

lymphangiectasis, if grouped with tumors—lymphangioma—must be clearly separated from the forms in which the essential process is the production of new lymph vessels. The cystic dilatations of lymph channels in the neck, that are virtual retention cysts resulting from maldevelopment in these channels, may form chains of sacs, large and small, lying along the internal jugular vein and other great vessels, and sometimes extending from the mediastinum to the cavity of the mouth. Their dissection is laborious.

Similar retention cysts or localized dilatations of the lymph vessels, and also described as lymphangioma, have been found in the mesentery. Weichselbaum has reported one under the name of chylangioma from its milky or chylous content. In an incarcerated omental hernia at the femoral opening von Hopfgarten found in the hernial sac a mass of tissue, 4.75 by 3.5 cm., in which there were numerous small subserous cysts, varying in size from a millet seed to a cherry.

His conclusion, after a careful microscopic examination, was that the cysts had their origin in lymph vessels that were dilated from obstruction. He points out the analogy between his case and the lymphangiomas which Wegner claims arise from granulation tissue by secondary changes—in other words, which take their origin from an inflammatory process.

That the lymph channels do proliferate in the ordinary processes incidental to healing seems evident from the descriptions of Talke, who in a recent article has described new lymph vessels in the scar tissue produced as a part of the adhesions about the ascending colon in a case of perityphlitis, and in analogous pleural lesions.

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LYMPHANGIOMA.—See *Angioma* and *Hygroma*.

LYMPHANGIOMA CIRCUMSCRIPTUM.—This is an affection characterized by the presence of small vesicles, often arranged in clusters, irregularly distributed, and deeply seated in the skin, and is of rare occurrence. The clusters may have a circular form, or they may be arranged in bands, which sometimes have the appearance of being seated over the course of nerve tracts, or of the large lymphatics. The affection has been found most frequently on the upper extremities, and especially in the scapular and axillary regions, and in a large portion of published cases it has appeared on the left side of the body.

These vesicles vary in size from a pin's head to a small pea, and the epidermis over them is often affected by a warty change, so that some of them may on first sight simulate warts, and occasionally there have been present long warty projections. An interesting feature is the presence usually of telangiectases, or large dilatations of the blood-vessels in the area occupied by the vesicles, as well as in the roof of the vesicles themselves. When the vesicles are ruptured they exude a clear, colorless fluid.

The affection is frequently accompanied by recurrent attacks of an inflammation of the affected area that resembles in type erysipelas, and it has sometimes been classed with the latter disease. These attacks are accompanied usually by some constitutional disturbance and considerable pain. In some instances they have preceded a fresh outbreak of vesicles, in others they have had no perceptible effect on the eruption. They differ from true erysipelas in not spreading to other parts of

the body, and have been compared by Besnier to the "erysipelas" that occurs in elephantiasis.

The affection is very slow in its course, appearing either at birth or in infancy or childhood, and often remaining stationary for many years. There is often an hypertrophy of the fibrous tissue in and about the affected area, so that a condition of elephantiasis may be produced. This is seen also in other varieties of lymph-

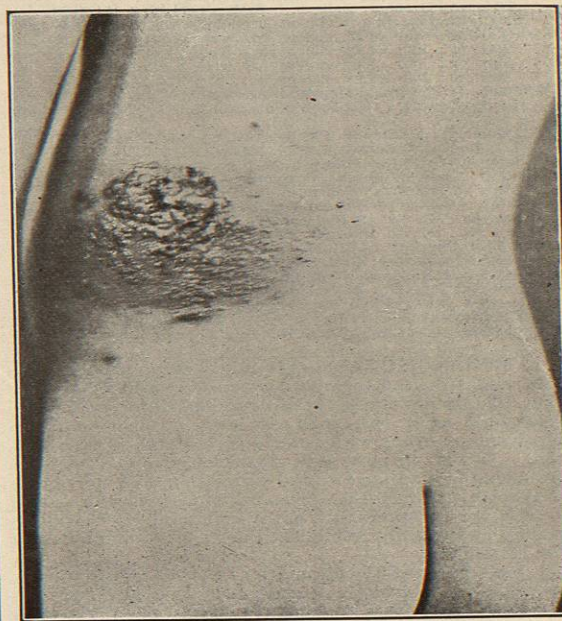


FIG. 3262.—Congenital Lymphangioma Circumscriptum. (Case of Dr. Isadore Dyer, of New Orleans, La.)

angioma. Thick, firmly adherent crusts are often produced by the bursting of the lesions, and, being deeply embedded, they may persist for a long period.

ETIOLOGY.—The disease usually begins in infancy or childhood, in one or two cases only in adult life. It is probable that it is always of congenital origin. Injury and irritation have been thought to affect the process, and in several instances excision has led only to an increase in the number of lesions.

ANATOMY.—The writer's examination of a lesion removed from the arm, which was not associated with any telangiectases, nor with fibrous or warty changes, showed numerous cysts in the upper part of the corium and approaching very near to the epidermis without implicating it. The cysts were filled with fibrin and a few leucocytes, and were often divided into subdivisions by septa formed of the unaltered corium. These cavities possessed an endothelial lining, and there could be no doubt that they represented newly formed or dilated lymph vessels or channels, as they communicated with the lymph channels below. There was a certain amount of leucocytic infiltration about the cysts. A few enlarged blood-vessels were seen.

The implication of the blood-vessels varies in different cases, and in different lesions in the same case. In some instances it has been found that the corium contains numerous dilated blood-vessels, together with the enlarged lymphatics, and that the telangiectases and vascular dots that have been referred to are caused by the presence of dilated capillary blood-vessels between the upper wall of the cysts and the epidermis.

DIAGNOSIS.—This may be made from the appearance

of the affection at birth or in early life, by the groups of thick-walled vesicles, often accompanied by telangiectasis and warty surface changes, by the discharge of lymph, when they are incised, and by the slow course. On superficial inspection the affection may resemble most a group of warts.

PROGNOSIS.—The lesions usually increase slowly until they have attained a certain degree of development, when they remain nearly stationary. In one recorded case there has been spontaneous involution. After operative interference, as in all forms of lymphangiomas, the lesions are very likely to reappear.

TREATMENT.—Excision and caustics have been tried, but recurrence after the operation is not uncommon. Electrolysis has been thought by some to offer the most hope of success, but in this case also recurrences have been recorded. Each vesicle is to be transfixed by a needle attached to the negative pole of a galvanic battery, eight or ten cells being employed. The poor results of treatment probably are due to the presence of deep-seated anastomoses.

John T. Bowen.

LYMPHANGIOSARCOMA. See *Sarcoma*.

LYMPHANGITIS.—All the tissue elements may be regarded as being bathed in lymph, which appears first in innumerable, minute, irregular gaps in the tissues, which gaps communicate in various ways with each other, and with minute lymphatic vessels, which latter, when traced onward from their beginnings, presently assume a structure comparable to that of narrow veins with very delicate walls and extremely numerous valves. These valves open away from the gaps of the tissues, as the valves of the veins open away from the capillaries. The lymphatic vessels emerging from the network of gaps unite to form somewhat larger ones, which pass either to a neighboring lymphatic gland or to join some larger lymphatic trunk. The lymphatics are arranged into a superficial and a deep set. The superficial lymphatics on the surface of the body are placed immediately beneath the integument, accompanying the superficial veins; they join the deep lymphatics in certain situations by perforating the deep fascia. The deep lymphatics, fewer in number and larger than the superficial, accompany the deep blood-vessels. Finally, the entire system ends in numerous vessels which open into two main trunks of very unequal importance—the thoracic duct and the right lymphatic duct. Lymphatics are found in nearly every texture and every organ of the body which contains blood-vessels. Interposed at numerous points in the course of the lymphatic vessels are the lymphatic nodes, which are small, solid, glandular bodies through which the lymphatic vessels pass. Lymph is the exudate of some of the liquid constituents of the blood as it circulates through the capillary blood-vessels into the tissue gaps or spaces, and carries nutriment to the tissues. It then receives from the tissues the products of their activity, and is collected from the lymph spaces into their lymph channels, whence it is carried to the lymph nodes, which act as filters for the lymph, besides adding to the lymph the lymphocytes, which act as scavengers (phagocytes) in the lymph and blood.

Reticular lymphangitis is applied to inflammation of circumscribed areas of lymphatic radicles, tubular lymphangitis to that of the larger continuous lymphatic trunks. Both forms often coexist. Either may be acute or chronic. Since we now know that all inflammation of lymph vessels is of microbic origin, we may drop the terms "idiopathic" and "traumatic" as being no longer descriptive. The lymphatics are so widely distributed that they must be severed or torn in every cut or bruise to a greater or less extent; but, as a rule, they collapse at once and give no trouble. From their open mouths, during the first hours following the receipt of a wound, comes much of the serous flow, to dispose of which drainage is necessary. This outward flow of the lymph, together with its coagulation and the collapse of the lymph vessels themselves, prevents the absorption into the or-

ganism, in most instances, of septic material. While lymphangitis is, generally speaking, the consequence of a wound, yet this is not an invariable rule, since infection has been known to penetrate through the unbroken skin of the hand, as seen in sepsis following immersion of the unwounded hands in the fluids of a cadaver at an autopsy, and also through mucous membranes in which there is no abrasion or scratch to be found, especially in the case of the throat, uterus, etc. The absorption of infective material is undoubtedly greatly facilitated by friction, pressure, the removal of the outer corneous layer, or the confining of a discharge under tension. Recent wounds are much more likely to be attacked than granulating ones, because granulations themselves, so long as they are uninjured, do not absorb, the current setting in the opposite direction toward the surface. Whatever the irritant may be, it probably does not cause inflammation of the wall of the vessel unless it is arrested; if this does not take place, it is hurried on to the neighboring lymphatic glands, and sets up inflammation there. Illustration of this is seen in cases in which surgeons have received the tiniest needle prick, so slight as to leave no mark, in which the first intimation of sepsis is found in inflamed lymph nodes in the neighborhood. The heat of the sun and the Roentgen rays produce an inflammation of the skin in which the lymphatics share to a certain extent. Lymphangitis is incidental to the course of specific diseases, such as scarlet fever, measles, diphtheria, tuberculosis, syphilis, and gonorrhœa; in these, however, the inflammation of the lymphatic nodes is the more prominent feature. A typical lymphangitis is seen in erysipelas (which see). It may also result from the bites of insects and venomous reptiles. It is a constant lesion in bubonic plague.

PATHOLOGY.—The changes are best seen in the larger trunks. Their endothelial cells swell, lose their distinctness of outline, and to a variable extent become detached. The walls of the lymph vessels and the delicate surrounding cellular tissue become more or less densely infiltrated with pus cells, fibrin, and serum. The lumen of the vessel, the interstices in its walls, and the cellular sheath are filled with a coagulating exudate. The stream of lymph through the vessel ceases because of the thrombus. The blood-vessels surrounding the inflamed area dilate, and the blood circulates more rapidly and in greater quantity. The future course, whether it is to be either resolution, organization, or suppuration, depends upon the cause. If the irritant be slight and transient, resolution may begin at once. The thrombus liquefies within the lumen, and the exudate within and without the walls is absorbed. The endothelium is regenerated and the circulation is re-established. Organization is likely to occur if the irritant action is chronic and persistent, as in syphilis. The lumen becomes occluded through transformation of the thrombus into connective tissue, and the coats of the vessels and the cellular tissues in which they lie become hard, dense, and sclerosed, likewise from organization of the exudate into connective tissue, and some degree of permanent thickening results in the tissues. Suppuration takes place when virulent micro-organisms are the exciting cause, producing coagulation-necrosis of the thrombus and exudate, and death of the vessel wall and surrounding tissues, resulting in cellulitis, or abscess, which may be circumscribed, or diffuse and spreading. The related neighboring lymph nodes are usually implicated also. The results of the extension of infection along the lymphatic channels are seen in some cases of suppurative appendicitis, where we may find inflamed mesenteric glands, isolated abscesses about the liver, empyema, etc.

SYMPTOMS.—In the reticular form the inflammation shows itself in red, tender, oedematous, swollen patches, which may succeed each other up the limb, one fading as a neighboring area blooms out. The inflammation extends from the periphery. Pain is always present and varies, like the other symptoms, with the severity and extent of the process; it is increased by movement, and is accompanied by a feeling of tension in the part. Ordinary erysipelas presents a typical form of reticular

lymphangitis in which the inflammation is produced by the invasion of the lymphatic channels by the streptococcus of erysipelas. If the inflammation is extensive there may be a considerable lymphatic edema and the circumference of a limb may be much increased. Some cellulitis accompanies all lymphangitis, and some lymphangitis, on the other hand, attends all cellulitis. Which element preponderates is very often a matter of uncertainty, but the question is not an important one, because both require the same treatment.

The tubular variety shows itself most plainly when the superficial vessels are involved. These latter appear in the skin as wavy red lines travelling toward the neighboring lymphatic glands. They are very tender to the touch, slightly raised from the surface, with a cord-like beaded feel, due to the infiltration and plastic thrombosis in and around them. Sometimes they are quite narrow; sometimes, when the poison is very active, an inch or more in breadth, from extension of the inflammation to the surrounding cellular tissues. At the same time the glands are swollen and tender, and, if the affection is extensive, the limb below may be oedematous. Here and there the red lines disappear, where the superficial lymphatics empty themselves into the deeper set, or swell out and become broader opposite plexuses and valves. In cases of virulent infection the inflammation may result in the formation of small abscesses at intervals along the course of the vessels before the glands are reached.

When the deeper vessels are affected, the diagnosis may not be easy if no superficial inflammation be present. Usually, however, faintly outlined patches of redness are visible here and there upon the skin, where the superficial plexuses communicate with the deep ones. In any case deep pressure along the course of the affected vessels is painful, but otherwise most of the usual signs are wanting. Diagnosis between it and ordinary cellulitis is difficult. In both varieties the glands are apt to be swollen and tender.

The constitutional symptoms will vary according to the extent of the local inflammation, the severity of the cause, and the general health and resisting power of the patient. Simple lymphangitis is accompanied by a varying degree of fever, with the usual results thereof—malaise, thirst, headache, anorexia, etc. When suppuration sets in, the general symptoms become much aggravated, pain is severe and prostration extreme, and high fever with possibly chills and sweating makes itself evident. In severe cases septicaemia may develop.

PROGNOSIS.—Simple lymphangitis is rarely serious and runs its course in from a few days to several weeks; the general health and robustness of the patient have a marked influence, recovery being slow in the subjects of alcoholism, chronic gout, diabetes, and renal disease, and in those debilitated by poor living and overwork. When suppuration supervenes (leading to a cellulitis) or when some virulent septic poison is the cause of the trouble, the illness may assume a grave character, viz., that of septicaemia. If the vessels which run in groups are extensively destroyed, a condition of solid oedema is likely to persist which may leave the limb more or less crippled.

DIAGNOSIS.—Phlebitis is closely related to lymphangitis in its symptoms, but a thrombosed vein forms a deeper-seated, coarser cord than does a similarly affected lymph vessel, the cutaneous redness is not so vivid, the pain is less acute, the general fever is not so intense, and the tendency to glandular involvement is much less. Inflammation of the deep lymphatics may at times be differentiated from ordinary cellulitis by an earlier involvement (in the case of the former of these two inflammations) of the neighboring lymphatic glands, by the presence of lymphatic oedema, and by the appearance of patches of superficial reticular lymphangitis at points of anastomosis with deeper trunks.

TREATMENT.—The first indication is to remove the cause, if that can be detected. All possible sources of infection should be sought for and appropriately treated. Pustules and abscesses should be opened and drained, unhealthy wounds are to be cleaned thoroughly and

opened further if drainage is not sufficiently free. These avenues of infection should be encased in compresses which are kept wet with some antiseptic solution. The part should be put at rest, and the limb elevated to diminish the amount of blood entering it, as well as to facilitate the return of the lymph. Tension within the area of lymphangitis, if very great, should be relieved by incision and drainage, without waiting for suppuration to take place. The whole affected area should be kept covered with compresses continually wet with some soothing, antiseptic solution, such as aluminum acetate, Thiersch's solution, creolin (one-half per cent.), bichloride (1 in 2,000), or a solution of lead and opium. These wet dressings should extend above and include the swollen lymphatic glands. Hot fomentations in some cases may be more grateful than the cooler solutions. As soon as pus forms or is suspected, the abscess should be freely incised, evacuated, and drained. In severe cases in which the process threatens to spread and is difficult to control, a very effectual means of combating this is found in the continuous immersion of the limb in an iced solution such as any one of those mentioned above.

Constitutional treatment consists in supporting and eliminating measures. The diet should be liberal and solid food should not be withheld unless a high degree of fever causes it to disagree. The bowels should be kept freely open. Quinine, and later iron in addition, are the most efficient medicines. Stimulants will be needed only in severe cases and should then be given in large doses (one to two ounces of whiskey every two hours). It seems remarkable (much discussion to the contrary notwithstanding) how favorably a free exhibition of alcohol in severe septic infections will affect the constitutional symptoms, as shown by a dry, brown tongue becoming cleaner and moister, by improvement in the appetite and in the cerebral symptoms, by strengthening and slowing of the heart, and by a diminution in the degree of the prostration. Persistent oedema and stiffness in muscles and tendons, after subsidence of the inflammation and healing of the wounds, are to be overcome by bandaging, hydrotherapy, electricity, and massage. It may be necessary to give analgesics and hypnotics, such as the bromides, codeine, and trional, during the acute stage. Opium should be used only as a last resort.

Chronic Lymphangitis.—This is seen in the course of certain diseases, such as elephantiasis (which see), bubonic plague, tuberculosis, syphilis, etc. Tuberculous lymphangitis occurs both in large and in small lymph vessels in whose walls miliary tubercles and diffuse tubercle tissue may grow, producing partial or complete obstruction. This may occur independently, but it is most frequently seen in connection with tuberculous inflammation of adjacent structures, particularly the lymph nodes. In the vicinity of tuberculous ulcers in the intestines, the subserous lymph vessels, which pass from the ulcers, are often distended with the products of tuberculous inflammation, which makes them look like dense white knobbed cords. Syphilitic inflammation of the lymph vessels not infrequently occurs in the vicinity of syphilitic ulcers in the primary stage. In later stages there may be thickening of the walls of the vessels and the development of gummy tumors in and about them.

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LYMPHATIC SYSTEM.—(Synonyms: Absorbent system; Latin, *Systema lymphaticum*; French, *Système lymphatique*; Italian, *Sistema linfatico*; German, *Lymphsystem oder Saugadersystem*.) The lymphatic or lymph vascular system consists of the vessels and spaces containing lymph or chyle (colorless or white blood), and of the lymphatic or conglobate glands situated in the course of the vessels, and through which the lymph must percolate in somewhat the same manner as water passes through a sponge. This system is an appendage of the blood-vascular system, its two terminal trunks, the thoracic duct and the right common lymphatic trunk, ending in the great veins at the base of the neck.

A tolerably correct pictorial idea of the entire vascular

system may be formed by considering the blood-vascular part as made up of a great tree, the heart forming a short trunk and the arteries, veins, and capillaries, the branches; but there is present the untree-like character of the direct union of the terminal twigs of the arteries and veins, that is, the venous and arterial capillaries are continuous. The lymphatic system may then be represented by two vines of unequal size, but which together follow all the blood-vessels to their ultimate ramifications, and in many places even send minute twigs beyond them. The analogy with a vine is further borne out by the lymphatic vessels, as they remain of a more uniform diameter than the blood-vessels; and, finally, the terminal twigs, like those of a real vine, end freely or blindly, often in slight expansions like leaves, thus forming a marked contrast with the terminal twigs of arteries and veins, which cannot be properly said to terminate at all. In a word, the blood-vascular system forms a complete circle or circuit in itself, while the lymph-vascular system joins the blood-vascular system at its central or trunk end, but ends blindly at the periphery.

HISTORICAL.—It is not to be wondered at that the lymphatic system should not have been discovered and investigated before the circulation of the blood and the general relations of the blood-vascular system had been investigated and understood; and yet, from the prominence of the lymphatic glands, they were seen by Hippocrates; but, having no notion of their true relations, he classed them with the other glandular structures of the body; so, too, there is strong reason for believing that the lacteals were seen in animals by the two famous Alexandrian physicians, Erasistratus and Herophilus; but their significance was not comprehended. About the middle of the sixteenth century (1564), Eustachius found the thoracic duct in the horse, and traced it, both to its beginning in the abdomen, where he became bewildered, and to its termination in the great veins in the neck. He did not profess to understand the significance of this vessel, but named it, from its color and position, *vena alba thoracis*.

It was not until 1622, when Asellius saw the lacteals in a dog, that the real significance of these vessels was appreciated. The whole scientific world was about this time aroused by the epoch-making discussions and discoveries of Harvey on the circulation of the blood, and everything like a vessel was scrutinized with inquiring eyes. The story of Asellius in connection with the discovery and comprehension of the significance of the lacteals will never lose its interest as long as the human mind is striving to comprehend the universe, either in its details or in the ensemble. Having opened the abdomen of a living dog, to show to some friends the arrangement of the nerves and the working of the diaphragm, Asellius saw in the mesentery some white cords in addition to the nerves and vessels with which he was familiar, and upon cutting one of them and seeing a white liquid exude, he immediately recognized that they were a new kind of vessel. Most fortunately for him and for science, the dog, killed on the following day to find out still more about these curious white veins, showed none of them. Fortunately, because it led Asellius to consider the conditions under which they appeared in the first dog, and wherein the conditions differed in the second. With the sure comprehension of a scientific mind, he saw that the only essential difference lay in the presence of partly digested food in the first case, and in the absence of food in the second. When this condition was realized in a third dog, the lacteal vessels reappeared, and the relation between the products of digestion and these vessels was fully established for the dog.

Not content with the experiments on the dog, Asellius examined many other animals, showing in every case that there was a constant relation between digestion and the presence of the white fluid in the lacteal vessels. Owing to the powerful influence of the prevailing opinion that all matter must first go to the liver to be assimilated, Asellius supposed that the newly found lacteals extended to the liver. It is difficult to comprehend how

a mere hypothesis could blind the eyes of so skilled an anatomist, but so it was, and the belief that the lacteals passed to the liver continued to prevail for nearly twenty-five years.

About 1650, the great facts concerning the lymphatic system, as they are understood at the present day, were discovered by four men in different quarters of Europe. In France, Pecquet showed that the *vena aquosa hepatis*, or lymphatic vessels connected with the liver, were not the continuation of the lacteals to the liver, but were vessels extending either to the lacteals, or with them into a common reservoir into which both opened, and that the reservoir was continued as a somewhat smaller vessel (the thoracic duct) through the thorax, to terminate in the great veins in the neck. The same facts were observed by Rudbeck, in Sweden, at about the same time, and completely overthrew the notion that all absorbed food must first pass to the liver for assimilation before entering the blood; for here was apparently the only path of the absorbed food, and it terminated directly in the great veins on their way to the heart.

At about this date, Bartholin in Denmark, Jolive in England, and Rudbeck in Sweden, discovered the general lymphatics of the body. They also showed that these lymphatics (*vasa lymphatica* of Bartholin, *vasa aquosa* of Rudbeck), or serous vessels, either united with the lacteals in the *chylocyst* or joined the thoracic duct, and consequently the lymph and chyle or lacteal fluid unite, and together flow into the great veins. In other words, they showed that the lacteals form only a special part of a great system distributed throughout the entire body. It may be said, in passing, that when the facts concerning these new vessels were presented to Harvey, he did not welcome the newly acquired knowledge. Doubtless the weight of years had quenched the enthusiasm of investigation, and he may have been troubled lest these newly discovered vessels might in some way prove a stumbling-block to his simple and easily comprehended explanation of the blood-vascular system.

Not much was added to the knowledge of the lymphatic system for nearly one hundred years after the main facts were established, and naturally, in those early times, with both undeveloped methods and superstition as impediments, knowledge was only general and obtained principally by investigating the lower animals. And yet, in 1628, a criminal was properly fed before execution, and the lacteals demonstrated in the mesentery after death, thus showing conclusively that the absorbed food in man takes the same course as in animals.

Between 1760 and 1787 there was a renewed activity in investigating the lymphatic system. In England the Hunters, Hewson, and Cruikshank, not only investigated the human lymphatics, but pushed their investigations to all forms of vertebrates, and they were found abundantly in all forms. The Munros, in Scotland, were also very active. In Italy the great anatomist, Mascagni, was preparing his magnificent work on the human lymphatics, a work which remains a standard to the present day; and reduced copies of his splendid folio plates are still to be found in every extensive account of this system.

As in all departments of human activity, the crowning discoveries in the lymphatic system are due to the work of an almost untold number of men; and yet a few present the principal and salient features so unnumbered with useless, distracting, or foreign details that they are, for the majority of minds, the true discoverers. They make the special knowledge a part of the knowledge of the race. So in the above historical sketch many names have been omitted, and undue prominence may have been given to others; barring these defects, it is hoped that it represents fairly well the progress from vague and uncertain to certain knowledge of this system.

Since the work named above, something noteworthy has appeared almost every decade, but it has been usually toward the elucidation of special details of function, origin, distribution, or structure, rather than an investigation of the whole field. The work of Sappey¹ forms an