I. PHYSIOTHERAPY OF POLIOMYELITIS

Peggy Baldwin

Physiotherapy of Poliomyelitis

by Peggy Baldwin

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OUTLINE

I. AN TERIOR POLIOMYELITIS OR INFANTILE PARALYSIS.

A. Definition.
1. What the disease is.
2. What has been found in autopsy.
3. Muscles affected.

B. History of Infantile Paralysis.
1. Number of years of research.
2. People affected.
3. Contribution of Jacob Heine in 1840.
4. Epidemic of 1881.
5. Dr. Bergenholtz's work.
6. Swedish physcian Medin --- his studies.
7. First great epidemic in 1905.
a. 1000 children paralyzed.
b. Ivan Wichman-- Sherlock Holmes of Infantile Paralysis
c. Discovery that adults could get the disease.
d. Disease played strange tricks.
e. Well people found to be carriers.
8. Viennese Karl Landsteiner. 1909.
a. First to take the disease from man to monkey.
b. No microbe could be found.
c. Work with monkeys began all over the U.S. and Europe.
9. Serums worked on.
a. Dr. A.Netter of Paris worked on serum.
10. Isolation technic tried during epidemics.
11. Great American epidemic during World War -- 1916.
a. Worst on record.
b. Every possible means of care, cure, prevention and treatment tried.
c. Set science back several years.
d. Laboratories resumed work after war.
e. Money for research was big problem.
12. Dr. William Park and Dr. Maurice Brodie --1935.
a. Experiments with vaccines and serums.
b. Dr. Edwin Shultz
c. Discovery of the fact that the unknown microbes must have the insides of nerves to travel along.
d. Nose found to be the means of entrance to the body.
e. Thousands of mothers and fathers wanted their children operated on to have the nerves of smell removed.
13. 1936 epidemic in southern states.
a. Charles Armstrong discovered a picric-alum spray for the noses of monkeys which prevented the disease.
b. Experimented on children.
c. Records inaccurate.
d. Children sick from spray.
e. Hopeful news from California from Shultz and Gebhardt.
f. Zinc Sulfat solution used as nose spray.
g. Money from Pres. Roosevelt's I.P. Research Comm.

14. New epidemic in Toronto in 1937
    a. Children's noses sprayed with new spray.
    b. Trouble with the spraying.
    c. Experiment unsuccessful.
    d. Important work still being done by doctors and researchers.

C. After-affects of Infantile Paralysis.
    1. Thousands crippled each year.
    2. Hundreds die each year.
    3. Economic problem to family, state and nation.

D. Statistics on Infantile Paralysis.
    1. Reports from various counties.
    2. Number of deaths in U.S. annually.

II. PHYSIOTHERAPY

A. Definition.
    1. Types of treatment.
        a. Message
        b. Manipulation
        c. Exercises
        d. Forms of heat and cold
        e. Radiant enerhy, x-ray, radium, and ultra violet ray.
        f. Mechano-therapy
        g. Occupational therapy
    2. Four types of physical remedies.
        a. Chemical
        b. Thermal.
        c. Mechanical
        d. Electronic

B. History of Physiotherapy.
    1. Oldest forms of therapy.
        a. Heat, cold, wet, dry, sunlight, message, motion.
    2. Started in early temples of the healing gods of Greece, E Egypt and Rome.
    3. Hot stupes and cold compresses used hundreds of years ago.
    4. First Hydro-therapeutic Instute founded in 1877 in Vienna.
    5. Lowman of California improved hydro therapy technic.
    6. Heliotherapy dates back to ancient civilizations.
    7. Leo Arons 1896, invented the mercury vapor lamp.
    8. 1901, Hewitt made improvement on the lamp.
    9. 1904, Kromayer developed another type of quartz - vapor u ultraviolet ray.
    10. Diathermia introduced in 1894 by Franz Nagedschmidt.
    11. Volta and Galvani discovered electrical stimulation of muscle in 18th century.
    12. Duchenne systematized the knowledge of electro-muscular reactions in 19th century by use of Farradic current.
    13. Lovett and Wright practiced individual muscle re-education.
    14. Jackson practiced muscle re-education tin the form of synergystic purposeful motion.

15. Delpech devised fraded exercises for strengthening all the muscles of the trunk and limbs.
16. Lucas Champoniere applied message and active motion to all types of deformities where the reactivation of muscles was necessary.
17. Per Henrik Ling of Sweden in 1839 founded the famous Swedish School of Physiotherapy.
18. Various improvements on all types of physiotherapy tr treatments up to present times.

C. Reasons for using physiotherapy for Infantile Paralysis.

D. Methods of physiotherapy.
1. Message
2. Hydrotherapy
3. Electrical stimulation
4. Exercise
5. Vapor-lamp
6. Whirl-pool bath
7. Diathermy

E. Technic for Infantile Paralysis.
1. Treatment in acute stage.
2. Treatment in convalescent stage.
3. Aim of convalescent care.

F. Work being done at several outstanding places.
1. Harvard Medical School.
2. Shrine Hospital at Portland.
3. Dornebecher Hospital at Portland,
4. Spaulding School for Croppled Children at Boston.
5. Jewish Community centers.

G. Importance of training parents to do the treatments.

H. Sorgery as an important factor.

I. Importance of good treatment for crippled children until an answer is found to prevent the disease.

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Poliomyelitis, Commonly known as Infantile Paralysis, is an acute infectious disease, accompanied in many, perhaps most cases, by paralysis. The paralysis is incidental and not essential, and when it occurs, is a weakening or total loss of power in certain muscles, with no gross disturbance of sensation. Infantile Paralysis is a general infection, the results of which are most marked in the nervous system, in which at autopsy the meninges are found to be edematous and injected, a slight increase in the amount of cerebrospinal fluid also being evident. The brain and cord are edematous and minute hemorrhages can generally be distinguished. The first stage in the pathological process is an acute interstitual meningitis usually most marked on the anterior surface of the spinal cord. In the cord itself there occurs a hyperemia and a collection of small round cells in the lymph spaces surrounding the vessels as a result of which in many places the cells are so numerous that they press on the lumen of the vessel and obstruct the circulation. The lumbar enlargement of the cord is most often affected, and the anterior horns more often than the posterior or the white matter, as in the former the blood supply is more abundant.[1]

In addition tto changes in the spinal cord it is very important to note that the same sequence of changes are found to a less degree in the brain, medulla, and pons. The posterior root ganglia are practically always involved by lesions similar to those in the cord itself. The destruction of spinal cells in any center naturally represents a loss of function of those cells, but the inter-communications between the bundles of motor cells and the connections between muscles and the motor centers are so free and

[1] Jones and Lovett. "Orthopedic Surgery" William Wool & Co. 1935

so manifold that, unless the destruction has been very extensive, the possibility remains of establishing function through the "over lap." This fact serves as a basis for muscle training. The changes which are found in other organs in severe infantile paralysis are less striking than those in the nervous system, but are practically as constant, and constitute an extensive involvement of the lymphoid tissue and pasenchymatous organs. In short, it must be remembered that poliomyelitis is a general toxemia process which affects organs throughout the body, but which apparently acts mildly; on the otherhand, it is characterized by lesions in the spinal cord which occasionally prove fatal by involvement of the nerve cells controlling respiration or these changes may lead to greater or lesser impairment of motor function in certain cells controlling muscular action, most often in the legs.[1]

The three factors, cellular exudate, hemorrhages and edema, appear to be the primary reaction of the nervous system to the virus of Infantile Paralysis. Although the process by which the vascular lesions affect the nerve cells is in a large measure a mechanical one, it is impossible to exclude the fact that the virus may exert some directly toxis action on these cells, but whether or not this is the case, many of the conditions may be explained by the circulatory disturbance and the exudate. The damaging effects therefore are to be attributed in part to direct pressure on the nerve cells of hemorrhages, edema and exudate, to which must be added the anemia following the constriction of the blood vessels and in addition to this may be the direct toxis

[1]Jones & Lovett. "Orthopedic Surgery." William Wood & Co. 1933

action of the virus itself on the nerve cells. On account of this pressure and anema the nerve cells degenerate, and if the hemorrhage and exudate are absorbed soon enough the cells may recover function , but if the unfavorable conditions have been prolonged too long or are excessive, the nerve cells may go on to complete degeneration.[1]

The affected muscles are of three types: (1) those greatly weakened but in which the patient can produce voluntary contraction; (2) those having no power of movement but are subject to contraction by contact with an electric current; and (3) those which do not contract with any kind of stimulation. This type is hopeless and treatment will not help. It is the first two types which we are interested in because with the proper training and physiotherapy their power to contract voluntarily can be increased a great deal.

Acute poliomyelitis is a disease which shows very definite seasonal variations in its incidence. The records of epidemics in many countries show that it occurs during the summer and reaches its maximum in the late summer and early autumn. In the swedish epidemic of 1905, 86% of the cases had their onset between July and October, and 35% during August. The New York epidemic of 1907 showed a similar curve, reaching its maximum, however, in September. Other epidemics show some slight variations in duration and in a period at which the highest point is reached, but that the disease is distinctly one of summer and fall has been generally accepted. There are a few well substantiated epidemics which prove that poliomyelitis may also occur during cold weather. Wickman cites one epidemic in the north of Sweden, lasting through the winter and reaching its maximum in April and May. He also reports three

closely related epidemics, occuring in neighboring sections of the country, the first lasted from June to October, the second, from July to December, and the third, from the end of September to February with its maximum in November and December. These winter epidemics are of interest in relation to attempts remaining dormant under all stimulation.[1]

To fight Infantile Paralysis, because of its terror and tragedy, the people are now ready to organize themselves. But what weapons will their fighters for life place in the people's hands?

That's why the war against the paralytic death can be truly said to be hardly more than started. The existence of this horror has been known for nearly a hundred years now. The groping of microbe hunters and healtmen into this maiming mystery has been going on for just half a century. The universality of the menace makes it a social leveler, for between the haves and have-nots of our economic order the subvisible virus of Infantile Paralysis makes no distinction, plays no favorites.

It is not--like tuberculosis and other deaths of children--the penalty of poverty. Once this paralytic terror begins stalking, wealth can't buy immunity. The well-fed babies of the boulevards are no safer than gamins in the gutter once this crippling, killing midget-microbe is on the rampage.

Infantile Paralysis was a no-account sickness when the old German bone-setter, Dr. Jacob Heine, first accurately reported it in 1840. It was not feared then as it is now. It was unheard of for it to sweep through communities, leaving behind it shambles of the maimed and dying. In Heine's day it only pounced upon a few babies here and there, and there was no indication that it was contagious. It is curious that Heine never saw a victim of this

[1] Peabody, Draper and Dochez. A clinincal Study of Acute Poliomyelitis The New York Rockefeller Institute for Medical Research. 1912

sickness till years after it had done its paralytic mischief, but remember that he was a bone-setter and it was in this capacity that he saw them. To him, over a long term of years, there had come maybe a dozen or two children with one or both legs thin and blue, or with the calves of their legs doubled back on their thighs. Or with the thighs pulled up close to the body. Some had one or both arms hanging limp like flails. He could not cure the, yet the kind-hearted old physician took a simple joy in exercising them,mud-bathing them, bracing them, operating them out of part of their hideous deformities, so that some could walk partly upright almost like humans.

In 1881 in a little town, Umea, Sweden, there was an epidemic of Infantile Paralysis. The ominous event was observed by Swedish Doctor Bergenholtz, yet it caused no excitement among the outside doctors because Umea was so remote from civilization. Now it seemed as if the demons of the paralytic plague were not sure of their epidemic genius, and the sickness skulked for six years with no one reporting it as a contagion. Then in 1887, a little epidemic of it exploded in Stockholm, Sweden, and now at last the sickness began to try its strength in what is called civilization. The Swedish physician, Medin, immortalized himself by first observing and widely reporting it as epidemic. Healthy children came down with it, suddenly, with high fever, restlessness, pains in their heads, stupors, upset digestion, and then in two or three or four days--paralysis. Medin watched this palsy strike the legs of a three year old baby girl, then creep up her body, till at last it paralyzed her muscles of breathing, and at last it strangled her, so that she died. Medin saw it choke an eighteen months old boy and a five months old girl to death. During this

1887 epidemic fourty-four children were stricken. Three little dead ones played their part in the fight against Infantile Paralysis. They were autopsied. The signs of the sickness were found in the motor nerve cells of their spinal cords and the lower part of their brains. These cells were wrecked and blasted by infection by what must be microbe which was unknown. Now again the terror went into hiding, flaring up only in little epidemics in France, and then curiously in Vermont in 1894. So till 1905 and this was the sinister summer of the first great Infantile Paralysis epidemic in human record. More than a thousand children were paralyzed, and hundreds of youngsters did not live. Mankind was fortunate this 1905 summer that there was in Sweden, a physician who may be called the Sherlock Holmes of Infantile Paralysis. This was Ivan Wicksman. He was everywhere that summer taking nobody's word for anything, goint into every Swedish home stricken with the new pestilence. Ivan Wickman was exact in his observations and he was fussily pains-taking with his records. Not only did it strike the children but Wickman saw it strike down the forty-six year old father of nine children only to pass all the rest of the family by, leave all the children healthy and walking.

The plague played strange and devilish tricks, no doubt of it. In the rural parish of Trastena, Wickman saw it break out in the parish school where it had smitten the schoolmaster's own children. But a school-going brother and sister--who had never suffered a sign of the sickness at all--had brought it home to paralyze their baby brother.

Wickman observed that the disease did tend toward recovery. Youngsters might be limp as rags, absolutely powerless all over their bodies, just barely able to breathe, not able to swallow,

not able to talk or even to cry at their terrible pain, and then they would up and slowly but surely get strong, bet better, and walking again at last.

In 1909 Viennese Karl Landsteiner took the terror from man to monkey. He injected a bit of the nerve tissue of the spinal cord of a dead child into the body of a baboon and also into a monkey. The baboon died and the monkey was paralyzed and sick. Yet, Landsteiner, keenest of squinters through highest-powered of microscope lenses, could spot no microbe in these sick or dead simians.

Landsteiner did a great deal of work in his laboratories on monkeys. His work set laboratories all over Europe and America. They found that once a monkey got over Infantile Paralysis he couldn't get it again. This caused a great deal of work by Simon Flexner and Paul Lewis at the Rockerfeller Institute in New York; Paul H Romer who was Principle of the Hygienic Institute of Marburg, Germany; searcher C Leiner and R. Von Wiesner, in Vienna; and Constantin Levadit of the Pasteur Institute in Paris. All were working simultaneously trying to figure out a kind of serum to prevent or cure the disease. They tried to find out how the disease was transmitted.

No good serum was found although at various times it was reported that some one had made a serum that worked--only to be disproven and found unsuccessful.

In these early days the sickness was only beginning to become the terror that it is now, there were not yet hundreds of thousands of children on crutches, and tens of thousands dead as there are now. Yet the statistics of America's and Europe's healthmen brought disquieting news of the spread and increase of

the maiming death and our searchers were working under the pressure of popular panics that grew worse summer after summer.

Dr. A Netter of Paris tried to give immune blood serum to children coming down with the disease in 1910. News flashed that here was a triumph at last. Certain children, undoubtedly sick, surely threatened, seemed to become less severely paralyzed after injection of this serum. But it was proven by Leiner of Vienna that these cases only happened to happen that way and so this theory was unsuccessful.

Such were the hopes and doubts raised by our poliomyelitis pioneers in those prosperous days just before the World War, when many laboratories still had money for monkeys, and when science was encouraged. They tried isolation but it was impossible to carry out good isolation technique because people transmitted the disease who weren't even ill.

Then, in the midst of the World War, the first great American epidemic spread its terror among fathers and mothers. Now our fighters for life had to come out of their ivory-tower laboratories and try--with what dubious weapons they had--to guard the limb and lives of the little ones among the people. Now out of the very disappointment of their hardly justified expectations emerged new science and it was not hopeless.

The New York Infantile Paralysis epidemic in 1916 was the worst up till then recorded, and even to this day it remains to. It was disastrous to the lives and limbs of thousands of children.

In 1935 Dr. William Park and Dr. Maurier Brodie of New York did a great deal of experimenting with serums and vaccines, etc. Dr. Edwin Shultz of California was also working along this line and proved that the vaccines Park and Brodie made would not work.

Many riddles were solved when they discovered that the paralyzing death must have the insides of nerves along which to travel to begin its deviltry inside the skulls and spines of men and monkeys. It is nerve tissue only that the paralyzing midget must feed upon. Without nerve tissue it must die.

By a succession of experiments, Shultz and his comrades proved that the nose was the channel for the entrance of the maiming death. Up inside the nose lie the tiny, hair-like endings of the nerves of smell. They are unique among all nerves of the body because they are the only nerves that are naked to the outside world. Thus, the only possible means of contracting Poliomyelitis is through the nose. When this information was first given out hundreds of mothers and fathers took their children to hospitals, and doctor's offices to have the nerves removed from their noses. The doctors wouldn't do this, however, because it was a serious operation and since it wasn't probable that these children would get Infantile Paralysis anyway, it would be cruel to make them miss the smell of everything all their lives and also spoil their sense of taste.

In the summer of 1936 during an epidemic in the southern states, Charles Armstrong discovered by experimenting on monkeys that a spray of picric-alum could be used in the nose and thus prevent infection from Infantile Paralysis microbes. It should work in children's noses, too, thought Armstrong, so he got ent experiment started and millions of children's noses were sprayed. There were all kinds of reports. Some good and some bad. It was such a mess with parents doing the spraying and so forth that it was impossible to keep accurate records on the results, so Armstrong's experiment was unsuccessful.

But now, in the 1936-1937 winter, while Armstrong was weighing the gains and reverses of this first dubious battle came more hopeful news from California of a new preventive. This chemical that so powerfully guards the monkeys and children is old, is simple, is common as mud, in nature. The metal from which it is formed is in our drinking water, in cereals, mild, eggs, meats, and oysters. It exists in weighable amounts in our own bodies. It is common zinc sulfate in 1% solution.

Edwin W. Shultz and Louis Gebharelt discovered this chemical. On five days in succession they turned batches of healthy monkeys bottomside up and with a power-spray shot the 1% zinc sulfate into each nostril of each monkey. They they poured great doses--overwhelmingly fatal--into the sprayed monkeys' noses. After many experiments as to number of times of spraying and length of time it lasted, etc., they found that one spraying would keep the monkeys from getting the disease for a month or more.

However Shultz made a conservative statement in the Journal of the American Medical Association. He said, "We may summarize the results very briefly by saying that two or three successive daily intranasal sprays with a 1% solution of zinc sulfate will generally protect all, or nearly all of the animalsso treated against virus administered one month after treatments have been applied."

Naturally, the next big question was how would it work in human beings? In 1937 a new epidemic broke out in Toronto, thousands of children's noses were sprayed but some were not sprayed carefully so that many did get the disease. There were two thousand or so cases among Toronto's maybe hundreds of thousands of children.[1]

[1] DeKruif Fight for Life. Harcourt, Brace and Co. New York 1938

Infantile Paralysis which, terrible in its after-affects, presents one of the most urgent and difficult problems confronted by modern preventive medicine, will be the object of a concerted three year attack launched by an international group of scientists seeking for its prevention. Dr. william H. Park, Chairman of the International Committee for the study of Infantile Paralysis, said that Jeremiah Milbank of New York had given $250,000 for the work. Participating in the researches are Chicago, Columbia, Harvard, and New York Universities in this country, and the University of Brussels and The Lister Institute of London.

"Whether or not the virus of poliomyelitis can be isolated and grown and utilized for an anti-serum vaccine, it a question of doubt," said Dr. Park, "but we are hopeful that something maybe accomplished. At any rate, such practical questions as the value of convalescent serum, the methods by which the disease spreads and means for its prevention can be wholly or partly solved, and some practical results be attained to prevent the disease which has killed or maimed thousands in the last decade.

Little has been discovered about the prevention and control of Infantile Paralysis, in spite of the immense amount of study which has been given to the problem. There is no periodicity to recurrences of the disease which is both endemic and epidemic. The death rate was higher in 1927 than during any year since the epidemic of 1916.[1]

Schultz tried the zinc sulphate on monkeys and found that by spraying it in their noses for three consecutive days they would not get Infantile Paralysis when exposed to it for over one month. Next, it had tobe tried on children. In 1937 during an epidemic

[1] Study of Infantile Paralysis. American Journal of Nursing June 1928

in Toronto they organized the doctors and decided to spray everybody's nose and to do it the correct way, but they just started on several hundred people and then had to stop. The results were fine as far as preventing the disease was concerned, but everyone got terrible headaches from the spray and they refused to have it done again. Now the doctors were stumped again and so the epidemic of 1937 was quite severe and the scientists continued to study the methods of prevention. Money was needed to carry on the experiments so now the International Foundation for Infantile Paralysis was available as a place to get money for research.[1]

The National Foundation for Infantile Paralysis in the United States was organized in January 1938 for the purpose of lending, directing and unifying the fight on every phase of Infantile Paralysis. The creation of a national foundation to unify the fight against this disease was not impetuous. It had been under consideration for years by those who had watched the ravages of that disease and its creation was the result of twelve years of thought and study by those connected with the Georgia Warm Spring Foundation at Warm Springs, Georgia. For twelve years, at that institution under the leadership of President Roosevelt, serious painstaking work has been going on to develop and discover treatments of value in the care of the after-effects of infantile paralysis. Warm Springs never made any pretense of caring for all those handicapped by this diseast. At the very

[1] McBride. "Crippled Children--their Treatment and Orthopedic Nursing. 1931

best, any institution can care for only a limited number of handicapped patients at any one time. Out of the work being done at Warm Springs, however, there came an arousing of the people of the United States to a full realization of the tremendous problems that constantly confrontthose afflicted with Infantile Paralysis on all fronts at one time through some such organization as the "ational Foundation for Infantile Paralysis.[1]

The National Foundation for Infantile Paralysis has a Board of Trustees of thirty-five representative individuals from all parts of the United States tremendously interested in this great fight and willing to give their time and effort in this great cause. There is also a General Advisory Committee which consists of five of the leading physicians in this country. Under this General Advisory Committee there are special advisory committees consisting of additional doctors skilled in their separate fields to advise on grants for scientific research for the purpose of discovering and eliminating, if possible, the disease itself; on grants for epidemic aid; on grants for education purposes such as the dissemination of knowledge of care and treatment; and on grants for the study of the prevention and care of the after-effects of the disease.[2]

The work of the National Foundation is primarily and essentially in the nature of assisting in study and research on the medical problem as a whole and not in rendering direct individual care to those afflicted. However, in 1939, to meet the requirements of direct aid to the individual cases throughout the United States, the Foundation was organizing local chapters in the various counties

[1] The International Bulletin. Volume A 4o. Published and distributed in the United States by the National Foundation for Infantile Paralysis, Inc. 1940

[2] The Internal Bulletin.

of the United States in which a part of the funds will undoubtedly result in the National Foundation having two or three thousand chapters throughout the United States and still further consolidate and unify all of the forces necessary to make and continue the attack on the whole fron t line of Infantile Paralysis in the United States. To date funds for the National Foundation have come from the proceeds of the annual celebration of President Roosevelt's birthday on January 30th. Each year on that date every city in the United States has a birthday ball and the public is urged to go. Each state keeps a certain percent of the proceeds and the rest is sent to the National Foundation. At this time there is also a campaign on all over the United States called the "March of Dimes". In newspapers and magazines and on the radio everyone is urged to send a dime or a dollar to the National Foundation or to President Roosevelt.

The after-effects of Infantile Paralysis are very serious. Each year in this country as in other countries thousands of children are left crippled for life from this disease. Many of these crippled children are so terrible deformed they cannot possibly ever be normal again. These children are a great economical and social problem to their families, community and the nation. Not only do hundreds become hopelessly crippled but hundreds die each year. It is for these reasons that the scientists and doctors are working so frantically in an attempt to find a means of preventing this dreaded disease. As an example for one year, 1935, there were 18,969 poliomyelitis cases in the United States. The number of cases in this country is not decreasing from year to year and so until some way to prevent this disease is found, there must be a great deal of work done to help those children who become crippled.

This help is obtained through the use of physiotherapy.

The Infantile Paralysis after-care committee of the Visiting Nurse Association of Chicago, together with the Home for Destitute Crippled Children and the County Home for Convalescent Children entertained Dr. Robert W. Lovett of Boston, who addressed the members of these three boards on the subject of "After-care of Infantile Paralysis." During the course of his lecture, Dr. Lovett emphasized that there were three things which added very greatly to the comfort, economic value and personal happiness of cripples: (1) the ability to sit down; (2) the ability to walk; and (3) the ability to go up and down stairs. So many cripples are confined to beds and wheel chairs or to walking on the level, that he emphasized these three things. He said that in a recent study made of the 811 cases under supervision of the committee and of the twelve nurses who devote all of their time to the after-care, it was brought out again and again that children supposedly hopelessly crippled when first seen, had been aided in all three ways by the use of physiotherapy. A statistical study of the results, in 1921, of 17,528 visits to the homes of children have been made and more than 200 of the 630 cases on the books, were attending either public schools or were in special rooms for crippled children in the public schools.[1]

Physiotherapy, as the name states, is the use of physical remedies in the treatiemt of disease or disability. Under the head of physiotherapy would come all remedies not medical or surgical in nature such as massage, manipulation and exercises in all forms, all electrical treatment currents, all forms of heat and cold including hydro-application, all forms of radiant energy including

[1]Foley, Edna L. R.N., A.J.N. Feb. 1921 page 317. Illinois.

radium, x-ray, ultra violet ray and the visible rays, mechano-therapy, occupational therapy, suggestion, etc. The various physical remedies are grouped under four general heads: (1) Thermal, (2) mechanical, (3) chemical, (4) electronic.

The oldest form of therapy known to the human race is the use of the simple phenomena of nature. The history of its development from the primitive stage of heat and cold, wet and dry, sunlight and massage, motion and rest, to the modern aspect of complex apparatus for the concentration and administration of a multiplicity of physical energies is a topic of vast possibilities but not in all its phases pertinent to this study. Physio-therapy, now a specialty in its own right, has been a handmaiden of every branch of medicine. The early temples of the healing gods of Greece, Egypt, and Rome were built around the spas or curative waters wherever these were located. In the large temples of the Askelpians could be found bathing pools of cold and hot water, both used in the routine of hydrotherapy. The application of hot stoupes and cold compresses was a recognized procedure when mankind was in its infancy, and in all ages has been probably the most consistently maintained therapeutic measure among both the practitioners and the laity. The first Hydrotherapeutic Institute in modern times was founded about 1877 by Winternitz of Vienna. However, Carbonai, of Florence has used hydro-therapy in its modern sense of pressure showers, sedative steam, and contrast temperatures, in orthodedic cases about forty years earlier. The whirlpool bath is a comparatively recent addition, and is an efficient means of applying a diffuse smooth, temper-controlled friction.

Of particular interest to orthopedists, is the work of Lowman, of California. He took advantage of the physical fact that specific gravity of water is much greater than air and has attempted the

re-education of paralyzed muscles following poliomyelitis with the body immersed in this denser medium. The buoyancy of the water is such, that a degree of muscle power totally inadequate to function against gravity in air, may be found quite competent to engage in active motion against gravity when submerged. By this means graded active motion can be started much earlier than was heretofore deemed possible, and slight residual power can be increased to a considerable percentage of the normal.

Heliotherapy is another physical measure of long antedecents, dating back to the ancient civilizations. The universal worship of the sun was not a part of a healing cult, but a manifestation of agricultural needs. During the late middle ages, however, certain Alpine villages had already gained prominence as resorts for the cure of numerous ailments. The earliest form of "artificial sunlight" was that produced by the mercury vapor lamp invented by Leo Arous in 1896. In 1901 Hewitt improved upon this with the introduction of the quartz-vapor lamp. Kromayer developed another type of quartz-vapor untra-violet ray in 1904. These appliances have afforded a constant source for heliotherapy under conditions unfavorable to exposure to direct sunlight.

In recent years various types of apparatus have been devised for the application of local heat. The introduction of the ordinary baker, which supplies heat by radiation of the incandescent lamp invented by Thomas Edison, was followed by a method for applying only the infra-red rays of the spectrum, the "heat rays." In 1894 deathermia was introduced by Franz Nagelschmidt. It was claimed that by this means heat might be generated within the body by direct thermo-chemical activation of the tissues. At that time,

however, the use of deathermia or other wave length modalities such as the more recent radiotherm in increasing the general body temperature for cases such as were discussed under hydrotherapy, was still in the experimental or at least observational stage and judgment as to their value was deferred.

The discovery of the electrical stimulation of muscle by Volta and Galvani in the eighteenth century lead almost immediately to the application of electricity as a therapeutic measure in conditions where muscle stimulation was thought to be indicated. First introduced in London, its popularization was rapid among the hospitals in the larger centers on the continent and in the United States. However, its use was more or less empiric until Duchenne systematized the knowledge of electro-muscular reactions during the latter part of the 19th century. Duchenne used the Faradic current to test the functional reactions of individual surface muscles. In recent years a different electrical modality has been introduced, the sinusoidal current for which is claimed the ability to cause repeated active contrastures of the paralyzed muscles.

Of greater importance than artificial muscle stimulation is the use of massage and active motion in the rehabilitation of the paralyzed limb. This therapy, known as muscle re-education, may take one of two forms; it may be direct either to an individual muscle, as practiced by Lovett and Wright in Boston; or it may follow the principle of Jackson, and be applied in the form of synergistic purposeful motion. Active motion (exercise) and massage has an almost unlimited arthopedic application. In scohosis the use of massage and controlled activity is as old as Galen, but in modern times has been again introduced as a rational procedure based on anatomic analysis by Delpech early in the

nineteenth century. He devised graded exercises for strengthening all the muscles of the trunk and limbs. During the third decade of the century, John Shaw was using grade exercises in England.

It remained for Lucas Champoniere to apply massage and active motion as a general procedure in all types of deformity or disability where the reactivation of muscles was necessary.

In 1839 the Swedish gymnast Per Henrik Ling developed the ancient Greek art of calisthenics to a science based upon sound anatomic and physiologic principles. He founded the famous Swedish school of Physiotherapy.

Many ingenious mechanical contrivances have been used at various times for muscle rehabilitation but have been discarded in favor of the simple massage and exercises. In 1891 Nikola Tesla first suggested the medical use of that form of electricity which we now call High Frequency. In 1898 D'Arsonval commenced this investigation.[1]

The aim of the use of physiotherapy in Infantile Paralysis is three-fold: (1) to prevent and overcome deformities; (2) to restore as much muscle power as possible; (3) to direct the patients activities in order to help him make the best possible use of the muscle power that he has. It should be clearly understood that you are not working with what is gone, but what you have left. A cell that is completely destroyed can never be restored. However, it is impossible to tell for many months whether a muscle is really lifeless. If there is even a flicker of power, there is a chance that more will return.[2] (Before discussing physiotherapy further it is wise to remind those interested that the

[1] Edgar M. Bick History of Orthopedic Surgery 1932

[2] Stevenson, Jessie. R.N. Infantile-Paralysis After-Care. P.A.N. August 1931

treatments must not be started until the muscles are ready to be worked on.) The child may seem to be well in a few weeks, but his muscles are still sick. One of the most important things to stress in the beginning is Rest. Rest in bed for many months seems tedious, but it may change the entire future of the child. There are no short cuts. The slow way is the sure way. Massage should not be started until all of the soreness has disappeared.

In the acute phase which lasts from the onset of the disease until the disappearance of the tenderness, the treatment should consist of rest, fixation and absence of irritation and the avoidance of muscle training, exercise and massage. Toward the end of this stage immersion in a warm saline bath is agreeable and apparently beneficial. Radient heat, diathermy, and possible ultra-violet, may have marked effects. If pressure and "the anemia following the constriction of the blood vessels" are important factors, then by the use of diathermy over the spinal cord circulation may in part be re-established, the pressure may be relieved, and the cells may recover function. The technic for this diathermy is as follows: a narrow metal strip is placed over the spine, first the upper section, then the lower. In the first instance a metal strip is placed over the chest, and in the second, over the abdomen. Several hundreds millamperes are given for various lengths of time. This is followed by diathermatizing the limbs which are affected. The treatment is continued until the limbs feel warm.[1]

The convalescent phase may be assumed as beginning with the cessation of tenderness. Having in mind the governing fact that all treatment must aim at securing the best ultimate function and remembering that muscular stretching, fatigue, deformity and improper

[1] Granger, Frank B. A.B., M.D. Physical Therapeutic Technic W.B. Saunders & Co. Philadelphia and London. 1929

muscular balance are detrimental factors of the highest degree, we come to a consideration of those physical therapeutic measures which we may use to carry out the indications just mentioned.[1]

Massage is a form of mechanotherapy. In some of its forms it is one of the oldest of therapeutic procedures and the fact that it has survived is proof of its helpfulness in many conditions. It is claimed for massage that it promotes metabolism, maintains nutrition, restores strength to weak muscles, prevents adhesions and helps break them up if already formed, breaks up fibrosis, hastens repair after infury, prevents and helps to restore lost function in muscles and joints and renders voluntary motion in diseased or injured parts easier.

Massage fills an important niche in any physical clinic and one should not attempt to do physiotherapy without it, but just as the ox cart was once the very best means of travel and still is a very sure means, although not so much used as formerly, it is no longer the very best way of accomplishing many of the things formerly given over to it almost exclusively. When it is the best known remedy for a given condition it was good therapy to make it the remedy of choice, but when advancement in knowledge of physics, biophysical or chemical reaction, appliances and technics for their proper use in producing them showed a better means of producing the desired reactions then it ceased to be good therapy to use massage in place of the better procedure. Some practices of massage give as many as seven different movements, but three main movements will cover. The others are modifications of one of these three. These three are effeurage, or stroking; petrissage, or kneading, grasping, compressing, or pinching; and tapotement, or striking, hacking or slapping.

[1] Jones, Sir Robert
Lovett, Robert W. --Orthopedic Surgery William Wood & Co. 1933

Massage is local or general in character according to whether a single extremity, joint or part is to be worked out for some local injury or whether the whole body is to be gone over systematically as in injuries or convalescence requiring long stays in house or bed, etc.[1]

The favorable action of massage on parts affected by infantile paralysis is understood, but it must be recognized that it has distinct limitations and that too much must not be expected of it. The proper stroking, kneading, and manipulation of an affected limb, placed in a position where the affected muscles are relaxed, stimulates the flow of venous blood toward the heart and increases the flow of arterial blood to the limb. It also facilitates the flow of lymph toward the centerof the body by mechanical emptying of the lymphatics, and direct manipulation of the muscles must also in ameasure empty them of wast products. Thus massage may be expected to retard and antagonize muscular atrophy by inducing better nutrition locally.[2]

Vibration should be classed as mechanical massage and is given by means of an apparatus which produces locally a succession of rapid blows to the tissues. It apparently is effective chiefly by acting on the vasomotor nerves which are stimulated to bring more blood to the part. It is also probable that the direct mechanical effect on the muscle of a series of blows is not to be neglected because it is well known that a blow to the belly of a muscle causes a contraction of the fibers. A succession of mild blows would therefore probably tend toward increasing muscular tenacity which is of course desirable. Practically vibration in connection with massage seems to make the latter somewhat more effective.[3]

[1] Sampson Physiotherapy

[2] Sampson, C.M. Physiotherapy Technic. C.V. Mosby Co. St. Louis 1923

[3] Lovett, R. W. The Treatment of Infantile Paralysis P. Blakistons Son & Co. Philadelphia 1917.

Thermal--The remedies coming under the head of thermal would be the three forms of heat: conductive, convictive and conversive. Conductive heat is heat applied to the body by contiguity and would include all such applications as poultices, hot water bags, various hydro applications such as immersion baths, contrast baths, whirlpool baths, the various sprays, douches, etc., hot sand or mud baths, hot and cold packs, etc. Convictive heat is heat thrown onto the surface from some outside source such as radient, super-heated air from electrically heated coils, gas or oil burners, etc.; conversive heat is energy converted into heat in the tissues themselves by virtue of the resistance of the tissues to the passage of oscillatory high frequency or heat waves through them.

Chemical--The remedies coming under the head of chemical would be the galvanic (the unmodified), the constitutional effects of the ultra-violet ray and certain eonizing effects of the x-ray.

Mechanical--Under this heading would come massage, manipulation, exercises, mechanotherapy and mechanical vibration and such electrical applications as most of the statis modalities, the faradic currents, and the interrupted galvanic.

Electronis--Certain physical remedies, such as static electricity, because of their predominant effects, fall under the heading of mechanical modalities, yet their use is followed by results that cannot be explained by any theory that is based upon the mechanical effects produced. Neither can these particular effects be produced by any other mechanical action whatever, nor by any other electrical devise except the static current. The static current being an extremely high voltage low Milliamperage current, its passage through living tissues is not followed by the formation of heat or chemical reactions in demonstrable quantity yet the clinical reaction can be foretold with certainty. A chemical reaction from an electronic standpoint is a very massive affair, thousands of electrons in millions of atoms participating, yet the difference between

a non-functioning atom and one functioning perfectly may be so slight as the gain or loss of a single electron.[1]

If a partly paralyzed limb is heated it is capable of performing better muscular function than before, because muscles work better at a high temperature. Moreover the heating of the limb apparently adds to the effectiveness of massage because if the massage is given directly after the heating, while the superficial capilaries are full of blood, a greater volume of blood is driven toward the center of the body to be replaced by a similarly large volume returning to the limb. Heat may be applied as radient heat or non-radient heat. Hot water is not desirable as a form of heat, as it makes the skin tender and cannot be borne at so high a temperature as can dry heat. In view of the fact that muscles function better when war, the paralyzed limbs should always be warmly clothed, for chilling of the affected parts is always bad and superficial necrosis of the skin is easily produced by chilling the feet and legs. If the proce s of heating is too long continued the reaction fails to occur, so that ten to fifteen minutes is long enough.[2]

"Diathermy, sometimes called "internal baking", is a high frequency current of the D'Arsonval type, with a fairly high voltage and milliamperage. By diathermy heat is applied to a part by means of conduction of an electric current through that part. The ordinary electric light current is not suitable because the cycles of electricity alternate only about sixty per second and a shock is felt the instant such a current is applied. It is necessary to break the alternating cycles of the electric current into infini-

[1] Sampson Physiotherapy

[2] Lovett, R. W. The Treatment of Infantile Paralysis P. Blakistons Son and Co. Philadelpnia 1917.

tismal frequency to avoid producing shock when it is applied. The heat is produced by resistance of the tissues to the electric current just as the electric current just as the electric toaster wires become hot. By proper regulation, therefor, a part can be intensly heated by the process. It is used in the treatment of Infantile Paralysis some, but more frequently in chronic joint inflammations, neuritis, and neuralgia.[1]

Heliotherapy is the treatment of disease by the sunlight. The ultra violet rays of the sun are the short rays and give but little heat in contradistinction to the infra-red rays which are long rays and more heat producing. The ultra-violet rays possess special chemical properties which penetrate the pigment of the skin and produce a therapeutic effect upon the blood. The sun is the natural and strongest source of ultra-violet rays. The rays, however, must pass through no intervening medium, such as plain glass before striking the body. The most successful treatment is carried out in the open air where the skin of the body can gradually be exposed directly to the sun's rays. As sunlight is not always available, the quartz light is used as a substitute. Quartz glass does not retard the passage through it of the ultra-violet ray of the spectrum. This form of therapy is not as successful as other methods for infantile paralysis. It is used more for tuberculosis of the joints.[2]

Hydrotherapy is the treatment of disease by the application of water. It may be applied locally by means of hot or cold packs

[1] McBride. Crippled Children--Their Treatment and Orthopedic Nursing

[2] McBride. Crippled Children--Their Treatment and Orthopedic Nursing

or by whirlpool baths. The body, in general, is treated by means of hot or cold showers, sprays, and douches.

Hydrotherapeutic Value: Influence of the heat of the water; the sedative action on the peripheral nerves; the dilation of capillary beds; the acceleration of lymphatic interchange; and the effects of pressure from density and depth are all of importance.

The peripheral circulation is affected by heat conveyed to the body through the water. The influence on the circulation is that of dilation of the peripheral vessels, and consequent improvement in the interchange of fluids and gases.

The pressure of water on the immersed part acts as a constricting medium against which the weakened muscles act, stimulating the resistance of the normal fascial sheaths, and increasing the rapidity of venous return.

Physiological Value: Absence of gravity pull permits the partially paralyzed muscle an increased range of joint motion with lessened stress. Nutrition to the involved part improves; return of power is built up to limits allowed by actual residual pathology. Elimination, appetite, circulation, endurance, breathing, and sleeping are likely to improve.

If given as soon as is possible after the quarantine stage of the disease, pool treatments will influence drainage of involved areas of the spinal cord. As the blood supply to the muscles which activate the spinal column is the same as for the cord, trunk movements within a painless arc foster more rapid blood flow. This improvement of venous return tends to drain the involved area in the cord and to reduce its congestion and oedema.

This reduction of pressure from oedema in the early stage should save many nerve cells which would otherwise become defunct, with the loss of the corresponding muscle. Great care is necessary in treatment during the early stage, as fatigue might actually cause loss of remaining active portions of a muscle.

Psychological Value: It should never be forgotten that movement in water is easier than on land because of natural biological stimulus to movement. Less effort is required to move a weakened or paralyzed member, due to absence of weight and influence of buoyancy. This results in the possibility of greater activity for the paralyzed person during pool treatment. The pleasure felt in movement is a most valuable aid in building up the patient's morale. This in turn helps develop his courage and staying power so that he is able to cooperate with the surgeon in relation to organization of a wise life plan.

Treatment: Treatment is directed along lines of restoring function to involved muscles and to developing old and new skill patterns. Due to the lack of gravity pull and the restraints of fixed environment, a new conception of muscular action is necessary.

The technique of working in a three rather than a two dimensional medium must be mastered. In the water, the patient's body can move in any plane. Trunk movements, rolls, and turning exercises are possible. All types of movements from horizontal or vertical axes may be made.

Amount, force and time of treatments should be limited. Fatugue, both mental and muscular, is always to be avoided.

All muscle action must be carefully observed by the technician, and body alignment as well as paralytic manifestations noted. Stimulus to effort must be repeated frequently. Before localization

is possible, synergistic action may sometimes be obtained by stimulation through old nerve patterns to start the flail muscle in stabilizing and contracting.

Reactivation of muscle takes place by action of the reflex mechanism; by direc neuro-motor control of isolated contraction, using volition; or by exercising reflexly, skill patterns already existing in area 2 of motor part of cortex.

The fact that a muscle cannot be moved by a patient when out of water is no sign that it is totally paralyzed. Nerve supply to most muscles comef from several spinal segments. It is important that all possible neuro-motor channels be kept open so that small islands of muscles which still remain alive are activated as early as possible. The careful gradation of dosage of work essential to prevent loss of these remaining viable areas, is obtainable in finer degree in working in the water than during muscle training in the gymnasium.

Formation of patterns of movement and the registration of tactile stimuli are important aids in the reeducation of the paralyzed muscles. In the water the patient not only sees his paralyzed leg move with the assistance of buoyancy, but feels the movemtne in the joint and in his contact with the water. This aids in the fixation of the idea and in the formation of a pattern of movement.

Early action of spinal and trunk muscles is important, In fact, the earlier the equilibrium of all physiological processes is established, the better.

Summary: Pool treatment, properly prescribed and administered, will aid in: correction of segmental malalignment; sensori-motor control of equiibrium; training of non-cooperative parts;

organic and structural influences; reactivation and control of local muscle function; visualization and performance of movements; influence on alteration of structure; organic integration with neuro-muscular and mental education.

Recreation and satisfaction of individual skill will be enjoyed and will aid the patient in making necessary adjustment, and in realizing improvement. All treatment should be made in relation to a definitely planned future for the patient.

The principle underlying this treatment is the application of "rushing" water, rather than running water, for the treatment of stiff joints, contractures, and injuries.

Tha baths first employed in this country were copied from the French model, in which hot and cold water supplies are led into a mixing chamber, whence the water at required temperature passes into the bath through a number of jets. After rushing around the bath, the water flows through an opening near the top. The whirlpool effect is thus produced by a constantly flowing stream of rapidly flowing water. To obtain a satisfactory stream a pressure of at least fifty feet is needed, and the water consumption is heavy. To obviate this disadvantage a bath was introduced in which the whirlpool was produced by means of an electrically driven burbine placed under a grating in the bottom of the bath. A small quantity of water only is admitted from time to time in order to maintain the temperature, while a corresponding amount is allowed to flow through the waste pipe.

Baths are made of various types and sizes--some for arms or legs, and a very large one in which not only one but several patients

can sit and be treated at the same time. The period of immersion is usually about twenty minutes. Temperature from 110°F. to 120°F, or as hot as can be borne comfortably. Shortly after the immersion the skin becomes flushed and real pain is relieved, and a comfortable sensation induced. The tissues become more supple and movements can be made which were previously painful or impossible.[1]

Several who have had experience in the use of under-water exercise pools comment that patients who have had preliminary training in the pool make more rapid progress in learning balance and walking and more readily attain independence in the functional use of muscles. This method of instruction has been found helpful, particularly for patients with extensive involvement of leg and trunk muscles. Leg splints and a corset should be worn to prevent faulty weight bearing. The water should be of shoulder depth. An overhead sling helps to support the trunk in the erect position and gives the patient a feeling of security in his attempts to stand, balance and walk. If crutches are used these should be weighted. Low stairs with hand rails extending our some distance into the water afford practice in going up and down stairs. Sitting down and getting up position also may be learned more readily by practicing in water which reaches above the shoulders.[2]

[1] Thomas Davey Luke Manual of Physio Therapeutics.

[2] Stevenson, Jessie L. Care of Poliomyelitis Macmillan Co. 1940.

Electricity--Electricity has been in the past very extensively used in the treatment of infantile paralysis and today, although the subject of much controversial argument, it has been until recently at least, probably the most generally used form of treatment,especially in the hands of the general practitioner. The reason for its general use has seemed to consist in a general impression that it would do good in some mysterious way not clearly formulated.[1] A muscle can be made to contract by the direct appliance of an electrode over its motor point. The normal muscle responds both to the faradic and galvanic type of stimulus. A paralyzed muscle almost invariably loses its response to faradism, but retains its response to galvanism with certain qualitative and quantitative modalities. One of the most effective methods of preserving nutrition in a paralyzed muscle is to induce a series of contractions at regular intervals. Interrupted galvanic stimulation of the affected muscles is thus a logical and sound method of treatment in poliomyelitis after the acute stage is over. This procedure should be used only in combination with heat and light massage, always with the limb or part supported in the position of physiological relaxation. Each muscle is picked out in turn by the electrode and a series of twitched produced. In a recovering muscle the faradic response reappears once more, so that at this stage interrupted faradic stimulation may be used instead of the galvanic current.At a still later stage when voluntary power has returned in a muscle formerly completely paralyzed the movement evoked by appropriate electrical stimulation is a useful form

[1] Lovett, Robert. Treatment of Infantile Paralysis. P. Blakiston's Son & Co. Philadelphia 1917.

of exercise. In very young children electrical stimulation has a comparatively limited application, but in older children and adults it forms a natural introduction to the stage of active muscle training.[1]

The training of the muscles should be begun as soon as the patient's limbs can be moved freely without pain. In some cases this will be within three weeks after the initial attack and in some after a much longer attack. It is possible to accomplish a great deal for cases that have been neglected for years.

Almost every muscular contraction is brought about by the stimulation of nerves from more than one spinal center. In infantile paralysis a localized myetitis has attacked the cord and has destroyed more or less at random certain areas of spinal nerve centers. Unless the cord lesion has been extensive the chances rather against the total destruction of all the centers and associations of any large number of muscles, some centers or associations having perhaps escaped. For this reason there exists in many paralyzed limbs a possible amount of muscular power that is not suspected and will not be available unless cultivated and developed.

The principles which underlie the training of muscles which have partially or wholly lost their power of voluntary contraction as a result of infantile paralysis do not in any way differ from those underlying the development of normal muscles. The result in both instances is an improvement in the nutrition of the muscle fiber and in the facility with which the nerves carry the impulses.

In paralysis the beneficial effects of muscular contraction on the circulation may be in part supplied by massage, heat, passive movements, etc, and they undoubtedly do, to a certain extent,

[1] Jones, Sir Robert. Lovett, Robert. Orthopedic Surgery William Wood & co. Baltimore 1933.

prevent the wasting away of the paralyzed muscle. Wherever there i s, however, the ability to contract a muscle even slightly by an effort of the will, the muscle cells are more favorably affected by this contraction than by any quickening of the circulation by other means. When not used the muscle cells degenerate, and the only way to increase their nutrition is to make them work. If a lively circulation is started in the muscle before it contracts, the contraction will naturally be attended by greater benefit to the muscle fibers. For this reason it is advisable in treating cases of infantile paralysis to make use of the therapeutic measures mentioned above before giving the exercises, even when the voluntary power of contraction is fairly good. Seriously weakened muscles should be protected against cold at all times.

If any muscle shows no signs of attaining any thing like a useful amount of function after the exercises have been faithfully carried out for a sufficiently long time, it may be adviseable to discontinue work on it as if is an advantage to give as few exercises as possible, in order to avoid unnecessary mental fatigue in the patient. Whether or not to abandon exercises for any given muscle should be partly determined by the importance of the muscle. It is is essential for walking, the time, which is perhaps uselessly expended upon it, should not be grudged, as there is nothing to lose, and everything to gain, by giving it every possible chance for recovery.

While performing the exercises the paralyzed limbs should be uncovered, as the action of the muscles cannot be observed accurately through the clothing.

In some cases, movements can be more easily made in warm water, or in warm salt water of increased buoyancy.[1]

[1] Shirley W. Wynne City of New York Department of Health Muscle Training in Infantile Paralysis.

Muscle training is fundamentally an attempt to restore a cerebral motor impulse to a muscle, an impulse which has been either impaired or lost during the acute stage of poliomyelitis. The method of muscle training aim at two things: first, at establishing a better co-ordination between the remaining nerve fibres supplying the affected muscle; and second, at securing contraction of the desired muscle, however feeble, which is of course the best possible treatment of the muscle itself. The muscles partially paralyzed in poliomyelitis are simply weakened muscles requiring an extremely small dose of exercise.

If a muscle is apparently without any power, the patient should concentrate his attention on the attempt to accomplish the movement while it is performed passively. It often happens that weak muscles may be able to carry the limb through only a part of its normal arc of motion. In such a case the limb should be carried by the surgeon passively through the remaining arc of motion, normal to the joint, and there should be no pause after the muscle has ceased acting.

It is usually enough to let the patient go through all his exercises once a day, six days in the week, as the one day of rest prevents him from becoming stale. Each exercise may be performed ten or twelve times in succession in slow enough rhythm to allow for complete recovery between efforts. Unless it is done as well the second time as the first, and the tenth as well as the second, it is being done too fast or being continued too long and the patient should be given a rest at once.[1]

Since the assistance of another person is necessary to insure that localized exercises are given correctly, the physician will have to instruct some member of the family in most cases. The following suggestions are given with the idea that the mother is to do the daily treatment.

[1] Jones and Lovett Muscle Training in Infantile Paralysis

(1) The patient must know what movement he is to do, and must try to do it--after which he relaxes, and lets the mother put the arm or leg back in the starting position ready for him to try again.

(2) The mother may make any of the exercises harder by resisting the movement with her hand. This resistance should not be given until the movement can be performed strongly and correctly, without help, ten times. When resistance is given, it should be smoothly graduated to the movement throughout, being great enough to make the muscle work hard to perform the movement, but never great enougnto stop it or make it jerky.

(3) The mother should understand that it does not strengthen the muscles if she moves the leg back and forth. The patients must try and should not be helped until he had done as much of the movement as his strength allows; then the rest of the movement should be finished for him while he still tries.

(4) The patient should never be allowed to turn or twist his body in order to get the part to the desired position, since this will entail the use of muscles other than the ones it desired to strengthen.

If he is unable to do the movement correctly, the mother must guide the limb with her hands, being careful not to help unless it is necessary.

(5) The exercises must be done every day to obtain benefit--in the morning, before the muscles become tired, is the best time. Each exercise should be done about five to ten times, with a stop to rest whenever the movement is done less well than the time before. Fatigue should be strenously avoided, and it is to

be judged better by the relative success in the performance of consecutive movements than by the expressed feelings of the patient.

(6) As a general rule, it is better not to give as exercises the movements which the child can do pretty well, for fear of producing a deformity from the pull of the stronger muscles, but instead to have him try to do the movement which he finds difficult. For instance, if a parent says that the child can pull the leg up, but can't put it down, or can turn the foot out, but can't turn it in, that child should have exercises of pushing the leg down and of turning the foot in, the mother being careful not to allow him to do the stronger movements.[1]

If the patient is a child the schemes for exciting interest and concentrating the interest on the effort to be made have to be varied day by day, but there should not be any sacrifice of precission in the performance of the exercises. If the child is too young to make any intelligent effort at formal exercises, the ingenuity of the mother will usually discover a means of bringing the affected muscle into place if she is made to understand what is required.

Accuracy and precision are of the utmost importance in obtaining a proper result. Carelessly performed exercises are of little value.

[1] American Medical Association 1933 Practical Suggestions on Poliomyelitis

The first school for crippled children was opened in Boston in 1894, and was called the Industrial School for Crippled and Deformed Children. This school is still in operation and has kept up with the modern trends in schooling and treatment of crippled children. This school in Boston employs orthopedic surgeons and physical therapists to take care of the treatment part of the children's handicaps. The Spaulding School in Chicago, Illinois has a school similar to the Boston school. It has ten physiotherapists and it has a hydrotherapy tank, a gymnasium, a swimming pool, a large solarium for untra-violet ray treatments and two occupational therapy rooms. The Shrine Hospital and the Dornebecker Hospitals at Portland, Oregon carry out a regular physical therapy program for the crippled children of that state. There is also a Shrine Hospital in San Francisco, California that has the same treatment set-up. Many of the large cities have Jewish Community Centers which give treatment to Poliomyelitis victims. The Georgia Warm Springs Foundation carries on a very extensive program of the same kind, giving treatment in all of the stages of the disease.

Surgery is performed for Poliomyelitis patients for one of three reasons: (1) to correct deformities; (2) to secure stability of joints; and (3) to improve function. Operations to correct deformities are necessary chiefly for neglected cases. Hip and knee-flexion contractures, deformities of the ankle, and sconosis are some conditions which develop because of lack of rest and support. Their correction requires skillful surgery plaster, traction, special appliances, or a combination of these methods. Operations to secure stability of the joints usually are performed to enable the patient to discard apparatus. Tendon transplant operations are performed to improve function and to prevent deformity by equal-

izing the balance of muscle pull upon the joint. These operations usually are not performed before two years following the onset of the disease in order to give the affected muscle a chance to come back. The use of physio therapy often restores the muscle function so that it isn't necessary to resort to surgery.[1]

The main factor of Infantile paralysis is to discover the cause and prevention of this disease, but until this is done we must make useof all the physio therapy treatments that we have, in order to help the thousands of children who are crippled from this dreadful disease.

[1] Stevenson, Jessie L. Care of Poliomyelitis The MacMillan Co. New York 1940