status Præsens.—Slenderly built and thin lady; countenance and lips somewhat blue in color. Attempts to rise from the bath chair produces dyspnea; this increases if she attempts to undress herself, so that she requires assistance. In bed she can lie only with the head raised. The left half of the thorax is somewhat more prominent, yet not markedly so. On the left breast one can see the heart pulsations in the fifth intercostal space and the apex of the heart can be determined both by palpation and percussion to be 1 1/2 to 2 cm. outside the nipple line. Percussion toward the right shows an increase of dullness of more than 2 cm. At the apex of the heart there is heard a loud presystolic murmur, the second sound now and then impure, the second pulmonic sound accentuated. The remaining heart sounds are normal. The breathing, even when at rest, is rapid and shallow; in the lungs there is no abnormality. The pulse is regular, but small and rapid. The left lobe of the liver can be felt about two finger-breadths below the costal margin, the lower border painful on pressure. No edema of the legs. The amount of urine during the day after arrival was 800 to 900 c.c. in the 24 hours; specific gravity somewhat above normal; uric acid in excess, but neither sugar nor albumen present.

Treatment was begun with a very mild course of baths. The baths were very gradually prolonged and their concentration very carefully increased. Ultimately, effervescing baths could also be tolerated. Of course, the patient had exact dietetic regulations as well as massage of the liver and of the upper and lower extremities. During the last few weeks a very mild form of resistance-gymnastics was also employed. By means of careful treatment lasting

7 weeks, and without the use of a single drug, such an invigoration was obtained in the heart-muscle that the patient was able to walk without difficulty on the level for some time and could actually undertake easy inclines. This condition has remained up till the present time without the assistance of medicinal treatment.

The pain which is occasionally associated with valvular defects is not in my opinion caused by the valvular lesion itself, as is asserted by some authors. If this were the case, such pain ought to occur frequently in compensated valvular lesions; it occurs, however, as is generally known, only very seldom in the pure forms of valvular defects. With a few exceptions these pains arise from the condition of non-compensation and are then caused either by pressure of the dilated heart on its surroundings, or, for example, in aortic insufficiency, from back-pressure in the long axis of the heart. Often such pains are the sequelæ of a general nervous condition; in many cases, however, they indicate the commencement of vascular changes from which they are then derived.

One can often observe that in severe cases in which digitalis had been previously used so freely that it had lost its efficacy, its activity may be regained if one employs this drug in combination with baths or gymnastics or with both. I have been able to demonstrate this several times to physicians and my own observations on this subject have been communicated previously.

In *chronic affections of the heart muscle* one must differentiate between definite pathologic changes in the myocardium and the simple disturbances which become apparent owing to functional weakness of the heart muscle. Febrile disturbances of many different varieties may directly alter the heart muscle and cause inflammation without affecting the valves.

For the last 25 years no infectious disease, apart from acute articular rheumatism, has had such untoward influence

on the heart as *influenza*. The number of heart affections caused by it and the severity of the cardiac lesions do not always go hand in hand with the geographic distribution or actual severity of the influenza epidemic. Not uncommonly a mild attack of influenza may leave behind it serious damage to the heart. Occasionally, the valves are attacked and valvular imperfections result, but on the whole these seldom occur; much more common is the occurrence of neuroses of the heart, but in the larger proportion of cases it is the heart muscle which is attacked. It is well to remember, however, that affections of the heart which have been caused by influenza are usually favorably influenced by therapeutic measures.

Constitutional diseases, such as diabetes and gout, as well as syphilis, may affect the heart muscle directly but most commonly this occurs indirectly as a result of vascular disease. The influence of kidney diseases upon the heart is also exerted in a similar manner. All processes which lead to sclerotic changes can also affect the heart muscle adversely; this is especially the case in diseases of the coronary arteries which result in a disturbance of the nourishment of the heart muscle and lead to physical changes in it. These latter, as is well known, may go on to the production of true angina pectoris. Injudicious methods of living, especially the abuse of alcohol and tobacco, and also of tea and coffee, are favorable to such processes; overeating, particularly associated with insufficient exercise, leads to different forms of fatty heart. As is well known, pathologic conditions of the thymus and thyroid glands are also very liable to cause fatty heart; recently, in fact, there has been differentiated a special form of "goitre heart." The disposition to fatty heart, with or without the concomitance of "adipositas universalis," during the climacteric period of women is very properly attributed to changes in the internal secretion of the ovaries.

Age plays an important part in the development of

chronic diseases of the heart muscle. In the growing period of youth the heart may be adversely influenced by too rapid growth of the body, with which it is unable to keep pace. There exists, however, wide differences of opinion as regards the occurrence of heart affections in childhood. According to certain writers, they are infrequent, if one excludes organic valvular defects; according to others, however, they are comparatively common. These differences of opinion have different origins. Those who have opportunities of treating many children from the poorer quarters of a large city, where rickets and scrofula are endemic, with or without anemia, will discover among these cases many more cases of heart affections than will those who examine only the children of well-to-do parents or of healthy peasants.

Another factor is that the former take notice only of serious diseases, while the latter pay attention also to the milder and more transient affections. Even in passing judgment on individual cases opinions may differ. It is known that during the period of growth murmurs appear very readily in the heart, as frequently at the base as at the apex. They occur also in the absence of anemia and chlorosis through weakness of the whole cardiac musculature, very especially, however, from atony of the papillary muscles. This may be observed not only in children who are weak but also in very rapidly growing children. The generally accepted conception of these cases is "that the heart cannot follow the general bodily growth quickly enough."

By means of an invigorating mode of life and suitable treatment these murmurs will completely disappear after a longer or shorter period. Some do not see anything pathologic in such murmurs while others consider them as abnormalitites and many are actually of the opinion that they are possibly connected with some abnormal condition of the pulmonary muscles. A real solution can only be

obtained by a long series of observations extending over a considerable period of time.

Children in whom the thorax, owing to the soft rib cartilages, is still easily distensible, very seldom suffer from dyspnea or palpitation; they complain more of a tired feeling, sleeplessness or discomfort of the whole body and as, in them, percussion does not always permit of definite conclusions, the diagnosis is often very difficult.

Still greater differences of opinion exist in regard to *neuroses of the heart* and *simple weakness of the heart muscle.* The readily excitable nature of a child has a powerful influence on the heart nerves, both sensory and motor. If these cardiac neuroses are only of a transient nature they require no treatment; if they persist, however, for a longer time they are then not without some adverse influence on the heart muscle and demand the attention of the physician as much as the weaknesses of the heart muscle arising from febrile and constitutional diseases, which can more easily be recognized.

In the succeeding period of youth, sport, masturbation, sexual and other excesses, may be added as likely causes for the occurrence or aggravation of heart affections.

It is a well known fact that old age leads not only to arteriosclerosis but also to direct changes in the heart muscle. At the same time, bodily and mental overwork, when they are extended over long periods, injuriously affect what was previously a perfectly healthy heart muscle, as can be directly demonstrated in no equivocal manner in the body muscles of man, as well as of animals. Certain of the muscular affections here mentioned must still be discussed more fully.

The general principle laid down for the treatment of chronic heart affections is once again that previously enunciated, namely, to stimulate the heart to a more restful and stronger activity. The results are well recognizable in just those cases of chronic affections of the heart

muscle in which the muscular change has not progressed too far. Along with the removal of the functional disturbances due to the more powerful action of the ventricles and auricles, clinical observation in many cases shows also an increased growth of the muscular tissue so that a commencing myocarditis either completely disappears or may be checked in its advance for many years. In a previously published monograph on chronic diseases of the heart muscle I have described some similar cases and have shown that the heart, as a result of the treatment, was functionally as good as ever and that arrhythmia and the dreaded *pulsus alternans* or *pulsus bigeminus* had wholly disappeared.

A very grateful subject for balneologic and gymnastic treatment is the *fatty heart*, of which three different forms are commonly distinguished; namely, the deposition of fat around the heart, the infiltration of the cardiac muscle bundles with fat, and lastly the degeneration of the heart muscle itself. The earlier dietetic methods of cure as, *e.g.*, Schroth's "semmel" cure, that of Harvey Banting, the Ebstein cure by administering fatty foods, were all forms of hunger cures which certainly produced a diminution of fat but frequently resulted in atrophy of the remaining musculature and weakness of the muscular power of the heart.

Carell's milk-cure, which has great advantages over those mentioned, is also, as is proved by the caloric value of the ingested food, fundamentally only a hunger cure and I have seen in recent years cases in which it had caused great disturbances in the heart as well as in the nervous system. The treatment, so common in earlier days, by purgatives, either salines or drastics, has lost ground year after year. If the case is one of a young person of muscular build, in whom the condition of the blood is normal, somewhat forceful methods of diminishing the amount of adipose tissue may perhaps be employed without producing ill effects. In other cases untoward results occur just as readily as from the treatment by forced hill-climbing.

These one-sided methods are also quite unnecessary since, by properly regulated dietetic measures, sufficient exercise in the fresh air combined with balneologic and gymnastic treatment, the amount of fat may be diminished without any concomitant disappearance of muscle substance; in fact, I could cite cases in which, along with the loss of fat, an increase in the muscle tissue actually occurred and all discomforts vanished.

The *angina pectoris* which occurs as a sequelæ of disease of the heart muscle will be discussed later, since it is usually associated with vascular disease or nervous disturbances.

Overwork of the heart, both *acute* and *chronic*, has recently and powerfully attracted the attention of physicians. Along with problems of a general nature there stands in the foreground the question, whether and in what manner the steadily increasing cult of sport leads to overwork of the heart. It was Peacock who showed on the basis of his observations among the miners of Cornwall that the carrying of heavy loads up ladders, in other words, bodily overexertion, produces heart disease. These observations found confirmation in many different countries as is shown by the works of a large number of authors. I may mention among others, Myers, Sir Thomas Clifford Allbutt, da Costa, Johannes Seitz, Leyden and Fräntzel. Personally I am able to furnish a casual contribution which the works of the above-named investigators indorse. In my opinion, *a chronic overstrain of the heart is only possible where a series of acute overexertions has preceded it.*

In order to observe experimentally the action of such acute overexertions on the heart I set healthy, vigorous men to wrestling with one another until such a time as dyspnea, profuse sweating and an abnormally augmented activity of the heart had taken place. In order to increase the intraabdominal pressure, so that the heart had also to fight against this factor, I had previously bound the abdomens of several of the wrestlers very tightly. From

these wrestling experiments the following observations were made: the rapid pulse becomes very small and easily compressed, while in some cases, arrhythmia develops, as I was able to demonstrate from the following sphygmograms (Fig. 28 to Fig. 33).

This arrhythmia is, according to Knoll's investigations, certainly a result of the increased intracardiac pressure. The breathing, at first deepened, becomes shallow; the heart sounds, at first very loud at the apex, become with the increasing dyspnea more muffled; here and there the first sound at the apex was actually somewhat impure. The blood-pressure at first rises very rapidly owing to the increased muscular activity. Well worthy of note by palpation is the downward and outward shifting of the apex impulse beyond the mammary line, the diaphragm, in fact, being pressed downward (this was determined by percussion). If one presses with the finger, directed perpendicularly to the thoracic wall, deep into the intercostal space it is possible, even with the powerful heaving of the chest wall, to determine very distinctly the position in which the finger tip is elevated by the apex beat. Percussion shows at first a diminution in the size of the heart; this can be determined very easily, a fact to which I have drawn attention in my earlier works. This picture of apparent diminution may be caused by a transient distention of the lungs as a result of the extreme dyspnea as well as by rotation of the powerfully contracting heart. If one allows the wrestling experiment to continue the cardiac enlargement becomes distinctly apparent; it is very easily detected first on the right side of the heart and then on the left.

After the conclusion of the experiment the symptoms just described diminish more or less quickly. Dyspnea and palpitation as well as the increased rapidity of pulse and respiration disappear gradually; the blood-pressure often becomes abnormally low, but finally rises again to its normal height. The apex of the heart slips back to its original

FIG. 28.—4.30 P. M. Before wrestling.

FIG. 29.—4.45 P. M. After 10 minutes' wrestling.

FIG. 30.—4.52 P. M. After further wrestling.

FIG. 31.—4.54 P. M. After 2 minutes' further wrestling.

FIG. 32.—5.20 P. M. After 1 minute's wrestling with a tight belt.

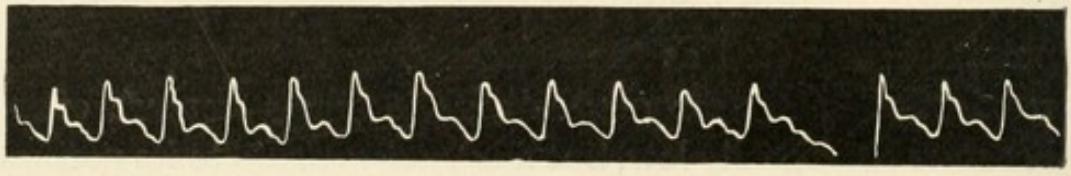

FIG. 33.—5.40 P. M. The same after 20 minutes' rest; vide Fig. 28.

position inside the mammary line and in many cases after a few minutes' rest no dilatation is detectable. In other instances, however, it takes a longer time for the heart to regain its normal dimensions.

By others as well as by myself, cases have been described in which a single excessive strain has led to permanent damage; indeed this has been the case even among persons in whom no abnormality was previously observable in the heart, or in whose recollection there was not the slighest evidence of previous injury to the organ.

These facts, determined esperimentally by acute over-exertion of the heart, as well as by clinical observations, show distinctly how a chronic overexertion of the heart develops; in other words, this is nothing more than an *accumulation* of single acute strains. This accumulation carries with it the fact that the heart-muscle gradually loses the power of recovering its normal size after each successive strain. There remain, as after-effects, conditions of weakness and dilatation with all their accompanying symptoms until the clinical picture of the definitely overstrained heart becomes a permanent fact. Experimental and clinical observations on this question completely coincide and supplement each other.

Nevertheless, grave doubt has been expressed as to whether multiple overexertions of the body alone were able to produce the condition of a chronic heart-strain in a previously healthy heart. It was generally presumed that such a heart had previously been abnormal or adversely influenced by alcohol, tobacco and other excesses. This doubt seems to find encouragement from the radiographic or orthodiagraphic researches of Moritz, Hoffmann and de la Camp. These authors found either no heart change or actually a diminished size of the heart after exertion and they concluded from this that the individuals concerned in my wrestling experiments already possessed abnormal hearts. It is now 20 years since my first experimental

investigations were made and I can point to the fact that these men whom I had selected for my experiments and who since then have been under my observation from time to time, at the present day possess still perfectly healthy hearts.

The unreliability of the results which one obtains from investigations with the X-rays may be explained as follows: in the orthodiagraphic as well as in the tele-radiographic investigation of the heart one obtains the orthogonal, that is to say the vertical projection of the greatest extent of the shadow on a flat surface. In a resting organ this plane is always the same; but it is quite otherwise with an organ like the heart, which is in perpetual motion. Certainly, one obtains clear pictures of the form and size with a quietly beating heart. But even in such instances quite distinct differences occur between orthodiagraphic and tele-radiographic photographs, differences which have their origin, on the whole, not so much in the difference in the technical details of the method as in the method itself. Still more difficult is the solution of the question, when it becomes important to draw definite conclusions from the results of a comparison of two heart photographs which have been taken at different times from the same individual, as is the case here. Changes in the position of the person under investigation and in the position of the diaphragm yield quite different pictures. These differences, however, become more apparent with a very rapidly moving heart. Rotations in all directions and around its own axis follow one another here very rapidly. Further, it must be added that with the single photograph one will obtain but two of the three dimensions of the heart, usually only the dimensions of length and breadth (the dimension of depth is lacking) and these form a plane which cannot be determined.

In recent years attempts have been made to overcome the differences which are caused by the fact that the exposure does not always occur at exactly the same moment

of a single cardiac cycle, but so far they have not proved a complete success. The attempt to compare skiagrams which have been obtained by photographing the heart simultaneously from two different positions is still a failure. Either *stereoscopic radiography* or *stereoscopic fluoroscopy* may, however, solve this problem at some future time.

Experience has shown that the results of Roentgen investigations for the purposes of comparison are still defective. The experiments of Baldes, Heichelheim, and Metzger prove the same fact; they obtained quite different results in healthy persons, who for experimental purposes had undertaken very long marches under great heat. Skiagrams showed, for example, increased size of the right heart with simultaneous diminution in the size of the left; on another occasion they showed exactly the reverse, namely, diminution in the size of the right heart with simultaneous increase in the size of the left. I also observed that the orthodiagrams taken in the course of the wrestling experiments showed varying pictures, that is to say, now a diminished size, now an increased size, according to the momentary position of the heart.

It is quite comprehensible that in a previously abnormal heart, the danger of overstrain is always present. That such an overexertion does occur even in healthy men, as my wrestling experiments showed, must again be proved beyond all dispute. This proof can only be obtained by experiments on animals. About 2 years ago I carried out experiments on dogs in the following manner. In order to make the beating of the heart visible from the outside and the boundaries of the heart easily felt with the finger, subperiosteal resections of portions of the dogs' ribs were made over the heart on both the right and left side. After the wounds were completely healed, the animals were set to run under great exertion inside a wheel which drove a water-pump. When these exertions had lasted for a considerable time, the dilatation of the heart could very easily

be seen and felt by other physicians present (including a veterinary surgeon) as well as by myself. For the purpose of a more exact investigation the animal was then killed and the post-mortem examination was undertaken by Fischer, the director of the department of pathological anatomy in the Senckenberg Institute at Frankfort-on-Main. The autopsy proved the general organs to be normal and the heart to be absolutely healthy.

The plethysmographic researches of Gerhardt and Bruns, which they communicated to the Congress for Internal Medicine at Wiesbaden in 1913, confirm the results of these experiments of mine. De la Camp also succeeded in obtaining similar results in his recent researches among ski-racers which he described on the same occasion.

It is, therefore, proved beyond doubt that the symptom-complex characteristic of a chronically overexerted heart may occur even in healthy hearts. This fact requires the careful consideration of physicians, since, owing to the excessive indulgence in sport, cases of cardiac overexertion threaten to become increasingly common. Mental overexertion also, as well as great excitement, not infrequently leads to abnormalities of the heart.

It need hardly be stated that in such overexerted hearts one should advise rest for some time. With hearts which have been subjected for a long time to continuous and powerful overstrain, rest may not, however, suffice to produce complete compensation. Weakness of the heart muscle and dilatation remain unaffected and such cases come for balneologic treatment in increasing numbers year by year.

While mild cardiac disturbances occasionally occur in otherwise healthy women during *pregnancy*, this is still more the case when affections of the heart, especially valvular defects, are already present. By careful treatment, in which either cold or very strong baths should be avoided, the disturbance can be improved or may, in fact, completely

disappear even while pregnancy is progressing. Where there is a tendency to abortion or premature birth, I have made it a rule not to allow such pregnant patients to bathe, but I must qualify this by the following statement: Some few cases which were affected with diseases of the cardiac muscle, or with valvular defects, and in which several abortions had formerly occurred, were sent to me by their physicians in the first months of pregnancy, on account of the patients' extreme discomfort, with the definite request to secure as far as possible an amelioration of their dyspnea by means of baths. As an actual fact the dyspnea was greatly improved by a careful course of baths and the pregnancy progressed normally.

Motor as well as *sensory neuroses* of the heart and *angina pectoris of the nervous type* form very satisfactory conditions for treatment. The sedative action of the baths and a careful course of resistance-gymnastics often result in a very rapid diminution and disappearance of tachycardia and arrhythmia, while bradycardia arising from a purely nervous basis often gives place to a normal heart frequency. Palpitation and cardiac pains generally disappear in a short time and by the restoration of the general nervous system *neurasthenic conditions of the heart* are also favorably influenced.

With this should also be considered the complex condition described by Herz some years ago under the name of "*phrenocardia.*" Principally it consists in sensory and motor neuroses which are associated with alterations in respiration; it arises from a sexual origin, mostly in the growing period of life, but often occurs much later. Naturally, in these cases concomitant psychological treatment may be used to advantage.

Tachycardia, even of the paroxysmal type, may exist for some time as a purely nervous condition without causing special disturbances; if, however, the isolated attacks are prolonged or follow each other at frequent intervals over an

extended period, they lead according to my records to weakness of the heart muscle with all its concomitant symptoms.

Several years ago I directed attention to the fact that in Graves' *disease* (*Morbus Basedowii*) it was especially the strongest baths, effervescing baths and effervescing shower-baths, which proved themselves more particularly active. Whether this is due purely to a favorable influence on the neuro-muscular apparatus of the heart or to an improvement in the secretory processes of the thyroid gland is still undecided.

My experience in the treatment of Barlow's *disease* extends to only a few cases. These were children between the ages of 2 and 12 years. In a girl aged 2 years the disease was very severe and demanded repetition of the treatment for several years. I still have occasional opportunities, after the lapse of 20 years, of seeing this girl who has in every respect shown normal development.

An animated discussion has recently taken place on the so-called *myoma-heart*. The occurrence of such a condition is as confidently asserted by one side as it is disputed by the other. It is certain that large myomata of the uterus may arise without the heart being markedly affected by such a condition, but in other patients even very small tumors have caused grave cardiac disturbances. The question at present remains unsettled whether in these cases neuroses, abnormalities of internal secretion or direct disturbances of the circulation are chiefly involved.

The treatment of *arteriosclerosis* has always awakened the interest of physicians in a high degree. It must in the first place be emphasized that the pathologic changes of arteriosclerosis, whenever they have once occurred, cannot be made to disappear by any known treatment, medicinal or otherwise. In such cases it can only be a matter of checking the further progress of this disease or to delay it, and remove or improve any symptoms resulting from these vascular changes. In patients with commencing or still

inextensive arteriosclerosis, such as form a comparatively large percentage of the yearly visitors to Bad-Nauheim, it is often possible to obtain very satisfactory results with physical methods of treatment.

Arteriosclerosis, of course, is considered at present as a vascular change which arises through wear and tear in its various forms. It is quite well known that in the pathogenesis of arteriosclerosis, a series of factors plays an important part. These, beside heredity, are especially constitutional diseases such as syphilis, diabetes, gout and also obesity. Furthermore, the abuse of alcohol and tobacco as well as persistent bodily and mental strain are concerned in its production.

The condition of the blood-pressure alone cannot serve as a criterion for the estimation of arteriosclerosis, as is assumed by many authors. It is not possible to draw the simple conclusion that a higher blood-pressure indicates a more extensive, and a lower blood-pressure a less decided arteriosclerosis. There are, for example, patients in whom large calcareous deposits exist in the vessels, while the blood-pressure is not much above normal just as there are actually others with abnormally low blood-pressures. This fact should be considered of great importance in making a diagnosis.

Useless as the height of the blood-pressure is as a measure of the greater or less extent of the arteriosclerosis, it is in itself of as little use for the determination of the value of therapeutic interference. As a rule, one considers that every measure which raises the blood-pressure is contra-indicated; in methods which lower the blood-pressure one believes he has discovered an important curative factor. Thus, for instance, in a number of treatises in which the action of iodine, electricity, and oxygen baths is discussed, the influence on the sclerotic process is measured only after the lowering of the blood-pressure. It has already been pointed out that iodine, without exerting any action on the

blood-pressure, influences favorably the discomforts of arteriosclerosis, most probably by a chemical action on the blood-vessel walls. It must also be mentioned that the action, generally transitory, of oxygen baths and electricity in lowering the blood-pressure itself gives no evidence of the influence of these therapeutic measures on arteriosclerosis. Here the action in lowering the blood-pressure is by no means the most important.

Of course, in cases of abnormally high blood-pressure, treatment must be directed toward preventing a still greater increase in the blood-pressure, since otherwise the heart as well as the vascular system may easily become damaged. In such instances physical treatment also demands special care. Too cold baths must not be given, and their content of carbon-dioxide must vary within narrow limits. On this account also the strongest forms of effervescing shower-baths are not to be employed for patients with arteriosclerosis. As regards the gymnastics, only small or moderate resistances can be brought into use. I have already pointed out in earlier works that it is possible to influence the blood-pressure favorably by properly regulated balneologic and gymnastic treatment. Last year, along with my assistant, Dr. Dagenhardt, I carried out, by the more recent methods of investigation, a series of blood-pressure measurements on a large number of patients, which have confirmed my earlier researches. A detailed account of these studies will follow in another place.

Very serious organic changes in the heart and vascular system are not suitable for physical treatment, as will be discussed elsewhere.

Angina pectoris takes quite a special place among chronic heart affections. This arises from the fact that its symptoms—paroxysms of pain associated with a great feeling of anxiety—can have different origins. Angina pectoris of the purely nervous type has already been spoken of. *In angina*

pectoris of vaso-motor origin the unpleasant symptoms are caused in a purely reflex manner from spasm of the peripheral vessels. Most commonly the anginal attacks are occasioned by sclerotic changes in the course of the coronary vessels or in the aorta, especially at the place of origin of the coronary arteries. This is *true angina pectoris*. The action of balneologic and gymnastic treatment on the purely nervous and vaso-motor varieties of angina pectoris is quite clear. In regard to true angina pectoris a distinction must be made between the treatment during the anginal attack itself and that during the periods of remission. Further, the question as to the manner in which the anginal attacks arise must also be taken into consideration. In a large number of cases they are indisputably caused by spasm of the coronary arteries and the resulting ischemia of the heart.

The interpretation of the manner in which the paroxysms of pain arise here varies with different authors. Ross, Head and Mackenzie assume that the sensation of pain comes about in a reflex way; in fact, that the irritations are conducted centrifugally to the heart by way of the spinal cord and brain (viscero-sensory reflex of Mackenzie). Neusser assumes that owing to the irritation of the vaso-motor nerves of the heart a spasmodic condition of the coronary vessels is induced and the pain is conducted centripetally from there through the sensory fibers of the sympathetic.

The nitrites have proved of great benefit in these paroxysms of pain. Nitroglycerin, especially in fluid form, transcends all other remedial agents. The other medicaments of this series have already been mentioned. During a very prolonged attack of pain associated with a condition of great anxiety, a subcutaneous injection of morphin can be administered with advantage and frequently exercises a very beneficial advantage by relieving the pain and calming the nervous condition of the patient. In many cases I have been able to replace the morphin by the application

of heat, as has been mentioned earlier; this often helps to dispel the heart paroxysms very rapidly.

Very important is the treatment during the periods of remission from attacks. It is not so long since it was common belief that the patient required no treatment during the intervals between such attacks; it was held that even in true angina pectoris it was only the ganglionic centers in the heart that were affected and anything else was of a secondary nature. The number of adherents to this theory to-day is probably insignificant. The pathologic and anatomic investigations and the clinical observations recorded in cases of long standing angina point to both organic changes in the muscle and vascular system of the heart and also to functional cardiac disturbances. In this respect Parry and Stokes had previously expressed such opinions and their teachings found confirmation later through the work of Traube, Potain, Germain See, Leyden, Fränkel and several others. Many years ago I pointed out in a monograph that in angina pectoris vera certain changes occurring in the course of the disease became apparent through auscultation and percussion. The heart sounds are often weaker, here and there arrhythmia arises, and occasionally even gallop-rhythm is noted. In other cases I have observed that during the attack the first heart sound was impure and remained so for some time after the attack. By percussion also it is often possible to detect a distinct enlargement of the heart during the paroxysm, the enlargement affecting chiefly the left side. Owing to a greater extension of the arteriosclerotic changes over a large coronary area, the whole heart may finally become dilated, and this is not only the case during the anginal attack but this condition may persist after the acute attack has subsided. The more frequent the attacks, the longer does the dilatation remain and ultimately it does not wholly disappear. The fact that, in advanced cases of angina pectoris vera, the whole cardiac musculature is ultimately affected, is

generally known. Many patients suffering from myocarditis alone come to the physician for treatment on account of their anginal disturbances.

It is quite clear from the above description that it is not sufficient to combat the anginal attacks alone; the treatment must as well be specially directed to maintaining the vigor of the heart and to easing and improving the circulation of the blood in the coronary vessels; in other words, it is a matter of resorting to a tonic treatment of the heart muscle, of the cardiac vessels and eventually of the nervous apparatus of the heart. If the sclerosis has not produced changes of too high a degree in the coronary vessels and if the heart muscle is still not too greatly degenerated, then balneologic and gymnastic treatment will often cause the attacks to yield more promptly, to occur less frequently and occasionally to wholly disappear. In fact, physical treatment has often proved of value in cases in which the nitrites and nitroglycerin have had no effect. Rives, for example, has described fully in the New York Medical Journal one of these cases observed by me.

The patients suffer severely not only during and after such an attack, but when the disease has persisted for some time, they cannot wholly free themselves from their condition of nervous excitement and depression. Such patients are constantly apprehensive and actually feel that the "sword of Damocles" is hanging above their heads. Besides the dietetic and other general directions, the direct heart treatment of these patients demands especial attention and care. A bath of too cold a temperature can readily precipitate an attack. Exhausting baths or too powerful resistance during the gymnastics, can increase the dizziness and particularly the sensation of pressure in the heart. As a result of this the whole nervous system becomes concomitantly affected, there is alternating excitement and depression and these sufferers rapidly lose their pluck and either give up treatment altogether or make it so difficult

that no benefit is received. It seems, therefore, essential to recapitulate here the method of treatment in one of these cases. The sphygmographic tracings, taken at the same time, show the changes in the vascular system (Fig. 34 to Fig. 46.)

A merchant, H., 40 years of age, first came under my treatment July 28, 1886. His previous history was as follows: In December, 1885, severe and prolonged attacks of emotional excitement were manifested. A few days later seizures of pain in the region of the heart set in; the attacks increased more and more, palpitation and dyspnea being associated with them. From the tenth to the eighteenth of April the attacks followed so frequently that the patient was confined to his bed. Since that time no week has elapsed without the occurrence of several attacks, both day and night.

Status præsens.—The patient has just had an attack and looks very pale; is unwilling to move himself; breathing is anxious, irregular and shallow. Complains chiefly of pain over heart, especially at upper part of sternum and in second left intercostal space; pain also radiates outward to left axilla and arm, as well as toward the back. The pulse can scarcely be felt, is easily stopped by pressure, and is irregular; pulse-rate 50 per minute; blood-pressure 80 mm. Hg. The walls of the radial artery are soft, and even in the other peripheral arteries no sclerotic changes can be detected.

Diagnosis.—This was undoubtedly true *angina pectoris.*

Treatment.—A few arm movements were ordered to be given with the mildest form of resistance and under the strictest surveillance. Each individual movement was divided up so that several pauses would intervene and at its close was followed by a prolonged period of rest. Particular care was also taken during the gymnastic exercises to see that the patient was breathing deeply and regularly. After about 10 minutes the patient began to feel distinctly easier

and in 15 minutes was comparatively free from subjective symptoms. Previously the anginal attacks had lasted for at least half an hour and many of them for two or

FIG. 34.—Before gymnastic exercises.

more hours. The pulse dropped to 72 and became fuller and more regular. The difference before and after the

FIG. 35.—After a half hour's gymnastics with weak resistance and pauses during each single movement and between each exercise.

gymnastic exercises is shown very distinctly by the two pulse-tracings seen above (Fig. 34 and Fig. 35).

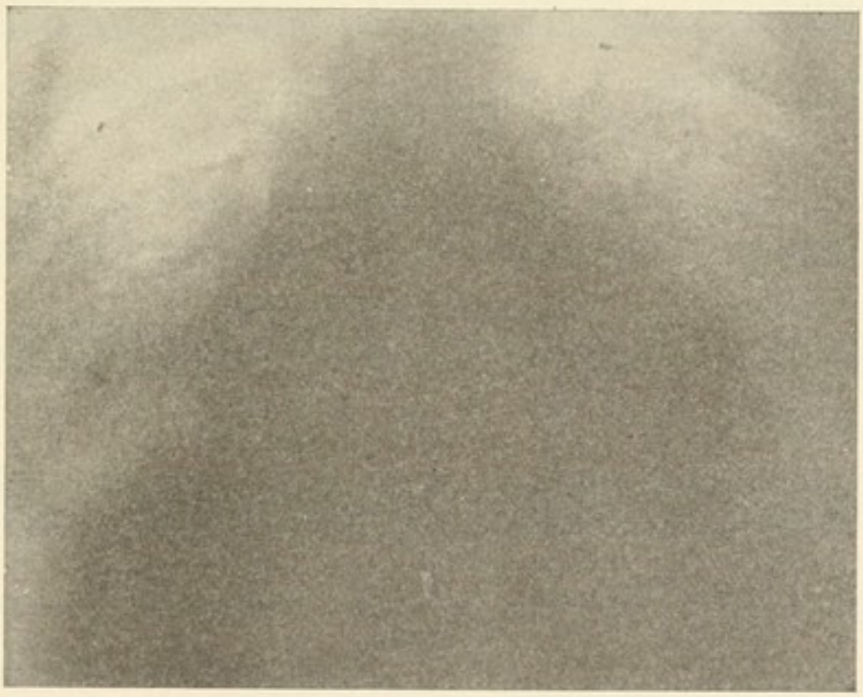

FIG. 36.—Angina pectoris. During the attack. (X-ray photograph of the heart.)

The X-ray photograph (Fig. 36) shows the condition during the anginal attack and Fig. 37 shows the improved

condition resulting from a half-hour's gentle resistance-exercises.

Blood-pressure, not constant; varies between 85 and 90 mm. Hg. (as measured by von Basch's sphygmomanometer).

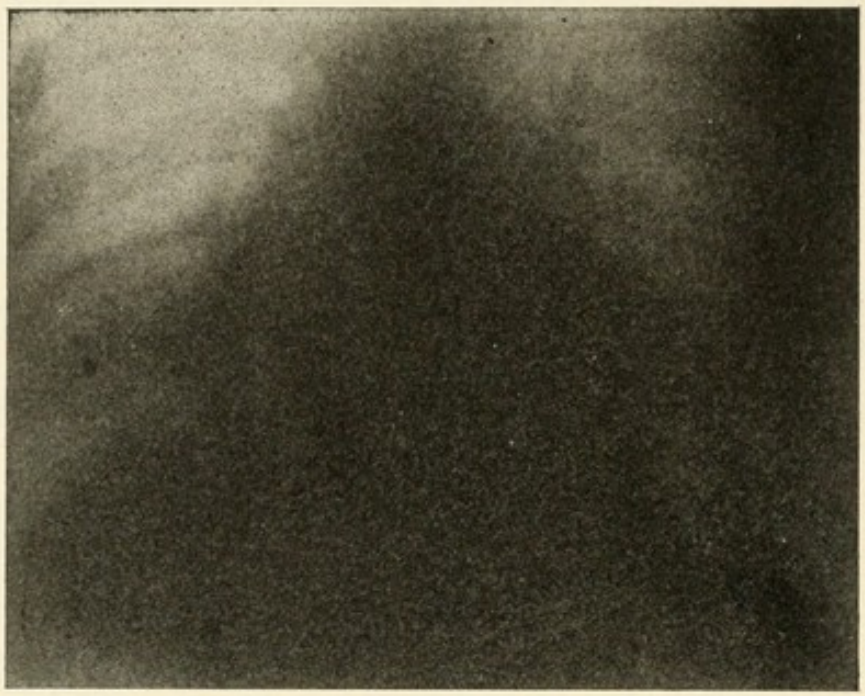

FIG. 37.—Angina pectoris. After half-hour of gentle resistance-exercises. (X-ray photograph of the heart.)

After the attack the patient felt tired and exhausted and complained of loss of appetite. Sleep during the ensuing night was bad and frequently interrupted.

On July 29, patient was given his first bath consisting of 1 per cent brine, free from carbonic acid, at 90° F.,

FIG. 38.—After the first brine bath (1 per cent) at 90° F., 6 minutes' duration.

and of 6 minutes' duration. After it the patient felt much stronger and more comfortable, breathing regular, pulse rhythmical and somewhat small, though fuller than before the bath. Blood-pressure 90 mm. Hg.

Next day the patient felt much more comfortable; the

baths were prolonged a little, lasting from 8 to 10 minutes; a pause being made every second day. On the second of August, contrary to orders, the patient indulged in some beer, which caused severe pain with a feeling of oppression in the region of the heart, and sleeplessness. Pulse on the following morning was irregular and very weak.

On the third and fourth of August his condition was good; on the fifth, half-an-hour's walking caused a severe

FIG. 39.—Before walking.

sense of oppression in the cardiac region, not, however, giving rise to an anginal attack. Although the pulse before the walk was regular and full, after walking it showed marked arrhythmia and was scarcely perceptible.

Contrary to my advice the patient did not remain quiet during the following day and had slight attacks during the night of the eighth and ninth of August as well as during the forenoon of the tenth of August. The last of these attacks I saw from its commencement and I could observe

FIG. 40.—After walking on a level surface for a half-hour.

very distinctly the effect of half-an-hour's resistance-gymnastics on the cardiac area and on the pulse. During the course of the exercises the dilatation diminished and the anginal attack disappeared.

The changes which the pulse showed, as represented in the following two sphygmograms (Fig. 41 and Fig. 42) require no special explanation.

During the next few days the concentration of the salt in the baths was increased to 2 per cent and along with this

was used weak carbon-dioxide baths. The baths lasted for about 15 minutes; temperature 89° F. During the whole week the patient felt very comfortable. The blood-pressure was mostly over 100 mm. Hg.; pulse-rate varied between 72 and 80, full and powerful, as the tracing (Fig. 43) shows.

FIG. 41.—Before the gymnastics, during an anginal attack.

During the next few days the patient was able to walk on level surfaces without any discomfort, for periods up to half an hour; because of this improvement but quite against my orders, he believed himself able to climb the Johannisberg on August 21. Even during the climb palpitation

FIG. 42.—After resistance-exercises for a half-hour.

and dyspnea occurred and a short time after the descent a severe sense of opression about the region of the heart set in, which feeling, however, rapidly disappeared on the application of a hot water bag and the careful use of very mild resistance-exercises; a definite anginal attack did not

FIG. 43.—Tracing Aug. 19 after 12 brine baths and resistance-gymnastics for half an hour once or twice a day had been given.

result. The pulse, somewhat smaller at the commencement (as the tracing Fig. 44 represents), regained its normal condition after gymnastics and the application of heat; the heart also, at first somewhat dilated, returned to its normal dimensions.

Meanwhile, concentration of the bath had taken place each day, so that by adding enough mother-liquor the CaCl content was augmented up to 6 liters to each bath; the temperature was reduced to 88° F., the duration was increased up to 20 minutes.

The patient now strictly followed instructions, drank several cups of milk or cocoa, a bottle of wine and about

FIG. 44.—After climbing the Johannisberg on Aug. 21.

100 c.c. of cognac a day; he ate every 3 hours, taking small quantities of an easily digested and mixed diet. He was allowed 100 to 125 gm. of butter each day in lieu of fat. The amount of water imbibed was not limited, but the taking of large quantities of liquid at one time, and the distention of the stomach with solid foods was prohibited for reasons previously stated.

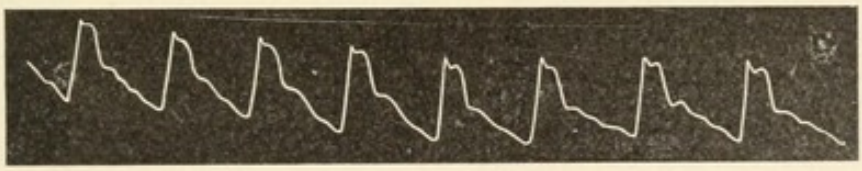

FIG. 45.—After the fifth effervescing bath, Sept. 2 (tracing taken a quarter-hour after the bath). The blood-pressure was increased to 120 mm. Hg.

On August 28 the first effervescing bath of 10 minutes duration was taken. He now felt quite remarkably well, so that it was thought best to continue the effervescing baths. A tracing taken after the fifth effervescing bath on the second of September is reproduced in the above sphygmogram (Fig. 45).

By this time the patient had learned the self-resistance-gymnastics which he practised twice or thrice daily for a half-hour. The action of these gymnastics is shown in the next sphygmogram (Fig. 46).

On September 20, after he had taken a series of 41 baths (consisting of 12 brine baths, 16 gaseous or Thermal and 13 effervescing or Thermal-Sprudel baths) within 8 weeks, he stopped the Nauheim treatment and went home. Objectively there was no form of abnormality detectable in the heart nor in the whole circulatory apparatus. Subjectively complete euphoria was established.

In the following winter, 1886–87, he was able to undertake extensive business journeys, during which period a

FIG. 46.—After self-resistance gymnastics for a half-hour. The blood-pressure was increased by them to 135 mm. Hg.

very mild anginal attack occurred but twice. The self-resistance gymnastics were continued regularly by the patient.

He returned to Bad-Nauheim the following season, on July 28, 1887, for a repetition of the bathing treatment. He looked in the best of health and only complained of occasional sleeplessness together with a loss of appetite and eructations at infrequent intervals. When the latter occurs he experiences uneasiness in the region of the heart and occasionally a slight palpitation. Objectively nothing can be detected in the heart. Patient remained at Bad-Nauheim for 6 weeks and after that made long journeys on foot; he could climb easy hills, but the steeper mountainous paths immediately produced palpitation. After 32 baths, of which 15 were effervescing, he felt that he was practically restored to normal health.

I had the opportunity of examining this patient frequently for several succeeding years and could discover no abnormality of any kind. He has been able to conduct his business without any symptom of cardiac disturbance.

Cases of Stokes-Adams *disease* are in my experience not

nearly so rare as was once believed. Mild cases occur after infectious diseases, and also, as shown by the literature, after large doses of digitalis. These often disappear very quickly under suitable treatment. Quite different, however, is the behavior of cases which originate from arteriosclerosis. Even here it is often possible to check the extension of the disease although the asynchronism of the auricular and ventricular contractions (fibrillation) persists. Investigation with the cardiograph and electrocardiograph prove this distinctly.

The invigoration of the heart and the improvement in the circulation of the whole vascular system obtained by baths and gymnastics, as is well known, brings about a *strengthening of the renal functions*, which first of all becomes apparent through an increased diuresis. Along with this the amount of albumen diminishes and ultimately the number of urinary casts, so that not infrequently the urine becomes quite normal. Edema, dropsy, ascites and anasarca then disappear, often in a very short time. The improved circulation is not only of value in cases of simple *congestion of the kidneys*, but one often notes also that *interstitial nephritis* distinctly improves under balneologic treatment, although in the parenchymatous form this treatment is less suitable.

By maintaining compensation and by observing strict dietetic regulations—especially important being a diet poor in salt, the avoidance of spices and of large quantities of albumen and water—the condition of the patient may remain tolerable for many years if sufficient bodily and mental rest is observed. Warning must be given against the employment of an actual "thirst cure" since a sufficient amount of liquid is necessary to flush the kidneys; otherwise, uremic conditions may easily arise. Should such attacks become frequent and if the Cheyne-Stokes phenomenon repeatedly occurs, physical therapy is practically useless.

Even in atrophy of the kidney one often observes that compensation can be maintained for many years. It is

quite astonishing with what small amounts of normal kidney substance the quantity of urine remains quite sufficient, so long as the heart acts powerfully enough to supply the kidneys with the necessary amount of blood and to drive the blood with sufficient force through the kidneys. In these conditions the special forms of treatment must be very mild and on this account are liable to consume a longer time.

In *emphysema*, as is well known, disturbances of the heart's activity frequently occur. Although improvement in the pulmonary circulation, through increased activity of the heart, results in better and deeper breathing, pneumatic treatment may frequently be employed with advantage in this condition.

Disturbances of the stomach and intestines with or without congestion of the liver are often met with in combination with heart disease; they are, in fact, not infrequently the cause of the heart disturbance. They demand, along with other treatment, a mild course of purgation. A course of mild saline waters along with physical treatment is often useful. Purgation with strong bitter waters or drastic cathartics should always be avoided in these conditions.

Great *distention of the bladder* from mechanical pressure leads to serious disturbance of the heart and should, therefore, be avoided.

Recent pericardial exudations, so long as the febrile process still persists, are a contraindication for balneologic treatment. If, however, the acute stage has passed and no fever remains, it is then possible in most cases to cause complete absorption of a recent exudate by means of baths containing a large amount of calcium chloride and having a temperature very near to the indifferent point. If adhesions to the heart or to the chest wall have already formed, an alteration by physical methods of treatment is not to be expected; they only have the power of combating such functional heart disturbances as may be present. In

severe cases of heart weakness and persistent dyspnea resulting from this condition, surgical measures have been employed with good results.

In all cases of heart disease, complicated with other ailments, such as *gout*, *diabetes*, etc., which, perforce, require special treatment, this is best administered concurrently with that directed to the heart. To enter into a detailed discussion of these special treatments is beyond the scope of this work.

The powerful influence which baths and gymnastics exert on the heart and circulation should warn us that there are *contraindications* to these methods of treatment. Among these must be considered all *inflammatory diseases* of the heart, so long as they are associated *with fever*, all *widely extended degenerative conditions of the heart muscle* as well as *extensive sclerotic changes in the blood-vessels*. Here the imminent danger, as is well known, is that of apoplexy and embolism. *Aneurysms of the heart and aorta* also belong to this class, since in these conditions some insignificant factor may bring about a rupture of the aneurysmal sac. Such patients should follow an expectant treatment at home; they are not fit to undertake strenuous journeys. Neither can the existing danger be eliminated by sanatorium treatment. The circumstance that some of these patients tolerate physical treatment has led to the belief that this may still produce lasting benefit, from the fact that effervescing baths at properly regulated temperatures withdraw the blood from the internal organs. In very advanced cases, however, this factor can form no criterion, since the powerful action of the solid constituents and of the carbon-dioxide can only increase the ever-present danger still more.

In many instances, extensive arteriosclerosis is found in men of advanced age. Old age in itself, however, is no contraindication to the treatment here described and in the course of many years I have had opportunities of achiev-

ing good results in persons of 70 years of age and upward. It is, of course, necessary that one should make use of those measures which fortify and complete the results of physical treatment. Of these the most important is the *regulation of diet.* A diet suitable for all forms of heart disease does not, of course, exist. Chronic heart affections and the various diseases accompanying them are in their very nature too different to permit of this. In most cases, however, disregarding the fat-reducing cures of Banting and others, the diet should be nutritious, since most patients suffering from heart disease are thin and anemic. Such patients require an increase rather than a diminution in their body-weight. Distention of the stomach should, however, be avoided, since a full stomach may press the diaphragm up against the lungs and heart, and thereby cause marked shortness of breath and palpitation. At the same time, owing to this excessive distention, the intra-abdominal pressure is increased and the heart has now to fight against this, which is synonymous with a weakening of the organ. It is best, therefore, to take food in *smaller quantities* and *more frequently*, but in order to promote easier digestion, the patient should be advised to *masticate the food* very carefully. Similarly, too large quantities of liquid taken at one time may act injuriously. The food should be easily digestible, and all vegetables which cause flatulence should be avoided, such as beans, old peas, cabbage, sauerkrout, cauliflower, brussel sprouts, and occasionally potatoes. For the same reason the patient should not indulge in strong effervescing drinks, such as gaseous waters, beer, sparkling wines or champagne.

In the vast majority of cases *a mixed diet is advisable.* Either an exclusive meat diet or a purely vegetable diet will do more harm than good. Strong spices and other condiments, including large amounts of salt, irritate the kidneys and mucous membranes and are, therefore, distinctly harmful. If stimulants are necessary the use of small

portions of a light but old wine should be recommended. Young wines which still contain fermentable substances are not advisable; the use of small quantities (1/2 to 1 ounce) of old cognac is to be preferred. The temperature of all nutritive material should vary within moderate limits; food and drink when taken hot stimulate the activity of the heart; very cold food and cold drinks, and here ice must be specially mentioned, not only cause gastric disturbances but may also bring about congestion of the liver.

Recently under-nourishment has been recommended as a dietetic treatment for heart disease; this was founded on the theory that the heart is thereby protected. The small amount of protection which may thus be attained cannot be considered as against the dangers of cardiac weakness which may readily occur from insufficient nourishment.

In the medical world at the present moment there is probably no longer any doubt that tobacco exerts a deleterious influence on the heart. The habit of smoking, chewing, or taking snuff, for the reasons already mentioned, must either be given up completely or largely reduced.

The patient should always select *seasonable clothing* adapted to the temperature of the external air. Where changes of temperature are frequent he should be advised to change his clothing several times a day. Neglect of this precaution very often results in catarrhal disturbances, or even in bronchitis with all its attendant dangers for cardiac sufferers. A tightly fitting corset, owing to compression, not only impedes the arterial but also the venous circulation of the abdomen. It also forces the diaphragm upward against the heart and lungs, thereby causing shortness of breath, because the heart must work much harder and is thereby more easily injured. It is always advisable to cover the skin of the trunk and extremities with an equable underwear. Whether this be made of silk, wool or cotton is less important than that the material should possess the property of quickly absorbing the perspiration formed on

the skin and of slowly giving it up to the outside air without great loss of heat to the body.

Patients with heart disease tolerate extremes of temperature very badly. Great heat, when it is continued for some time, has such a weakening effect on the heart that a condition of collapse is not infrequently caused by it. Breathing while facing a strong wind will cause shortness of breath and, therefore, cardiac weakness. Long continued movement in a very cold temperature or in a cold mist is not suitable for sufferers from heart disease since even with careful attention to clothing the warm air is driven out from between the skin and the clothes, the skin becomes chilled and the blood is driven from the surface to stagnate in the internal organs. Every form of draft is bad, but the insidious bedroom draft is especially dangerous because the normal resistance of the patient is lowered during sleep and the peripheral circulation is then easily depressed.

Persons with heart disease, as everyone knows, require a large supply of oxygen and, therefore, one must take care that they always have fresh air in their rooms. Overheated and overcrowded rooms are not well borne by such patients; it is also known that the thin atmospheres of highly elevated mountain resorts cause discomfort of various kinds, owing to the reduced amount of oxygen and increased atmospheric pressure. Heights of over 1,000 to 1,200 meters (3,000 to 4,000 feet), apart from patients with Graves' disease, are tolerated very badly. That patients with heart disease are compelled, often suddenly, to abandon high altitudes and seek lower planes has already been stated. Preference should be awarded to places of moderate height in which the patients may walk in well laid-out and shady paths in the woods. During the winter those climatic health-resorts should be selected where the changes of temperature are not too great and where the large amount of sunshine permits of living in the open air. In Europe the most important of these are the regions about

the Mediterranean Sea, that is to say southern France, the Riviera, and the Dalmatian coast; the south coast of England and the Isle of Wight; and, in addition, some of the coast resorts of Spain and Portugal. In Africa, Algiers and Egypt are available; while in the United States, southern California, North and South Carolina and certain localities in Florida, Texas and Georgia should receive favorable consideration. Bermuda, Cuba, Jamaica and Panama have also been recommended as salutary winter climates.

Hypnosis, in combination with suggestion or auto-suggestion, has fallen short of its cherished expectations. Nevertheless, the psychic influence of the physician on the patient may be of great value, if it is possible for him to induce thereby a soothing influence on the nervous system and a banishment of the feeling of anxiety. With reference to this condition of anxiety which so readily arises in heart disease, special attention is necessary in respect to what shall be told to the patient himself about his illness. So far as possible one should limit oneself to such statements as are necessary for his mode of life. The physician must often, however, tell the plain truth to patients with heart disease who have an inordinate love of pleasure or who live careless lives, in order to guard them from the dangers of overindulgence.

Of great importance is a decision on the question often put to the physician whether patients suffering from heart disease may marry, and closely connected with this is the question whether heart disease is hereditary. A direct hereditary transmission of valvular defects does not occur; on the other hand, one not uncommonly sees that the tendency to acute rheumatic polyarthritis which so often leads to valvular lesions affects whole generations of a family, so that the thought of hereditary transmission cannot be completely banished from one's mind. The physical tendency may be similarly transmitted in the case of fatty heart, in arthritic and diabetic cardiac affec-

tions and above all in neurasthenic and other nervous heart diseases. Closely connected with these is the occurrence of early arteriosclerosis.

There was a time when the opinion of physicians was largely against the consummation of marriage by patients having heart disease. This applied especially to all those suffering from organic diseases of the heart. More recently, however, opinions have changed somewhat and even in severe organic heart affections medical men have given their consent to marriage, perhaps rather freely as may be learned, for example, from the work of Lenhartz. It is, of course, readily understood that during the existence of compensatory disturbances marriage is inadvisable. If no disturbances have occurred for a long time, one may more readily advise the patient to marry; regular family life, and the pleasure of domestic companionship, etc., may exert a calming influence on the heart as well as on his general condition. With women, however, pregnancy and parturition carry with them such grave dangers that many patients with heart disease become victims of these complications. As a rule, it is mostly cases of advanced mitral stenosis and of congenital heart disease that run these risks. But even in such cases the physician must be very cautious in giving positively adverse advice, since he will often be confronted with conditions and circumstances that appear much more convincing to the patient and his friends than all the professional advice to the contrary.

According to my experience we are to-day able to cope with many threatening and constantly present dangers; further misgivings will diminish as the certainty of the prevention and treatment of heart disease increases.

CHAPTER XV

GYMNASTIC POSES FOR RESISTANCE-EXERCISES

Many of the resistance-exercises which were first presented by my brother and myself, as outlined in Chapter XII, have been described and illustrated in various publications, but never before has so numerous and orderly a collection been presented as will be found on the pages that follow. The very practical plan has been adopted of exhibiting photographic reproductions of the actual gymnastic movements as posed for me by two of my trained operators who have had long experience in this class of work. While these illustrations do not cover all the movements that can be executed, a quite general selection has been made in order to elucidate the subject as fully as possible.

The principles laid down in Chapter XII have been adopted by ourselves and accepted by our colleagues, and are, therefore, the present governing standards. We will, however, briefly recapitulate a summary of the more important regulations which govern these passive resistance-exercises:

1. Passive resistance-movements include abduction, adduction, flexion, extension and rotation in a vertical, horizontal or lateral direction.

2. These movements should so alternate that new groups of muscles are continuously made to act in sequence, thus avoiding fatigue.

3. The resistance should be made by the operator as slowly and gently as possible, but with as much firmness and muscular power as the patient's physical condition will warrant.

4. The operator should never grasp the patient's limb tightly, but should oppose its movement by firm counter-

pressure against the advancing side, thus retarding the movement but always permitting the patient to retain the "*balance of power.*"

5. The operator should change his resistance whenever the direction of the physical force is changed.

6. To gain a well-balanced and uniform effect these exercises should always be bilateral.

7. The operator should closely watch the patient's breathing and circulation and at the slightest sign of embarrassment should stop the exercises. *The patient should never be allowed to hold his breath while exercising.*

8. A pause of 1 or 2 minutes should be allowed between each exercise in order to avoid any fatigue. The patient may sit down during the pause, especially during the latter half of the séance.

9. The length of time devoted to each séance should be about a half-hour. At the end of that period it will frequently be found that the number of heart beats has been reduced from 10 to 15 per minute and that the area of cardiac dullness has been made to contract an inch, more or less.

10. After the séance is finished the patient should rest quietly on a couch for at least 15 minutes.

When the patient has acquired sufficient experience with the resistance-exercises as given by an expert operator (especially after returning to his home) he can train himself to imitate these movements by a scheme of "self-resistance." This method requires the simultaneous contraction of muscles that are antagonistic to each other. All the rules previously laid down for passive resistance-movements must be carefully observed or physical injury to the myocardium may be the result of such neglect.

The illustrations of the resistance-exercises which follow are self-explanatory, but a descriptive legend has been appended to each figure, thus presenting a detailed account of the various movements(Fig. 47 to Fig. 87).

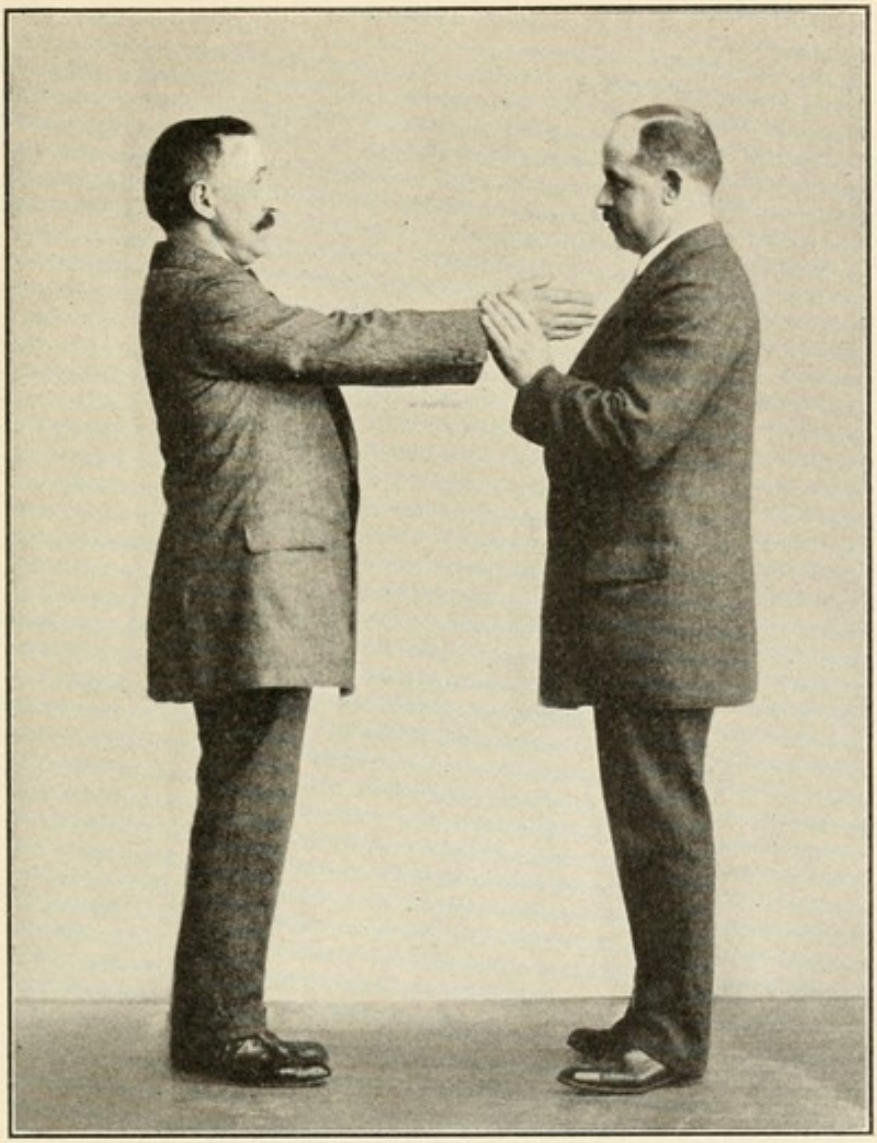

FIG. 47.—**Exercise No. 1.** (First movement.) The *patient* standing erect extends both arms directly forward at the shoulder level, with the tips of his fingers touching. The *operator* places his fingers on the outer side of the patient's wrist and his thumb on the patient's palm. The *patient* now swings his arms outward in a quarter circle until fully extended at right angles. The *operator* advances a step toward the patient and makes resistance on the outer aspect of both wrists until the movement is completed.

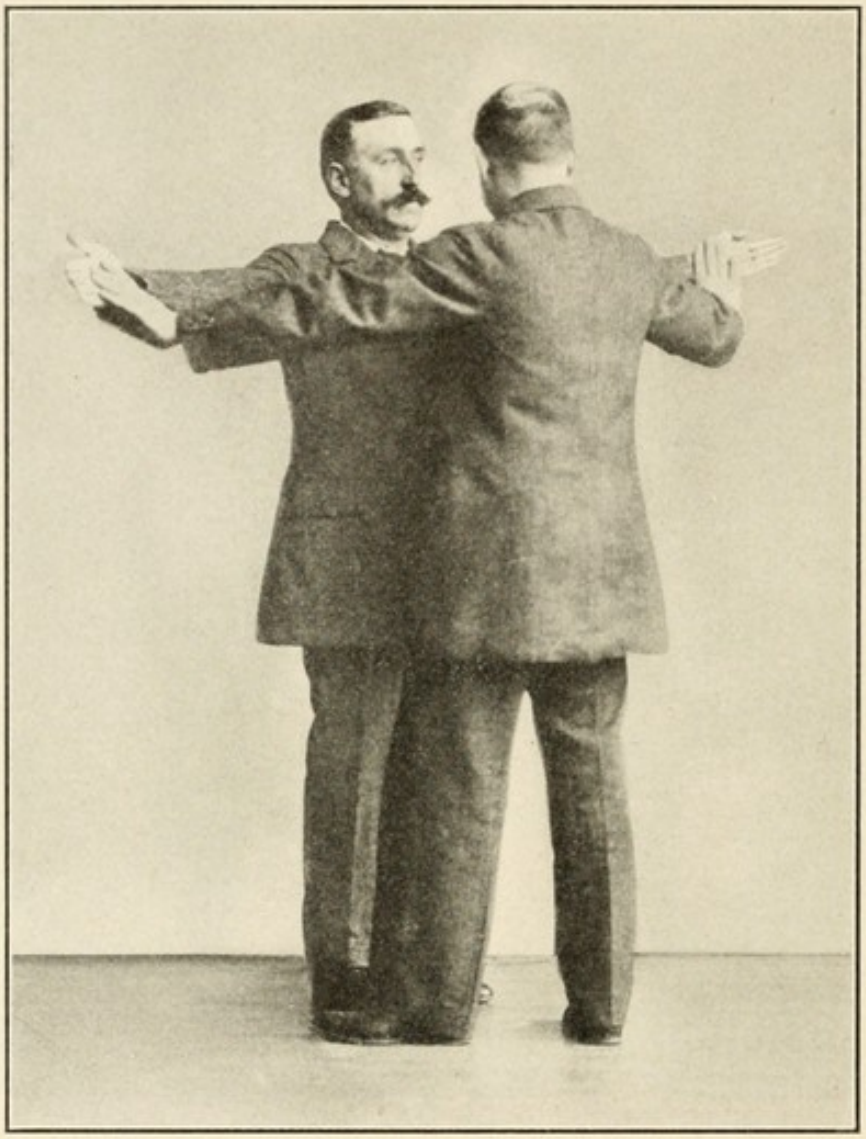

FIG. 48.—**Exercise No. 1.** (Second movement.) The *operator* shifts his fingers to the palmar surface of the patient's hands and again makes resistance as the *patient* returns his hands to the primary position in front. The operator retreats a step backward to allow room for the patient's hands to come together.

-PAUSE.-

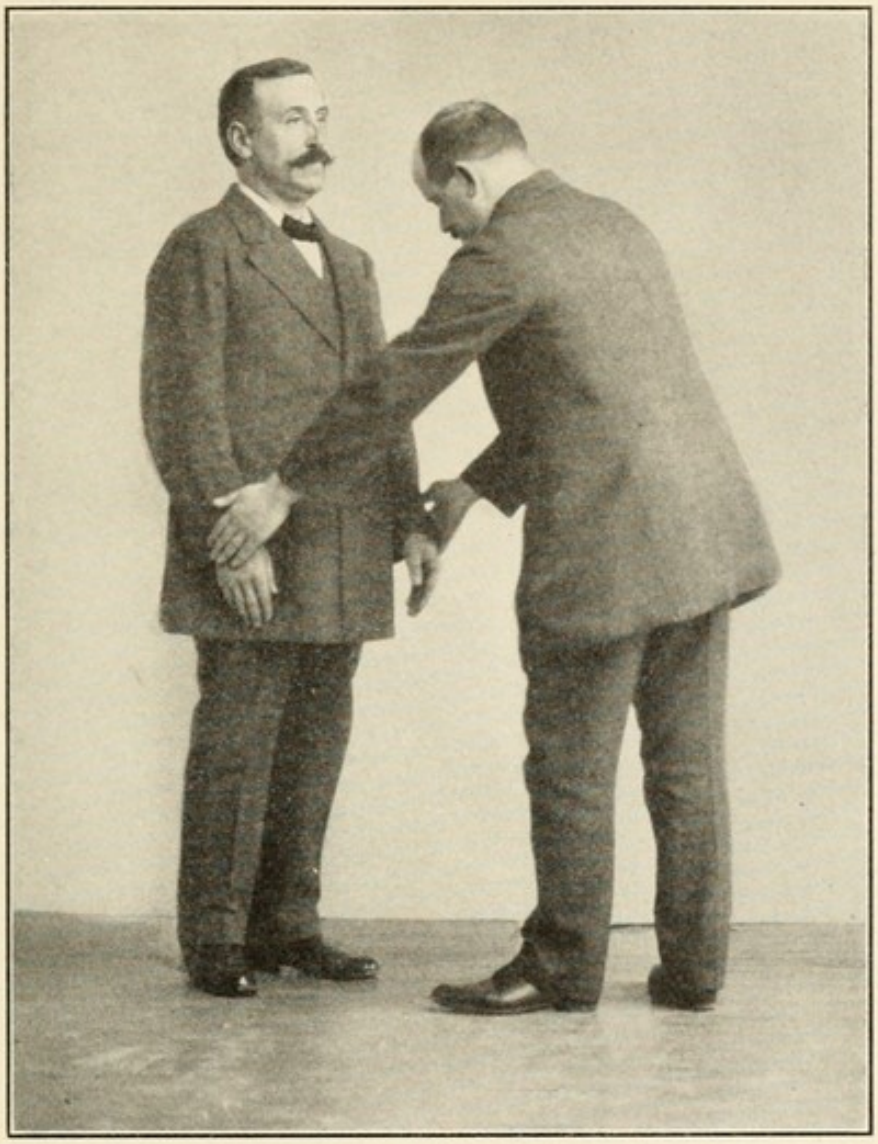

FIG. 49.—**Exercise No. 2.** (First movement.) The *patient* standing, with hands at his side and palms against his body, raises both his arms outward and upward to the level of his shoulders. The *operator* makes resistance by pressing on the backs of the patient's hands with the palms of his own hands.

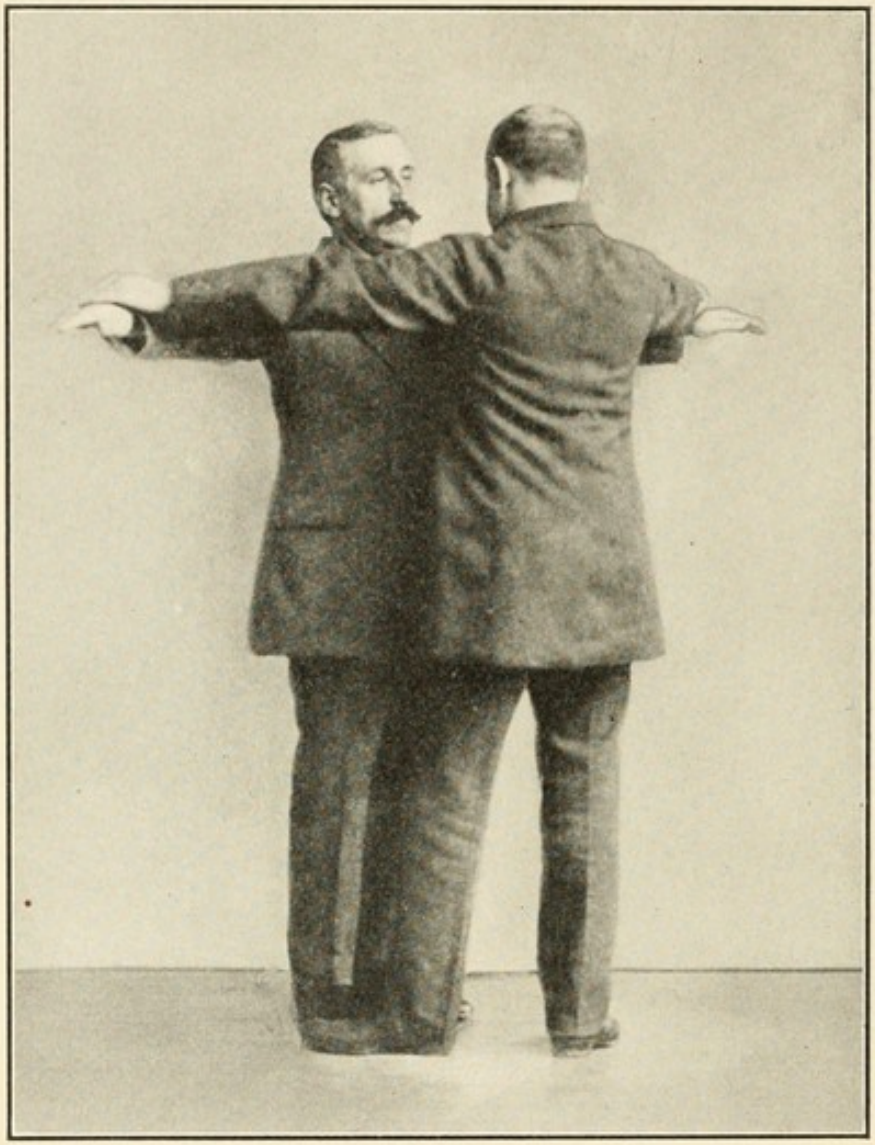

FIG. 50.—**Exercise No. 2.** (First movement completed.) The arms of the *patient* are now fully extended and the first movement completed to the level of his shoulders, while the *operator* still maintains his resistance.

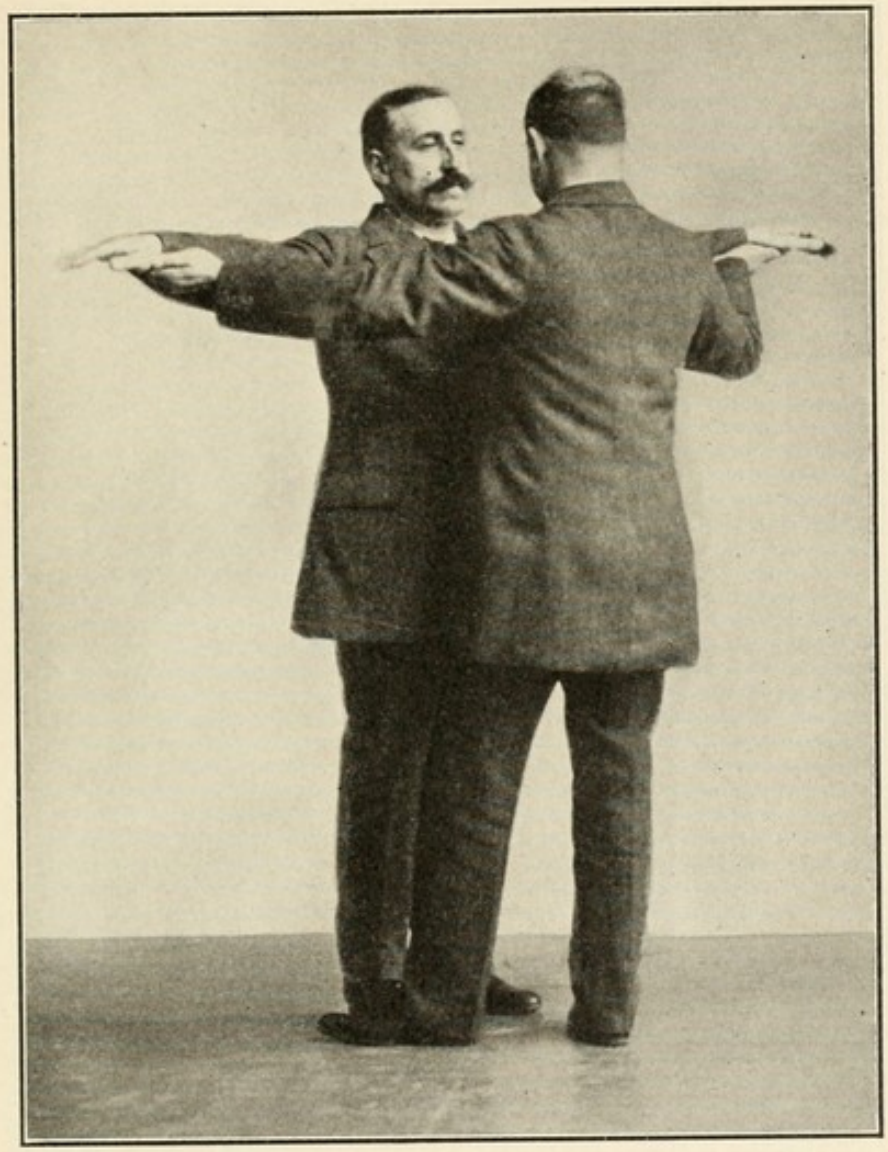

FIG. 51.—**Exercise No. 2.** (Second movement.) The *operator* changes his resistance by placing his palms beneath the extended palms of the patient, while the *patient* returns his arms to the primary position at his side.

-PAUSE.-

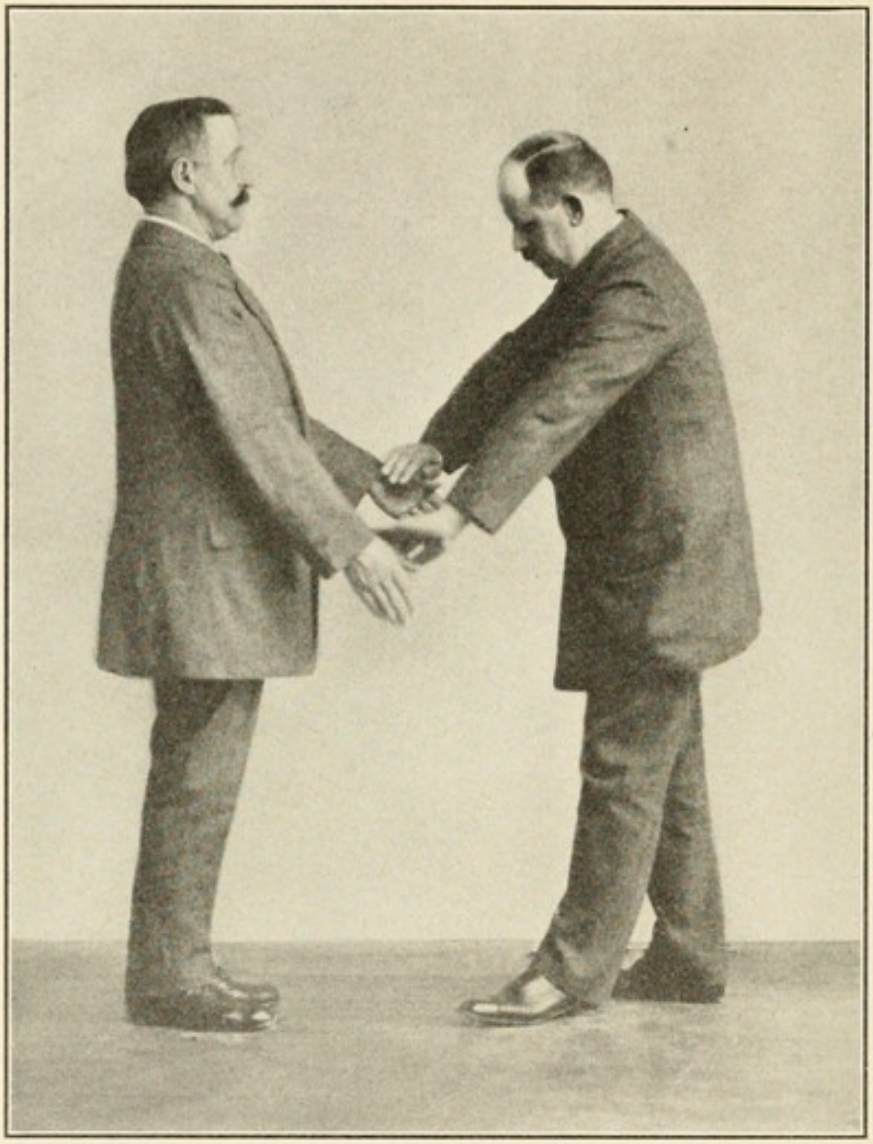

FIG. 52.—**Exercise No. 3.** (First movement.) The *patient* standing with his arms at his side raises his hands forward and upward to the level of his shoulders. The *operator* makes counter-pressure on the upper edge of the patient's wrists with his thumbs but substitutes his fingers as the movement nears completion.

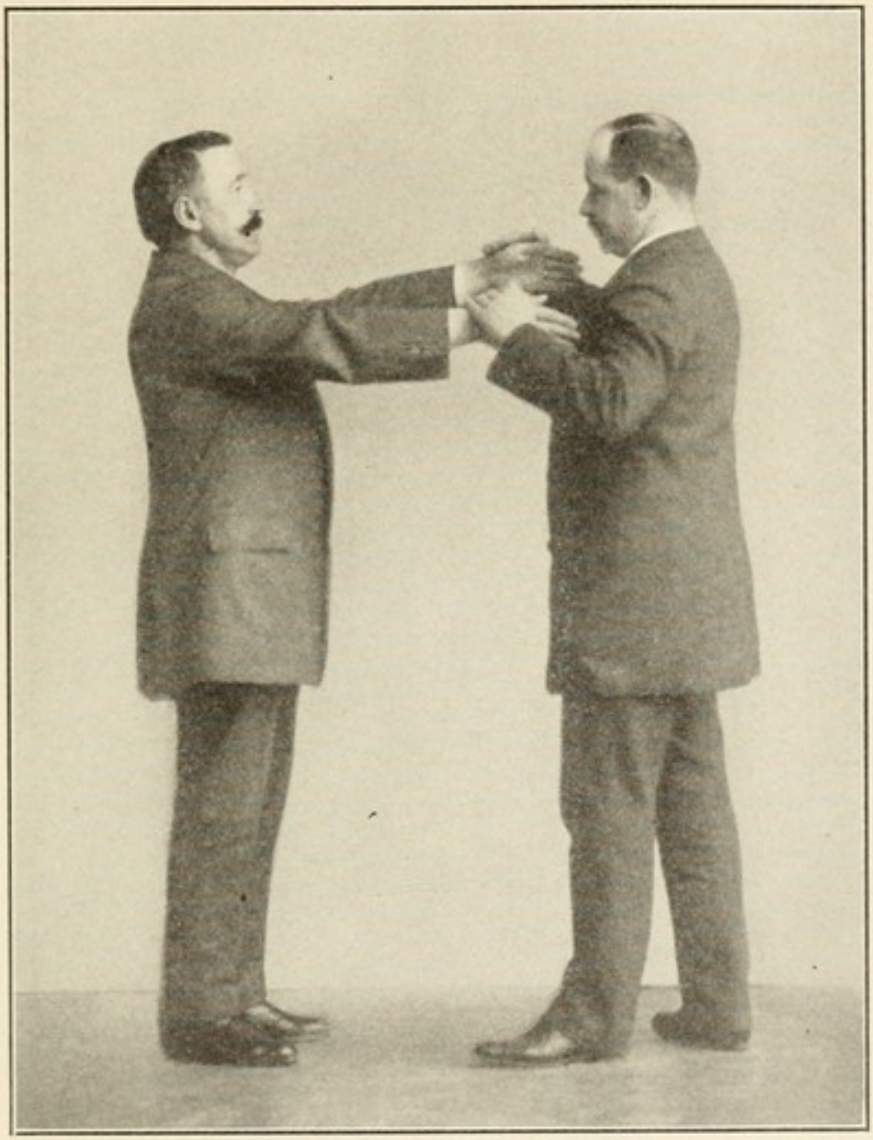

FIG. 53.—**Exercise No. 3.** (First movement continued.) The arms of the *patient* are extended in front while passing upward from the horizontal position to a vertical position above his head. The *operator* continues to make resistance with his palms on the patient's wrists.

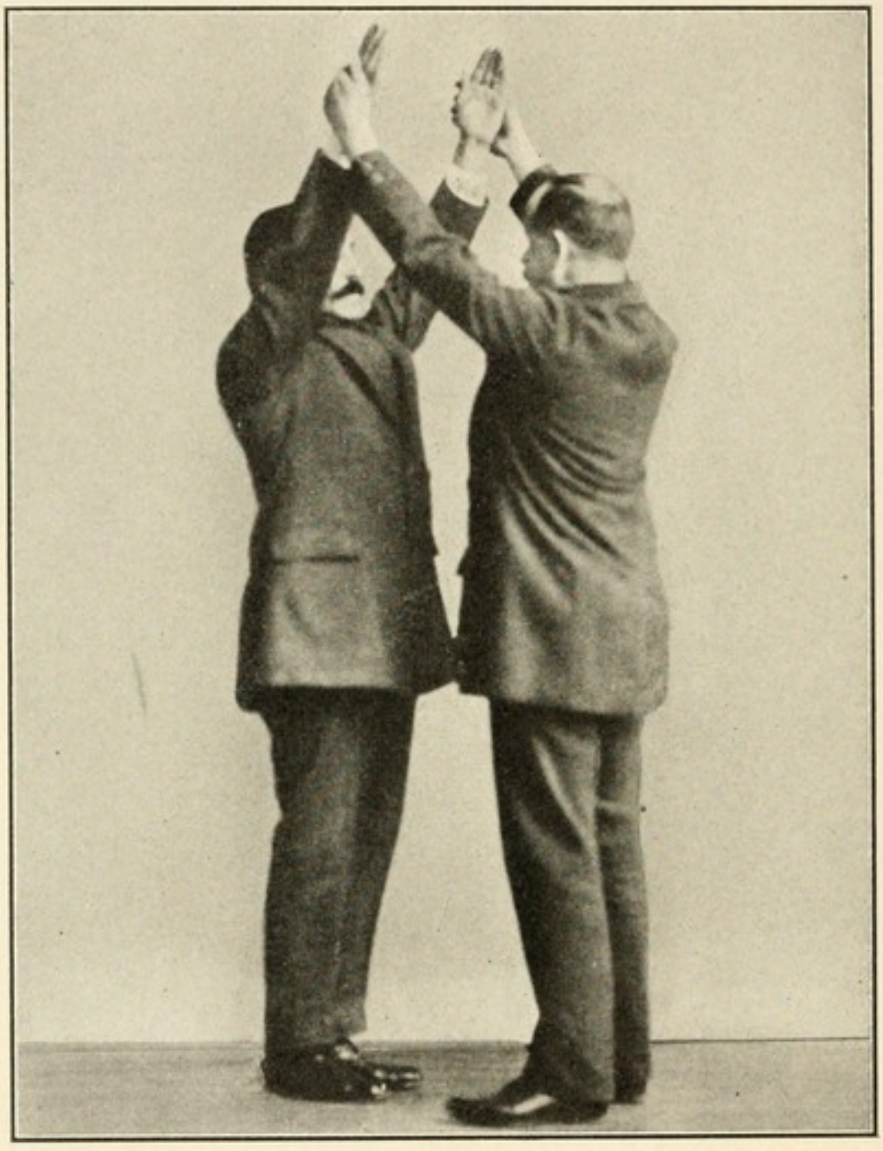

FIG. 54.—**Exercise No. 3.** (First movement completed.) The *patient's* arms have reached a vertical position. The *operator* is still opposing this movement by pressing his palms on the backs of the patient's hands.

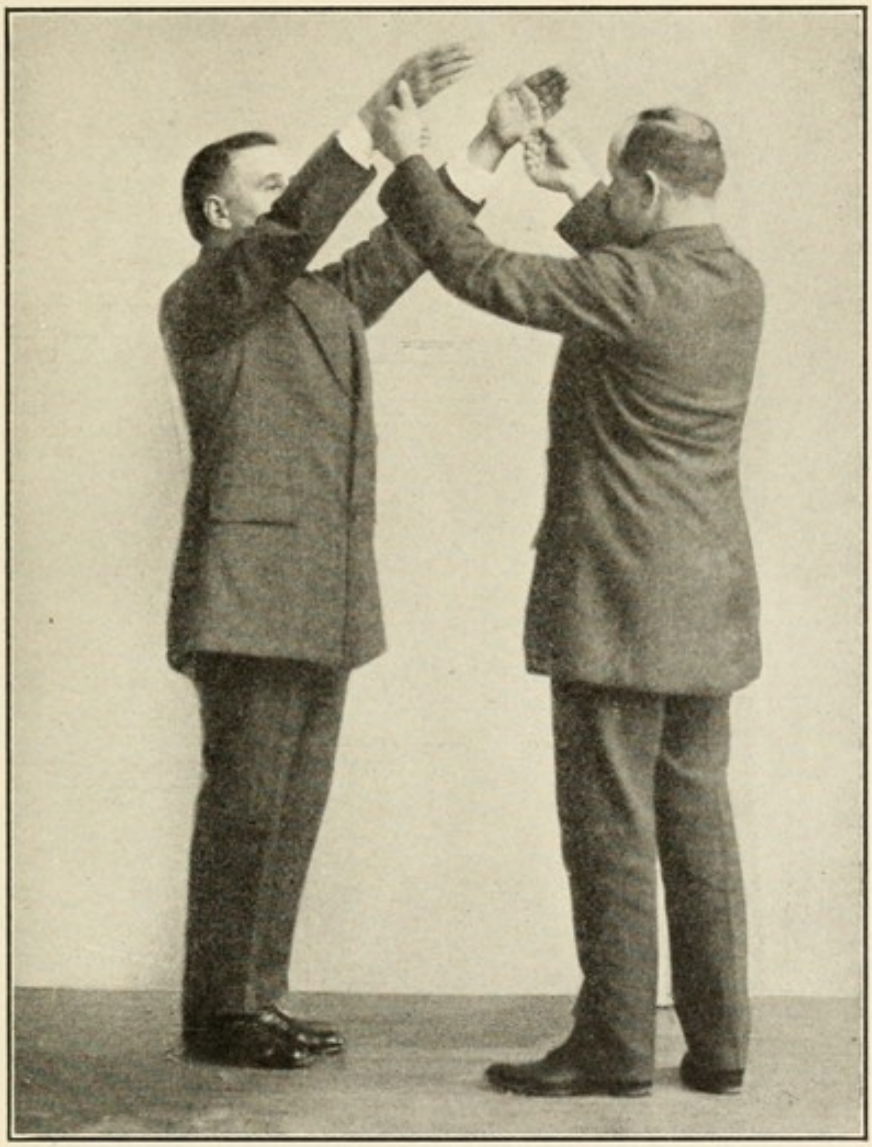

FIG. 55.—**Exercise No. 3.** (Second movement.) The *patient* now reverses the movement and presses downward, returning his arms to the primary position at his side. The *operator* changes his resistance by pressing against the lower edge of the patient's palms or wrists with the tips of his fingers.

-PAUSE.-

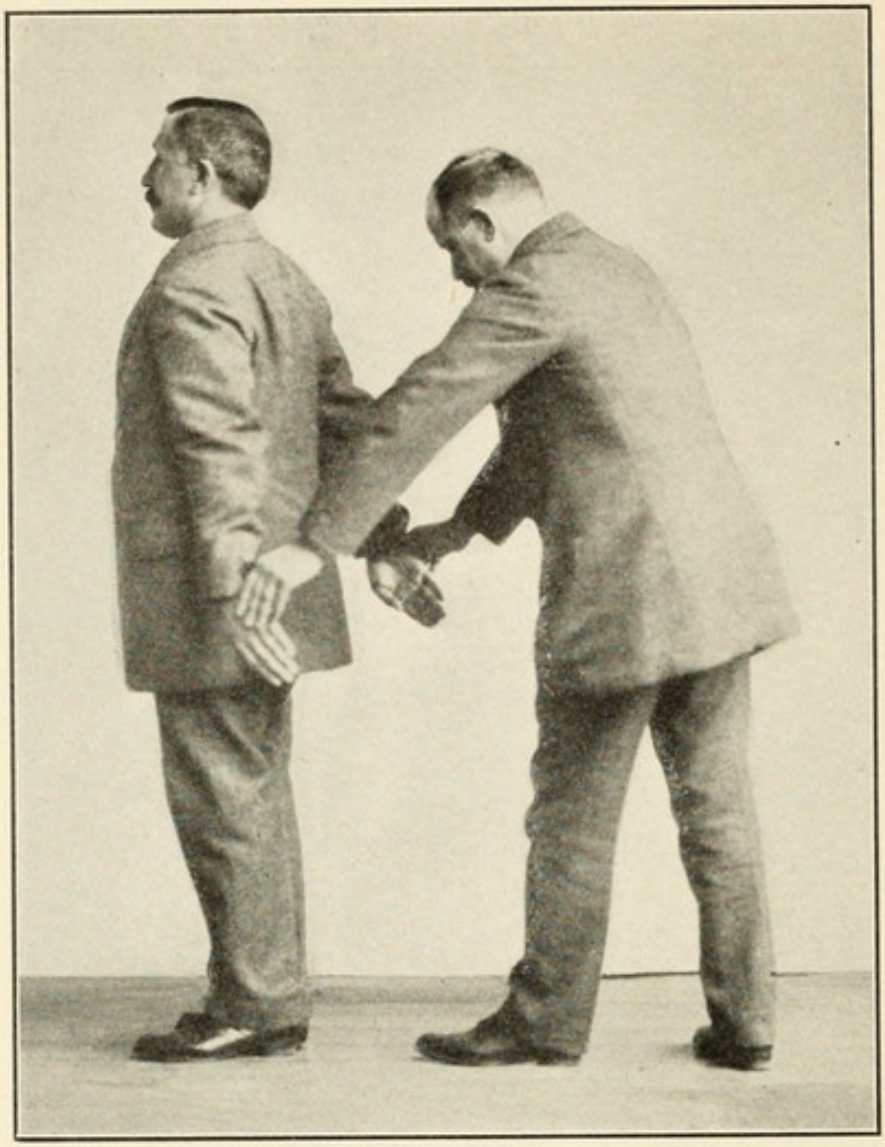

FIG. 56.—**Exercise No. 4.** (First movement.) The *patient* standing with his arms held at his side presses backward and upward. The *operator* standing behind resists this movement by pressure on the backs of the patient's wrists. When the limit of this movement is reached the reverse is begun and resisted by the operator who makes pressure on the front of the patient's wrists until the primary position is reached.

-PAUSE.-

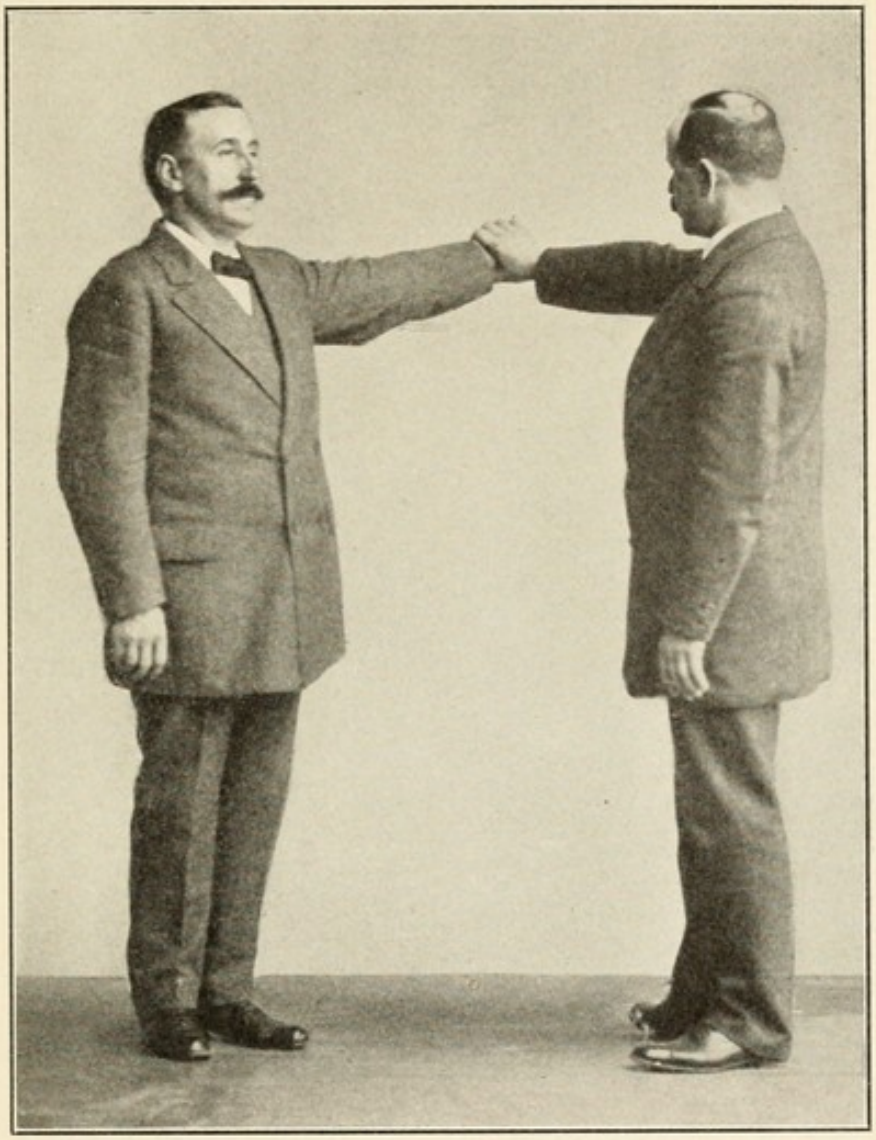

FIG. 57.—**Exercise No. 5.** The *patient* standing rotates his left arm. The *operator* offers resistance by grasping the patient's wrist.

The patient duplicates this exercise by rotating his right arm in the same manner.

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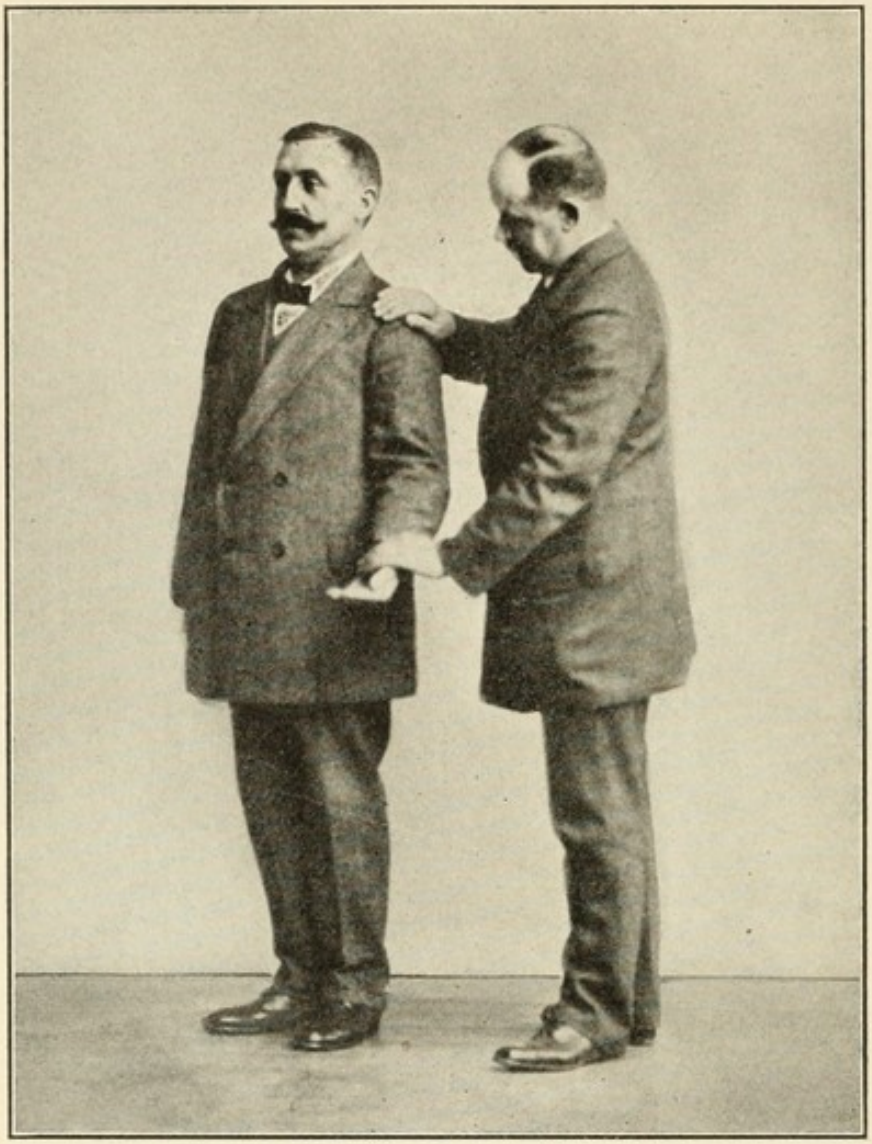

FIG. 58.—**Exercise No. 6.** (First movement.) The *operator* standing just back of the patient places one hand on the patient's shoulder and the other on his wrist. The *patient* standing with his arm at his side and his elbow fixed flexes his arm until the palm of his hand touches his shoulder.

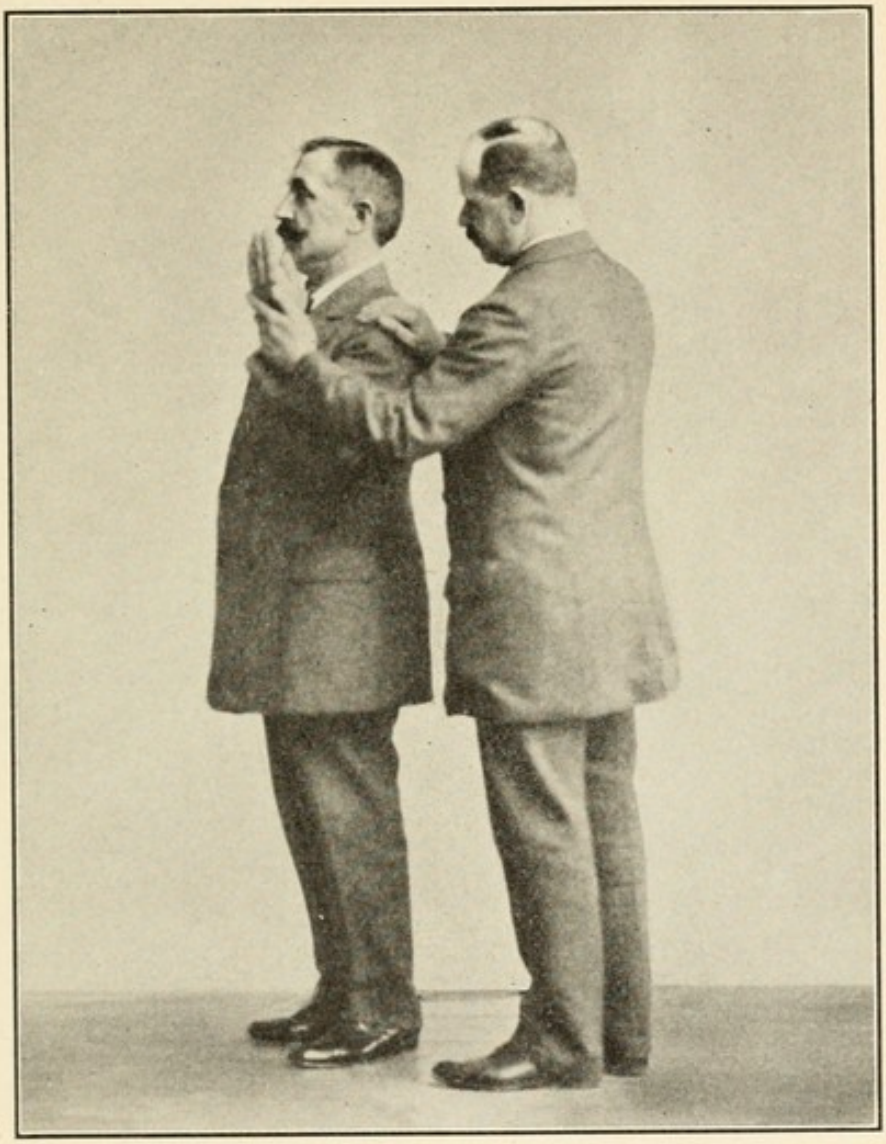

FIG. 59.—**Exercise No. 6.** (Second movement.) The *operator* now offers resistance to the back of the patient's wrist as the *patient* extends his arm and returns it to the primary position.

The patient repeats the same exercise with his other arm.

-PAUSE.-

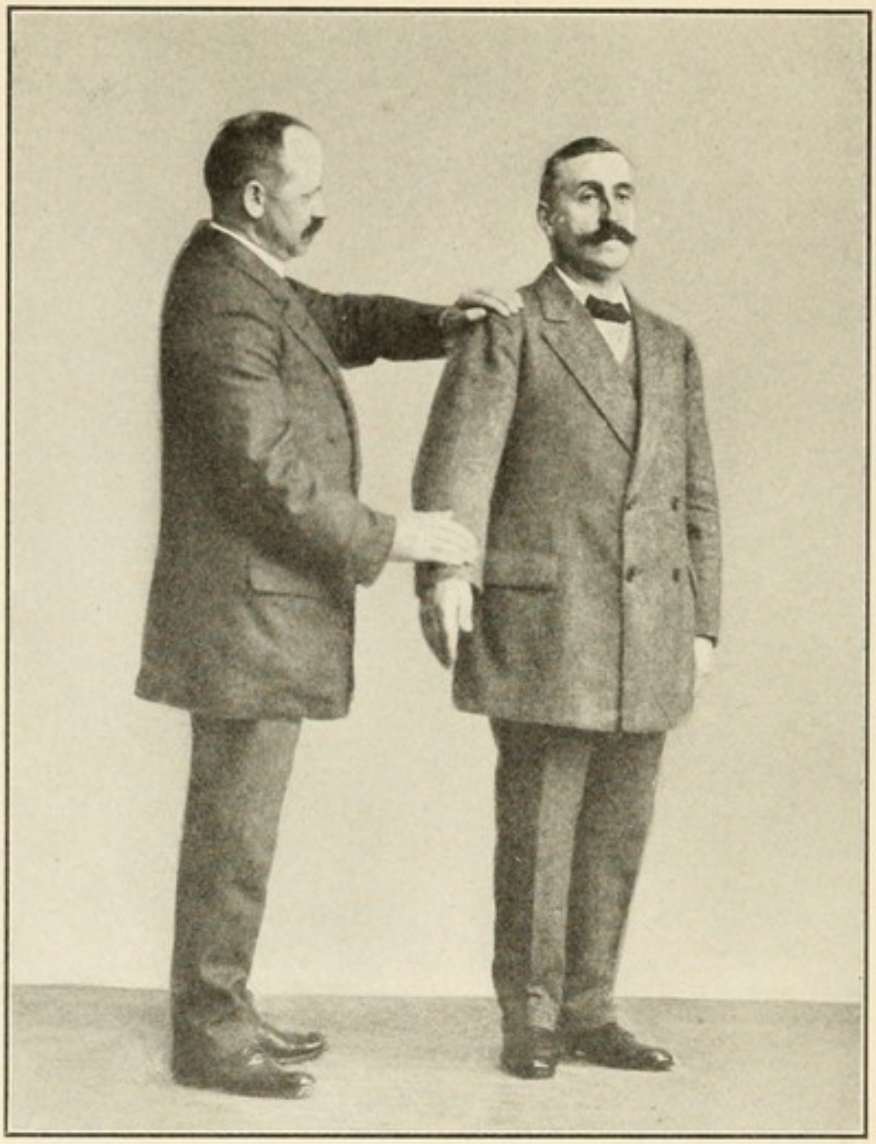

FIG. 60.—**Exercise No. 7.** (First movement.) The *patient* standing with his hand against his side presses his right arm forward and upward without bending the elbow, gradually describing a complete circle and returning to the primary position. The *operator* places one hand on the patient's shoulder and makes resistance with the other hand on his wrist. He changes his resistance as the direction of the force changes.

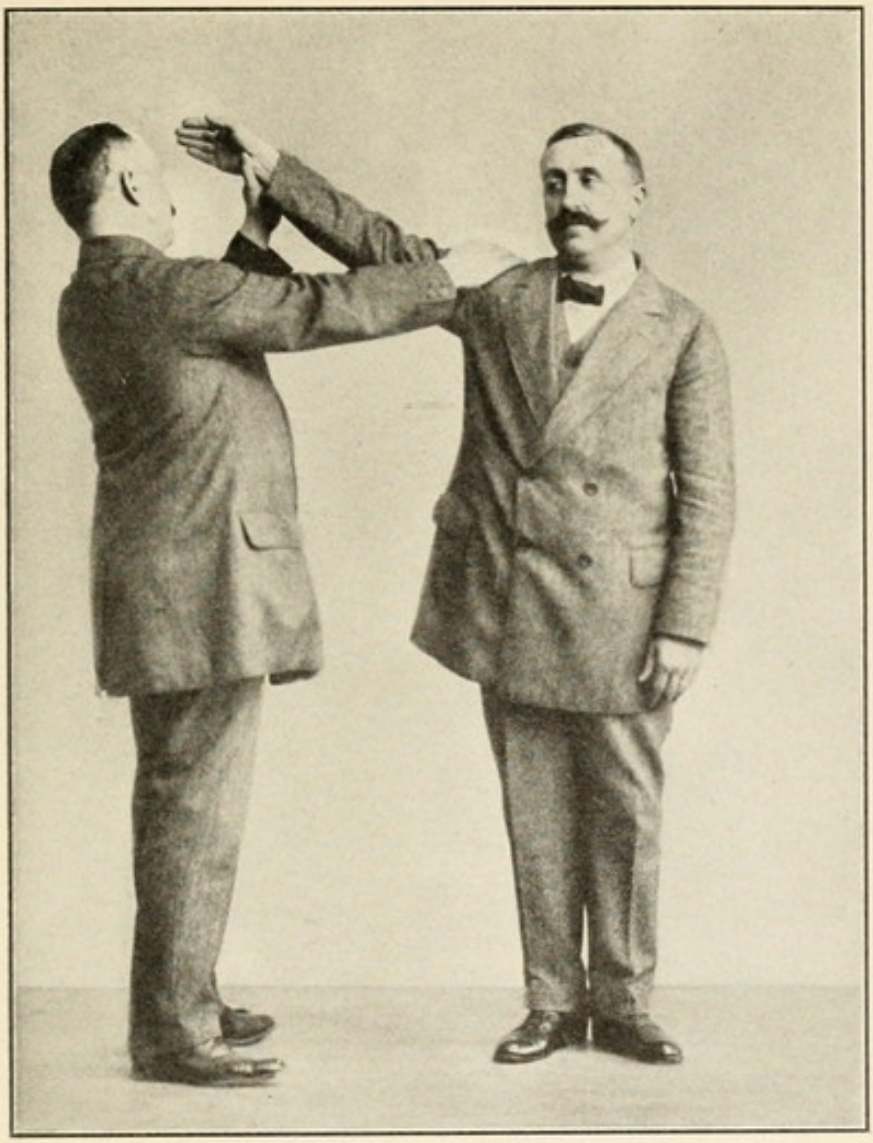

FIG. 61.—**Exercise No. 7.** (Second movement.) The *patient* is returning his arm to the primary position. The *operator* has shifted his resistance to meet the changed conditions.

The patient repeats this exercise by describing the same arc with his other arm.

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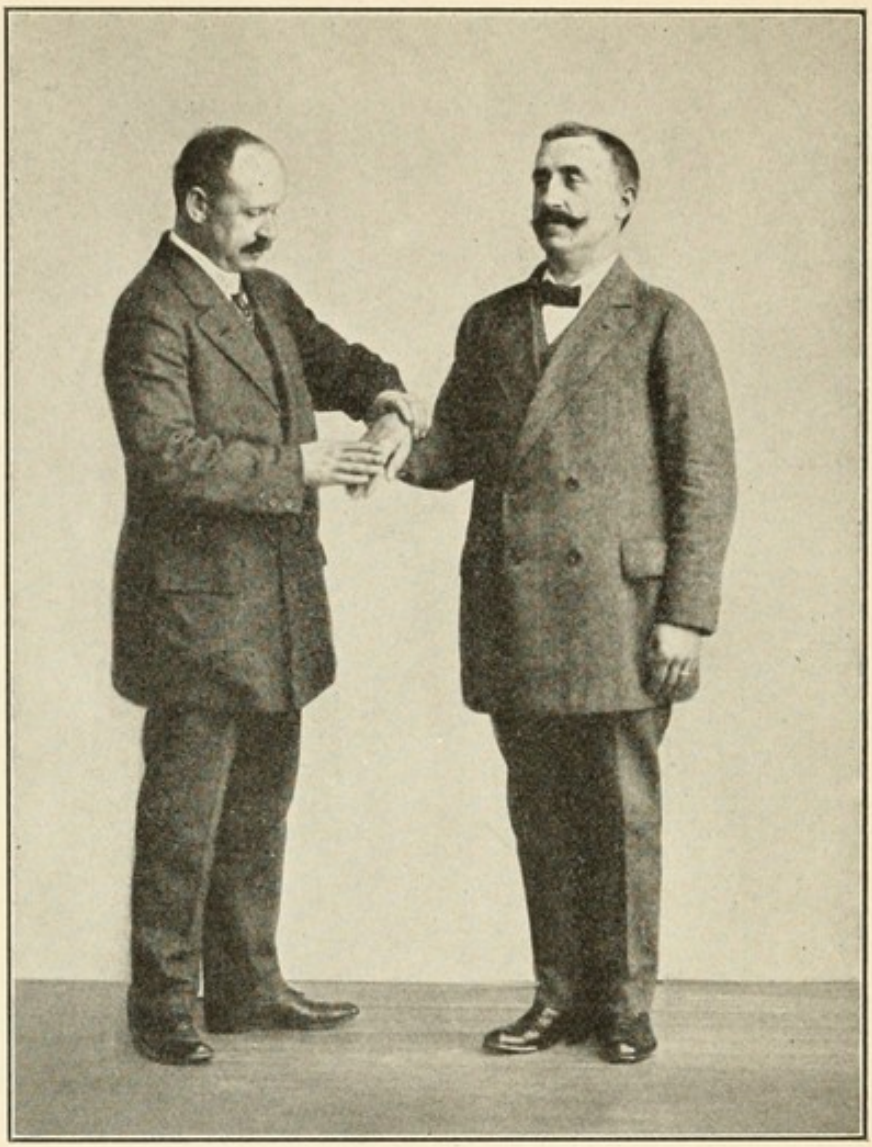

FIG. 62.—**Exercise No. 8.** The *operator* grasps the patient's wrist loosely with one hand and makes counter-pressure on the back of the patient's hand with his other hand. The *patient* extends his hand by an upward movement, and then flexes by a downward movement.

The patient repeats the same exercise with his other hand.

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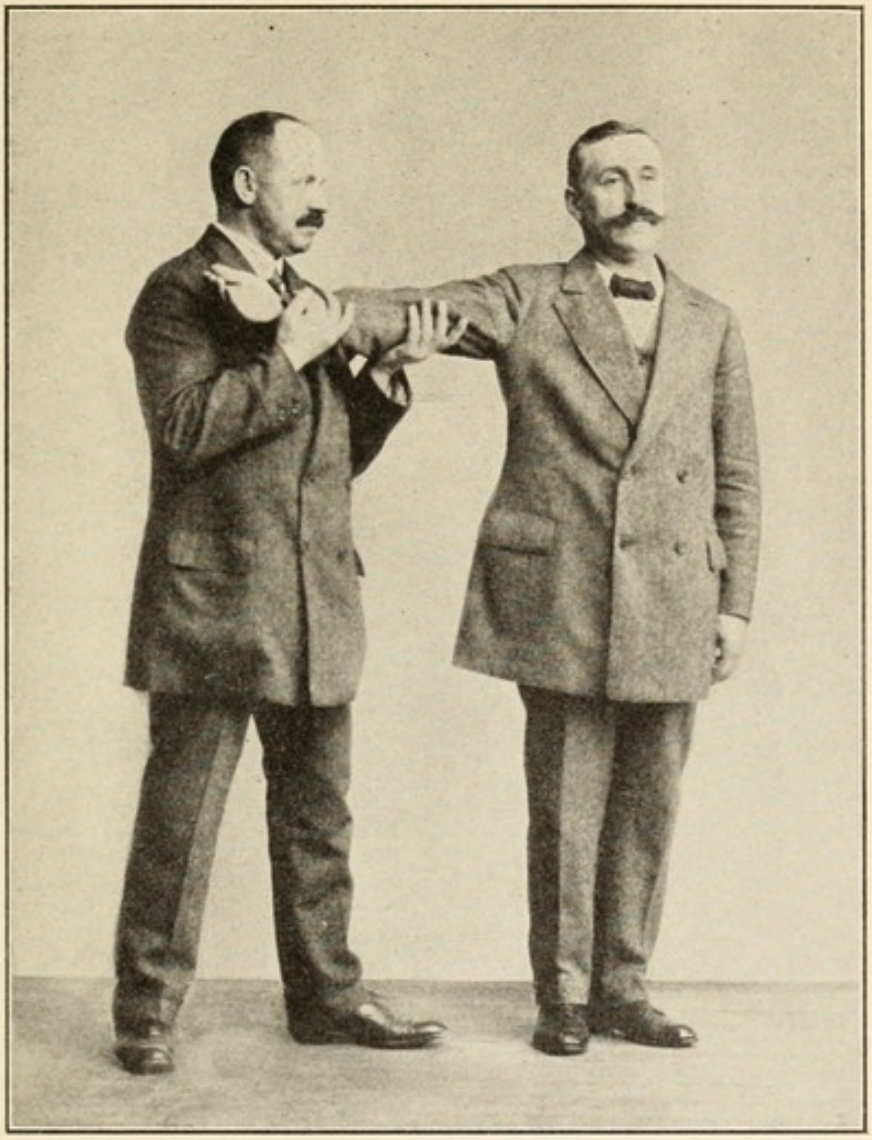

FIG. 63.—**Exercise No. 9.** (First movement.) The *patient* standing with one arm extended at right angles and the palm of his hand facing upward flexes his arm until his hand touches his shoulder. The *operator* supports the upper arm of the patient by placing one hand beneath it and makes resistance by pressing on the front of the patient's wrist with his other hand.

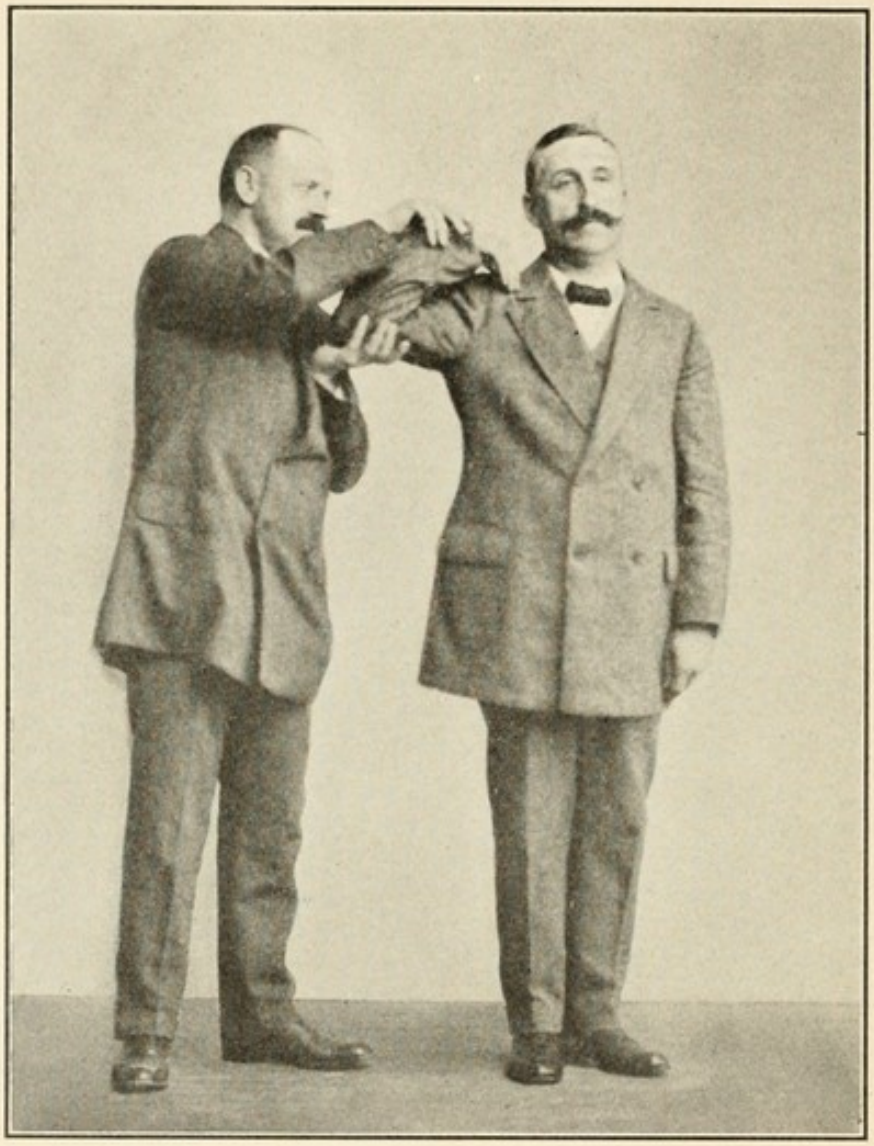

FIG. 64.—**Exercise No. 9.** (Second movement.) The *operator* supports the patient's elbow with one hand and makes counter-pressure on the back of the patient's wrist with his other hand as the *patient* returns his arm to the primary position.

The patient repeats the same exercise with his other arm.

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FIG. 65.—**Exercise No. 10.** (First movement.) The *operator* stands at the right side of the patient and with his right arm extended across the patient's chest grasps the left shoulder with his right hand, and at the same time presses on the small of the patient's back with his left hand. The *patient* then slowly bends the trunk forward until a right angle is nearly reached.

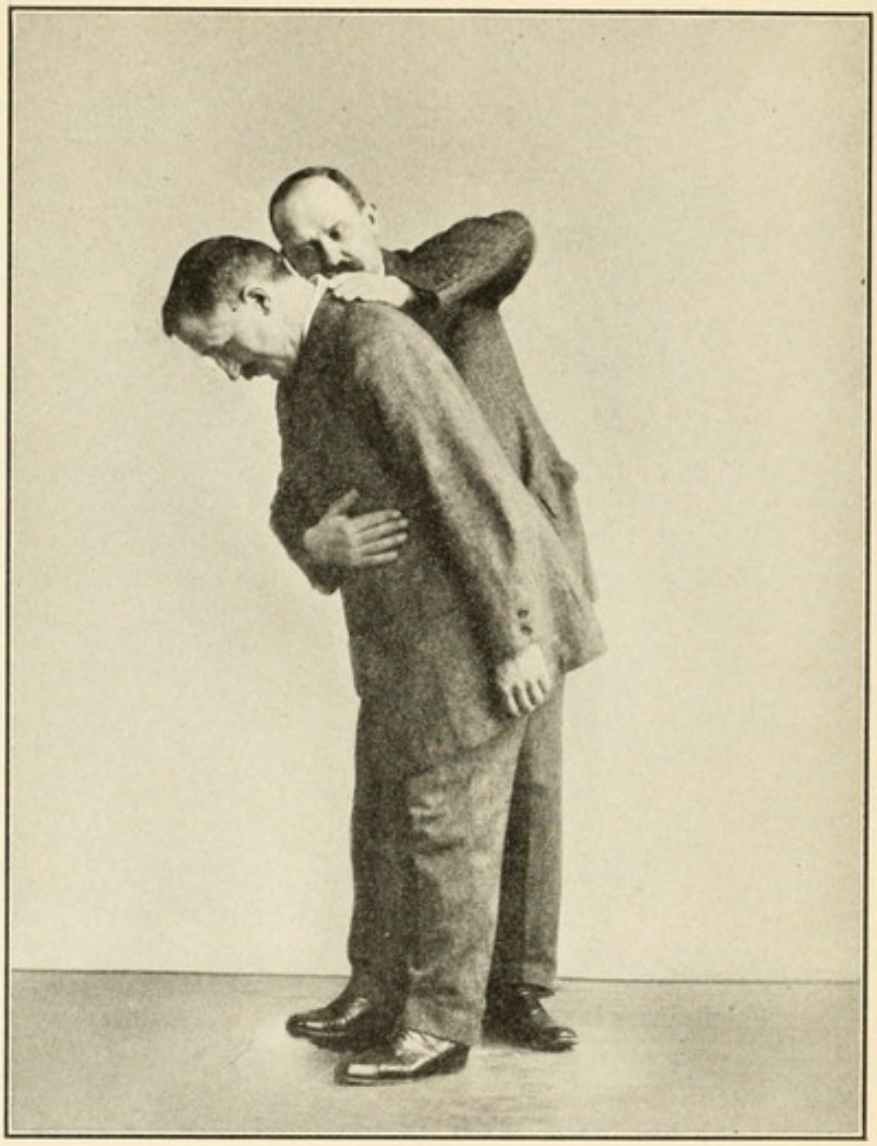

FIG. 66.—**Exercise No. 10.** (Second movement.) The *operator* changes his right hand to the front of the patient's chest and his left hand to the patient's back between the shoulders, where he makes counter-pressure as the *patient* straightens up into the primary position.

-PAUSE.-

FIG. 67.—**Exercise No. 11.** (First movement.) The *patient* properly supported by the *operator's* hand on the back of his neck and the other on his chest, bends his trunk backward as far as possible.

FIG. 68.—**Exercise No. 11.** (Second movement.) The *operator* presses with his right hand on the patient's chest and his left hand on the small of the patient's back as the *patient* returns to the primary position.

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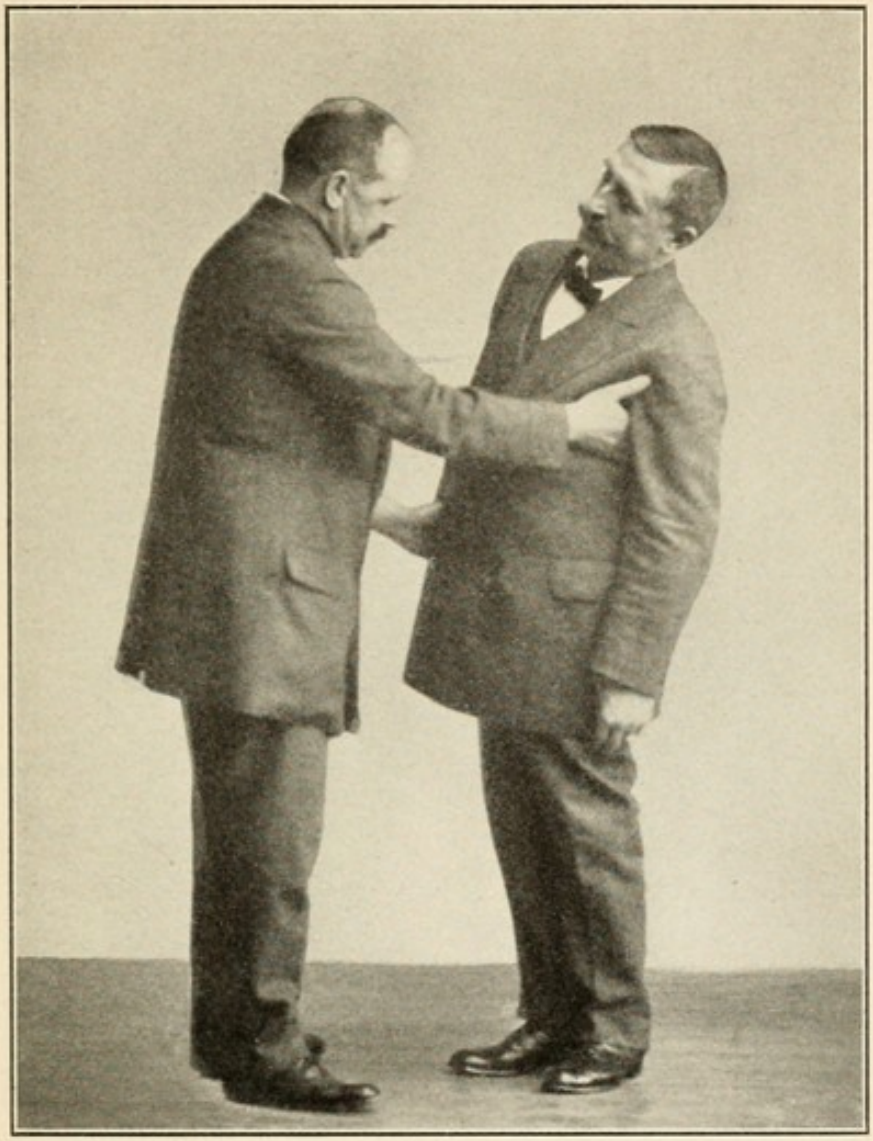

FIG. 69.—**Exercise No. 12.** (First movement.) The *patient* bends the trunk of his body sideways. The *operator* stands at the front of the patient with his right hand on the patient's chest under the left axilla and his left hand on the patient's right hip. The *patient* then bends his body toward the left side.

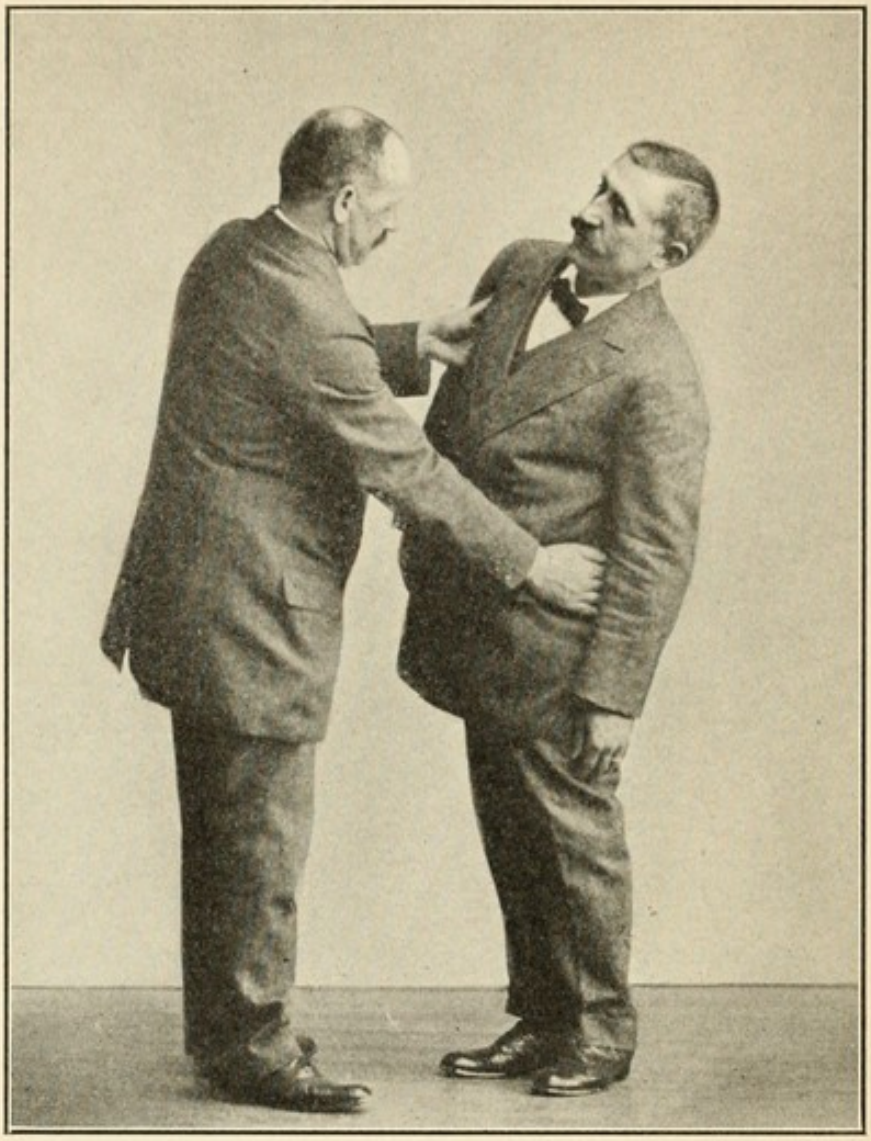

FIG. 70.—**Exercise No. 12.** (Second and third movements.) The *operator* now reverses his hands and makes counter-pressure as the *patient* bends his body toward the right side. The *operator* again reverses his hands and makes counter-pressure as the *patient* returns to the primary vertical position.

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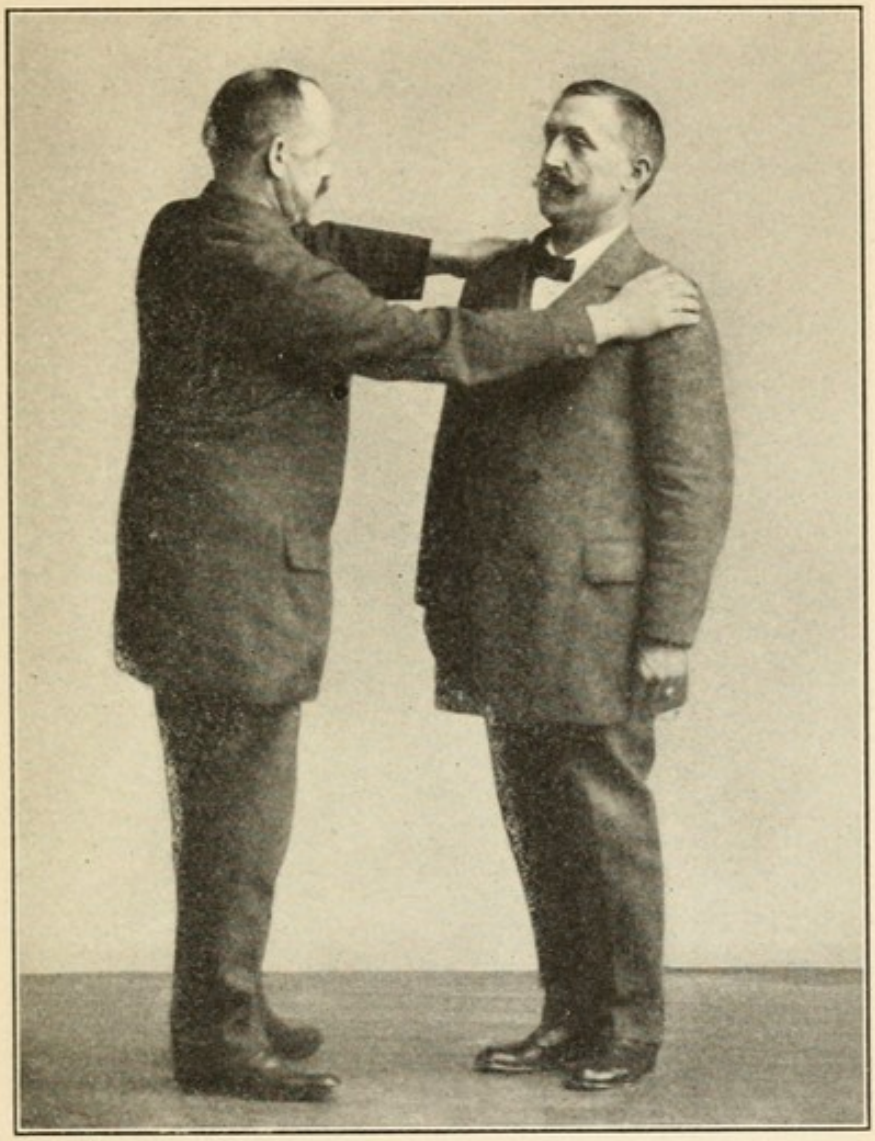

FIG. 71.—**Exercise No. 13.** (First movement.) The *operator* standing in front places both hands on both shoulders of the patient. The *patient* then rotates his trunk to the extreme right side, while the *operator* presses against the left shoulder and pulls on the right shoulder, meanwhile stepping halfway around the patient.

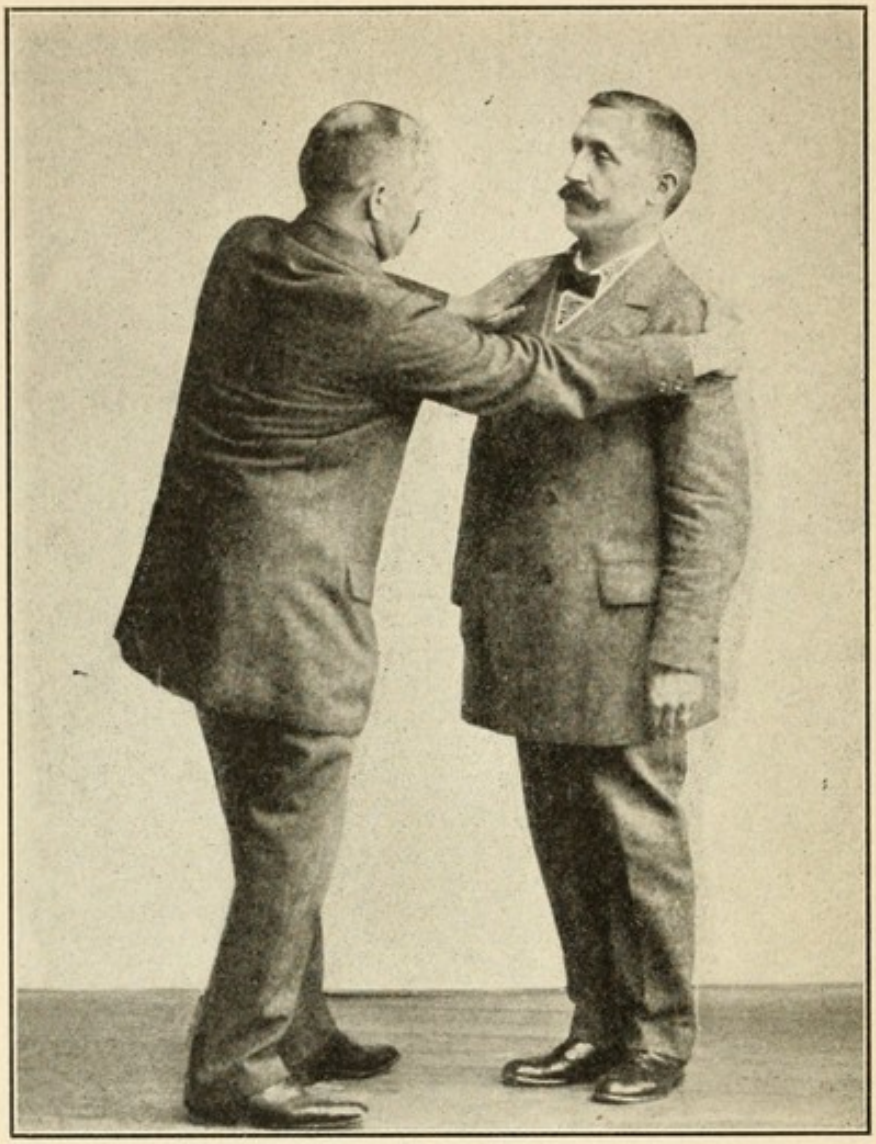

FIG. 72.—**Exercise No. 13.** (Second and third movements.) The same movement is repeated by the *patient* turning toward the left side, the *operator* pulling on the left shoulder and pressing on the right. The *patient* again reverses and returns to the primary position, while the *operator* makes a reverse counter-pressure and steps back to his first station.

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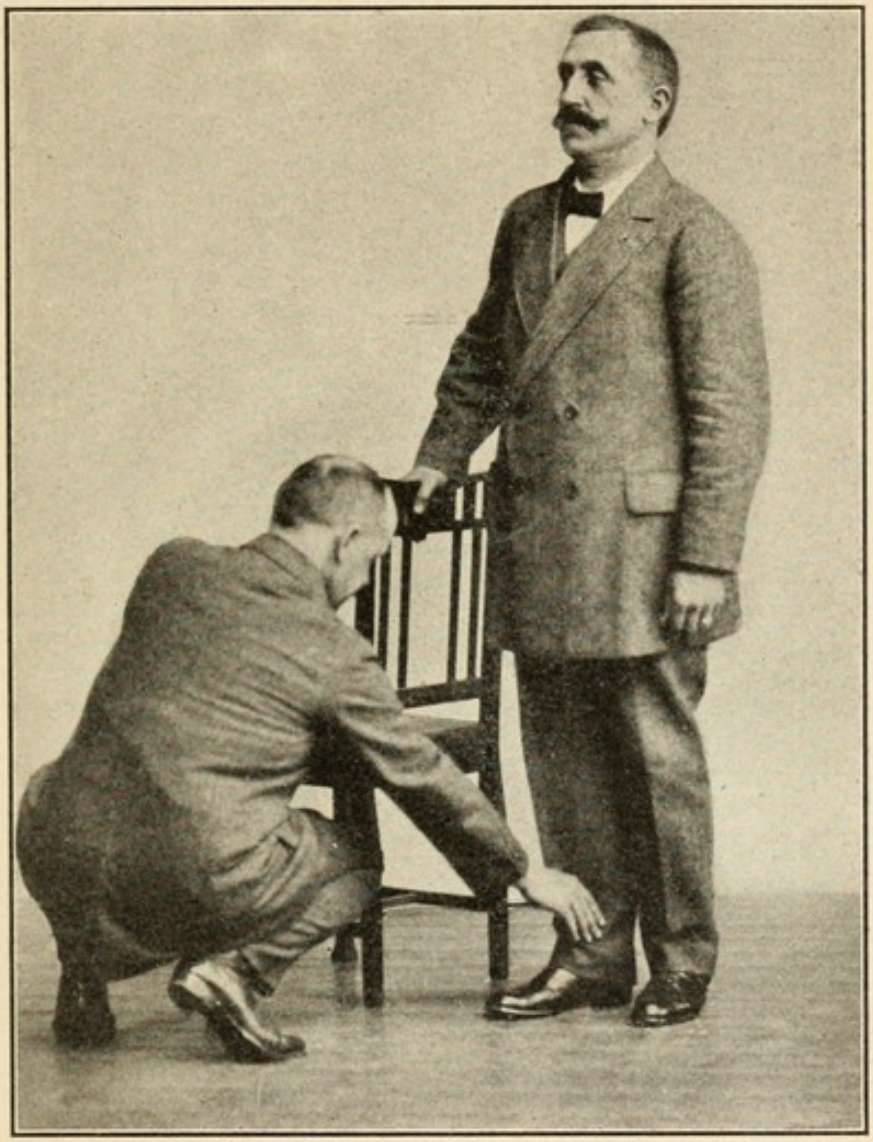

FIG. 73.—**Exercise No. 14.** (First movement.) The *patient* standing rests one hand on the back of the chair while the *operator* stooping places his right hand on the front of the patient's ankle and resists the forward extension of the patient's foot.

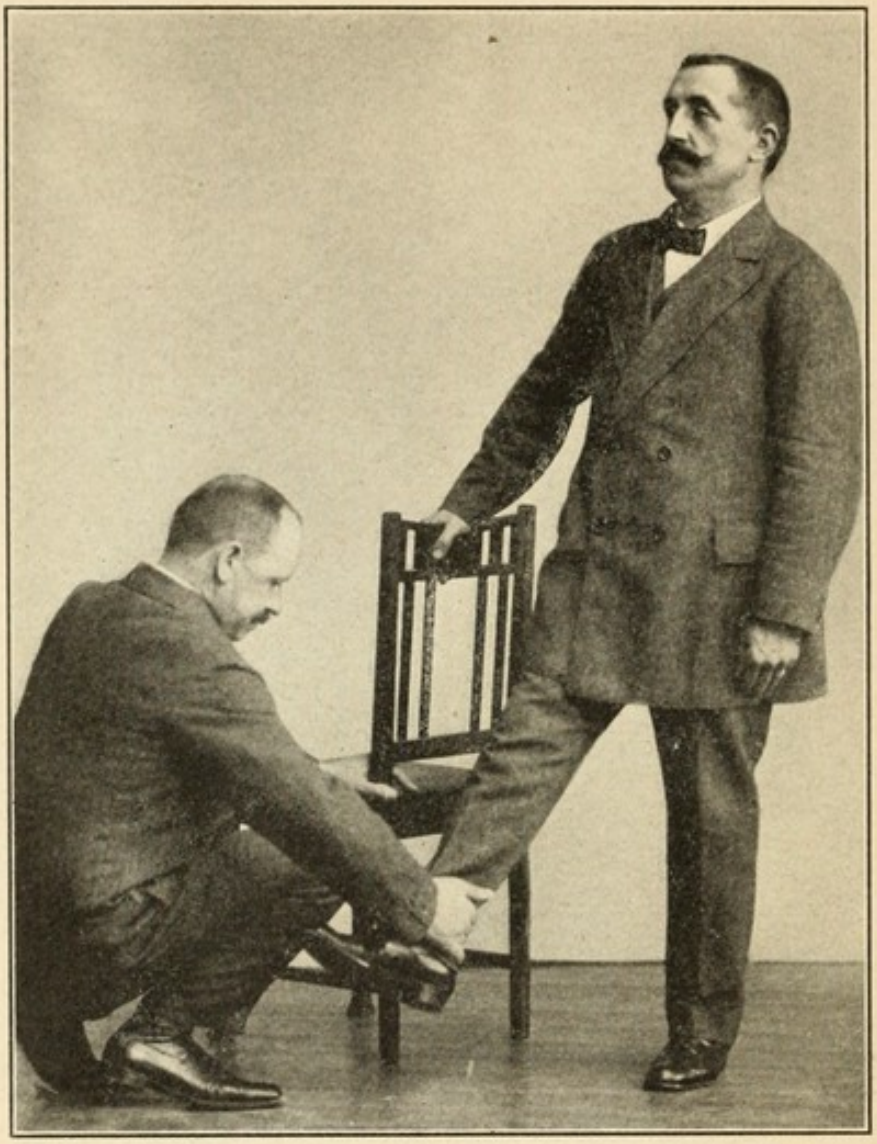

FIG. 74.—**Exercise No. 14.** (Second movement.) The *operator* reverses his hand to behind the patient's ankle while the *patient* draws his foot backward to the primary position.

The same exercise is repeated with the patient's other foot.

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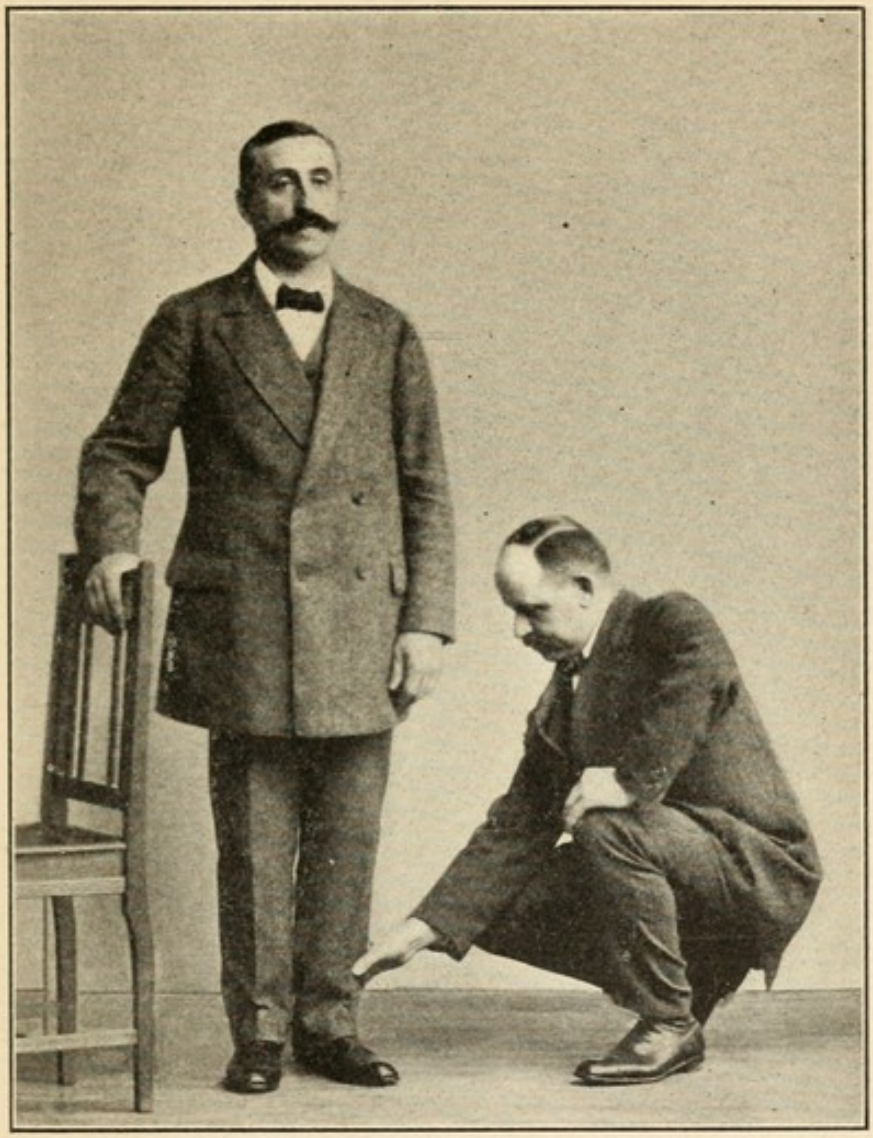

FIG. 75.—**Exercise No. 15.** (First movement.) The *patient* standing rests one hand on the back of the chair and extends his foot laterally, outward and upward, while the *operator* stooping makes resistance on the outer side of the patient's ankle.

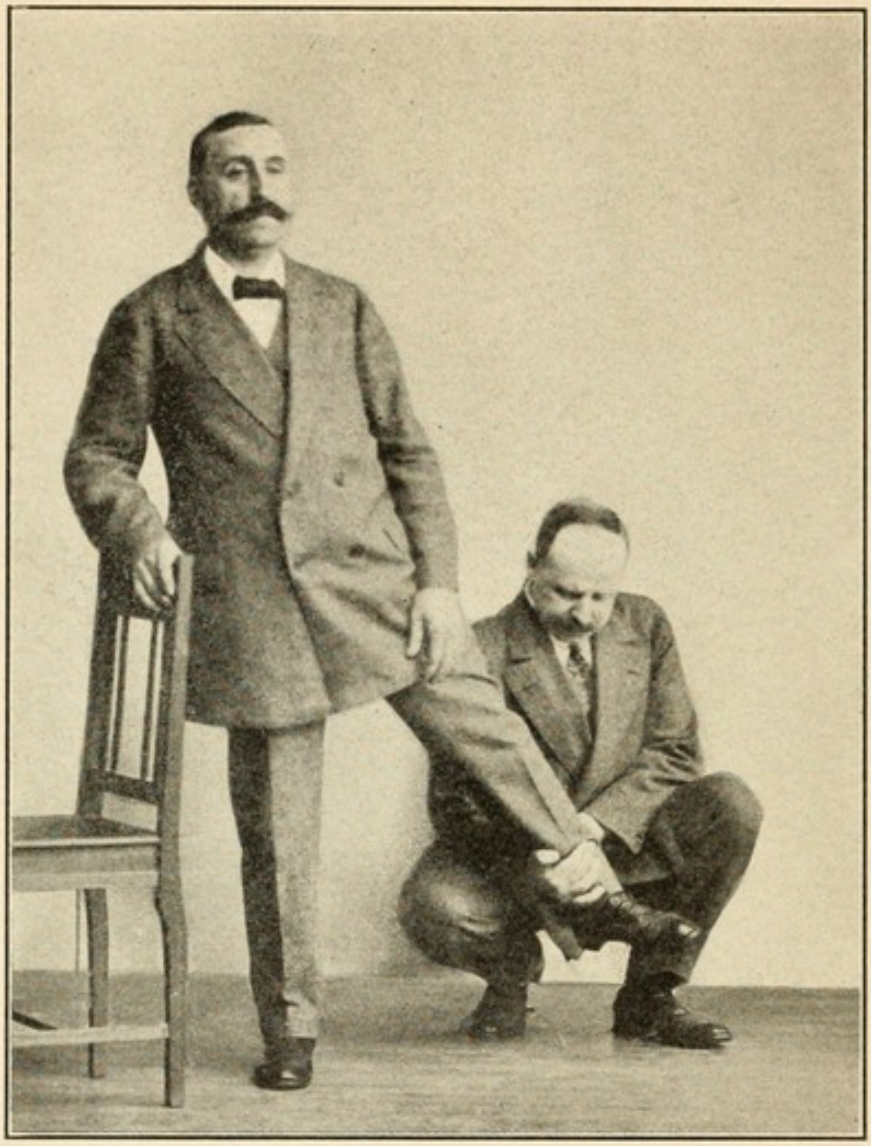

FIG. 76.—**Exercise No. 15.** (Second movement.) The *patient* returns his foot to the primary position on the floor while the *operator* presses on the inner side of the patient's ankle.

The same exercise is duplicated with the patient's other foot.

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FIG. 77.—**Exercise No. 16.** (First movement.) The *patient* standing with both hands resting on the back of the chair presses his leg backward and upward while the *operator* stooping makes counter-pressure on the back of the patient's ankle.

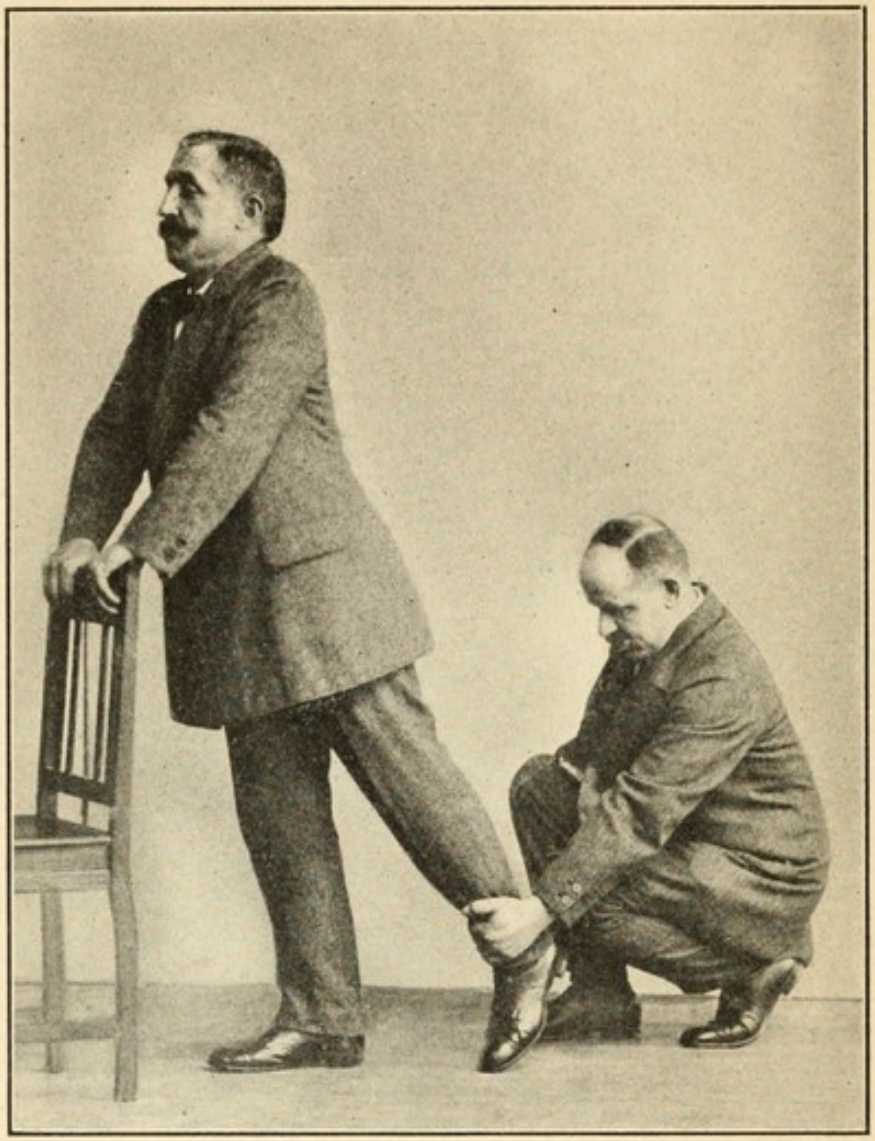

FIG. 78.—**Exercise No. 16.** (Second movement.) The *operator* changes his resistance to the front of the patient's ankle, as the *patient* returns his foot to the primary position.

The same exercise is duplicated with the patient's other foot.

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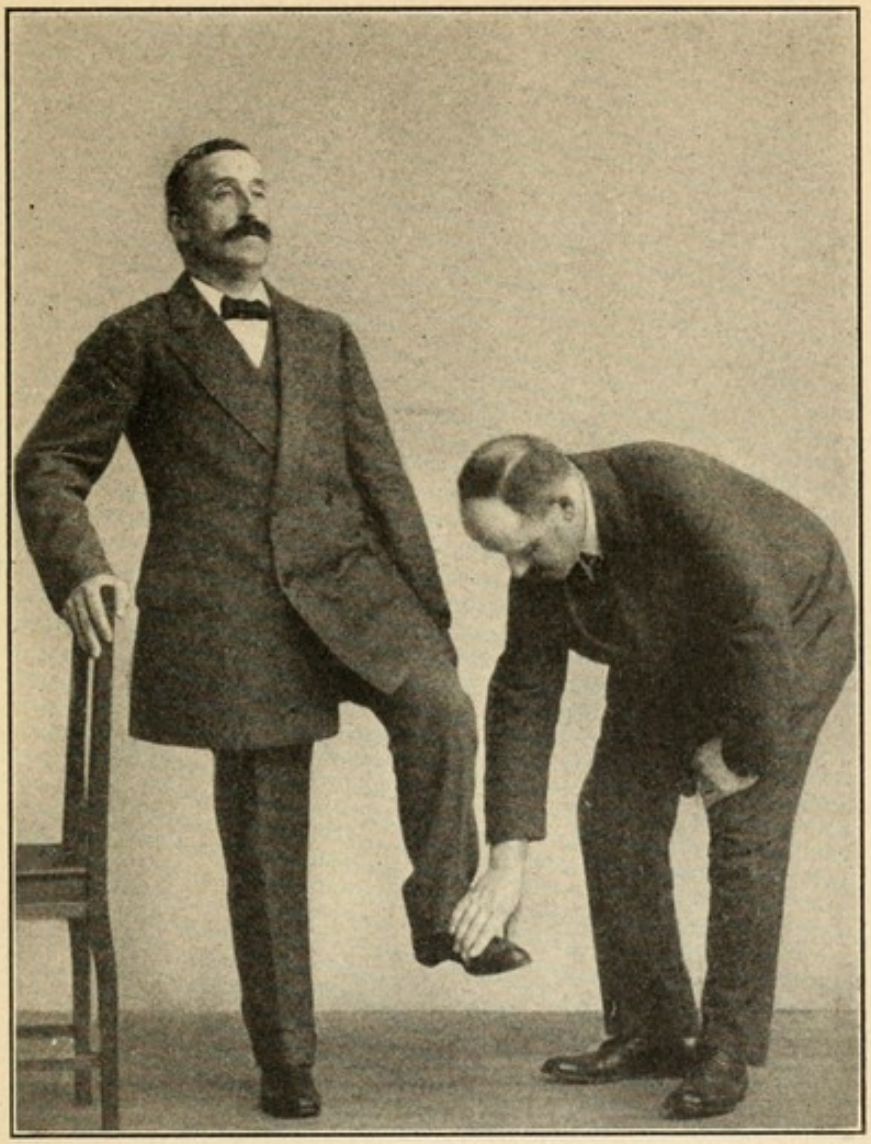

FIG. 79.—**Exercise No. 17.** (First movement.) The *operator* stooping makes pressure on the top of the patient's foot while the *patient* standing rests one hand on the back of the chair and draws his foot directly upward.

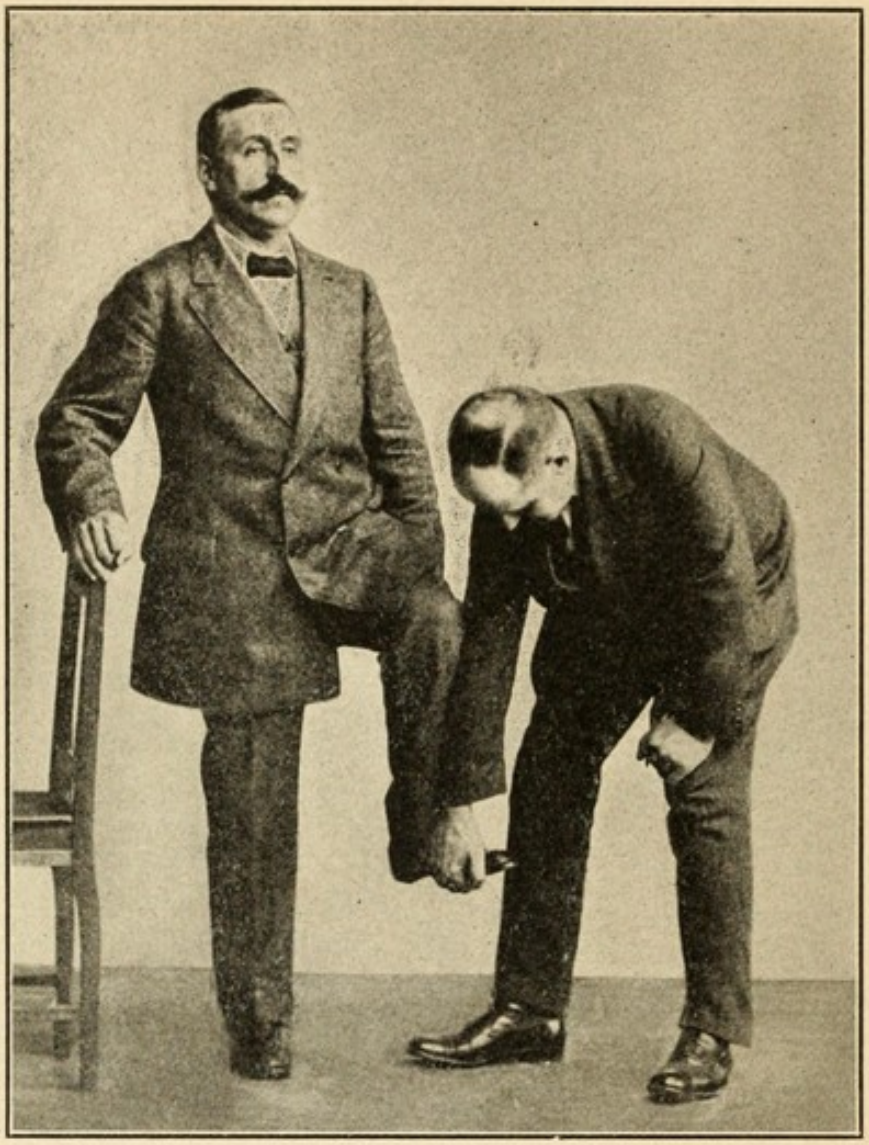

FIG. 80.—**Exercise No. 17.** (Second movement.) The *operator* reverses his resistance by placing his hand beneath the sole of the patient's foot as the *patient* returns his foot to the primary position.

The same exercise is duplicated with the patient's other foot.

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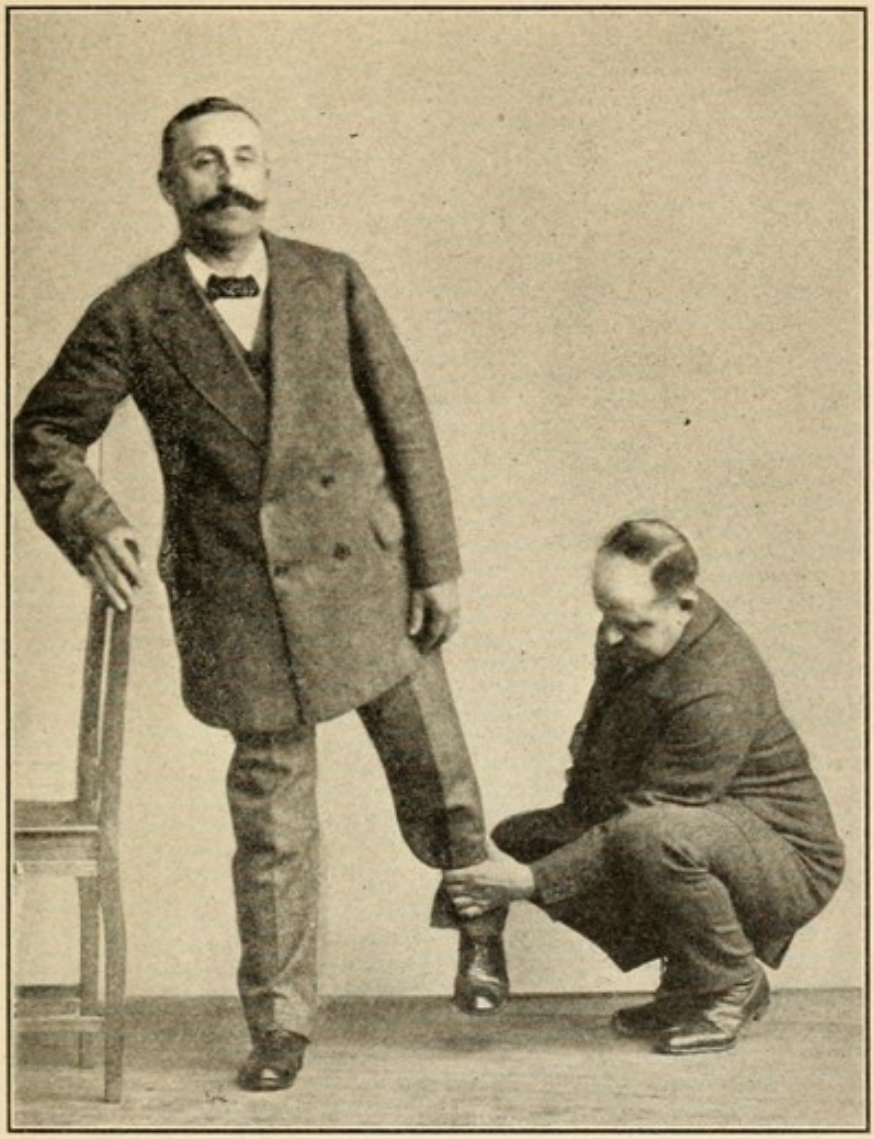

FIG. 81.—**Exercise No. 18.** The *patient* standing rests one hand on the back of the chair and rotates his leg to the right and left while the *operator* stooping grasps the patient's leg near the ankle.

The patient repeats the same exercise with his other foot.

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FIG. 82.—**Exercise No. 19.** (First movement.) The *patient* seated in a chair presses one foot forward while the *operator* stooping makes resistance with his hand on the front of the patient's ankle.

FIG. 83.—**Exercise No. 19.** (Second movement.) The *operator* makes counter-pressure at the back of the patient's ankle as the *patient* returns his foot to the primary position.

The patient repeats the same exercise with his other foot.

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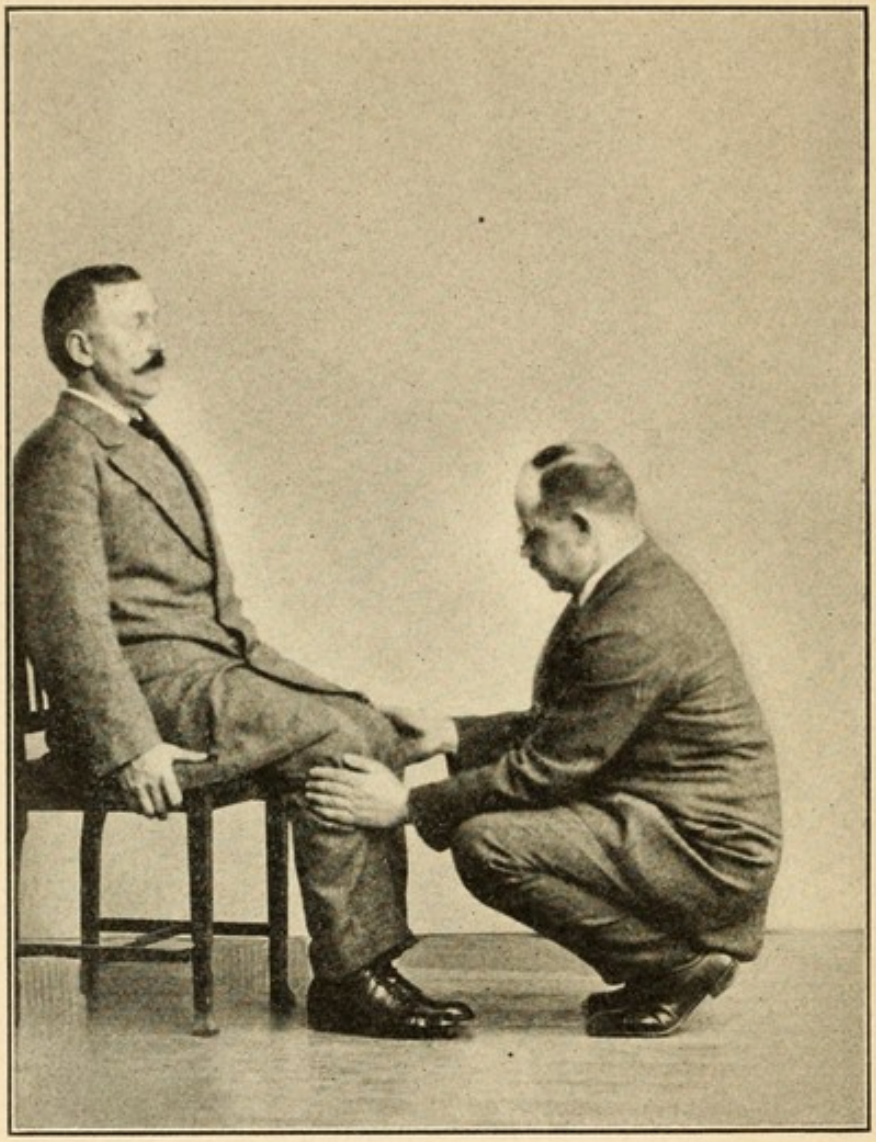

FIG. 84.—**Exercise No. 20.** (First movement.) The *patient* seated in a chair presses his knees outward as the *operator* stooping makes counter-pressure with his hands on the outer side of each knee.

FIG. 85.—**Exercise No. 20.** (Second movement.) The *operator* changes his resistance to the inner side of each knee as the *patient* returns his knees to the primary position.

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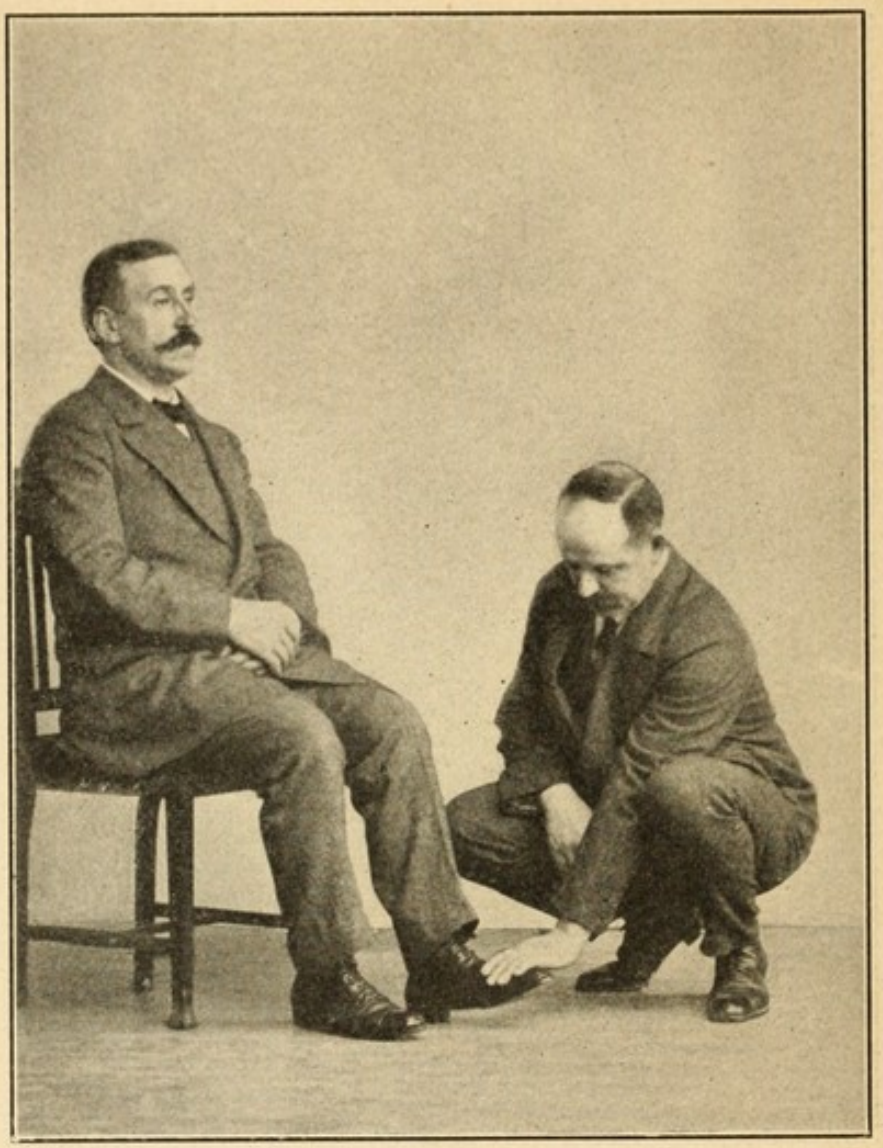

FIG. 86.—**Exercise No. 21.** (First movement.) The *patient* seated flexes his foot as the *operator* stooping makes counter-pressure on the top of the patient's foot.

FIG. 87.—**Exercise No. 21.** (Second movement.) The *operator* changes his resistance to the sole of the patient's foot as the *patient* returns his foot to the primary position.

The patient repeats the same exercise with his other foot.

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