INTRODUCTION

It is the purpose of this paper to discuss the clinical and pathological facts which have accumulated about the specific peripheral nerve sheath tumors. It has seemed worth while to do this because, although a great deal is known about this specific tumor type when it is found attached to the spinal nerve roots and to the intracranial portions of the cranial nerves, its appearance elsewhere in the body has not been studied in a comprehensive fashion. A great many articles have been written about individual tumors or small groups of them, but this information has not been synthesized. The impression exists that they are rare, but it seems as if this must be simply because they frequently go unrecognized. When it is realized that 52 tumors in 50 new cases are being reported in this paper, and that only 194 adequately described additional cases could be collected from the literature of the past hundred years, the cogency of this statement will be appreciated.

It is proposed to omit all of the other tumor types found associated with the peripheral nerves and their sheaths, such as the pure fibroma, the neurofibroma of von Recklinghausen’s disease, and the various malignant tumors, and to limit the discussion to that specific encapsulated tumor composed of highly differentiated tissues which is so characteristic of the nerve sheath within which it develops. This type was first adequately described histologically by Verocay in 1908, and christened by him “neurinoma” in 1910. Since then it has received several other names, the most important of which are “perineurial fibroblastoma,” “schwannoma,” and “peripheral glioma.” Unfortunately, reasonable objections can be raised against all of these terms. The
last three were designed to indicate the cellular origin of the tumor. However, there is no general agreement on this point, and therefore none of these terms is universally acceptable. Neurinoma is the term most widely used, especially in Europe, but there is the insuperable objection to it that it means "nerve fiber tumor." Whatever else they may believe, all authorities are convinced that this is not a nerve fiber tumor but a nerve sheath tumor. Therefore it seemed advisable to take this phrase "nerve sheath tumor," which is properly descriptive and at the same time not controversial so far as cellular origin from fibroblast or Schwann cell is concerned, and to construct from it a new name for the neoplasm. After consultation with Dr. G. F. Laidlaw and Dr. F. H. Vizetelly, editor of the *New Standard Dictionary*, the word "neurilemoma" has been constructed and it is proposed to use this term for the tumor under discussion.

The questions as to the cellular origin of these tumors and their exact relationship with the development of malignant sarcomas will not be dealt with in the present paper. They are subjects of great interest and importance, and it is proposed to discuss both of them in separate communications at a later time. In regard to the sarcoma question, this paper will bring out the fact that in only one of the 41 new cases reported was there a sarcoma (Case XL), but whether or not it developed from a neurilemoma is unknown.

An historical review will also be omitted. Such an essay is always fascinating, and in this case would carry us back into the 18th century and probably earlier, but it would be far too lengthy and complex a task to be developed here. It should properly be undertaken by the individual who will write the modern monograph covering the entire subject of tumors of the peripheral nervous system. Such a work is much
needed, for our knowledge has greatly expanded since the publication of the works of Wood, Smith, Thomson, and Lewis and Hart.

**Etiological Factors**

Erb (1923) analysed 42 published cases, finding 24 males and 18 females, of ages varying from six months to seventy-five years. Of our group of patients, 22 were males and 28 females. The age at which the tumor was first noticed varied from less than a year to sixty-five years, and the ages at the time of diagnosis ranged from thirteen to sixty-eight years. There was no preponderance of cases in any particular age group. The average interval between the appearance of the tumor and its removal was 7.8 years, ranging from a few weeks to sixty years.

![Diagram II. Distribution of 246 Peripheral Neurilemomas Including Personal and Reported Cases](image-url)

Reported cases have a comparable range. In only 5 of our 41 cases was trauma recorded in the history. This was insignificant in 2 (Cases V and XIV) and more severe in 3 (Cases XII, XVI, and XXII). There is no reason to suppose that the trauma played an etiological rôle in these cases.

It is well known since the days of Verocay that neurilemomas can be found sometimes in cases of von Recklinghausen’s disease (multiple neurofibromatosis). Of our group, Cases XVII, XXXIX, and XL showed definite evidence, and Cases V, XVIII, XXVII, XXXI, XXXII, and XXXVI presumptive evidence of the presence of the systemic disease in an inconspicuous or abortive form. The majority of house officers and surgeons do not look for the stigmata of von Recklinghausen’s disease, or if they do notice them fail to include them in the record unless they are of the extreme and deforming types. Therefore, there is no possibility of knowing in how many of our other cases they may have been present or absent. Does the presence of one neurilemoma signify the existence of the systemic disease? Erb (1923), Guleke (1926), Derman and Borchardt believe that it does. Penfield
(1932) is non-committal and rightly so, for we cannot be certain without more definite evidence. However, the presence of stigmata in 18 per cent of 50 cases is a sufficiently large proportion to make a denial of the relationship impossible.

**Distribution of Tumors**

Although the statement has been made more than once that these tumors may be found attached to nerves in any part of the body, there do not exist reports in the literature to support this statement. Diagram I shows the distribution of the 52 tumors reported in the present paper and Diagram II the distribution of all reported peripheral nerve cases including the ones in this paper, a total of 246. These charts

![Image of tumor in the forearm](image)

**Fig. 1. Case XII: Tumor of the Median Nerve in the Forearm Before and After Removal**

indicate that the tumors are found usually in certain definite parts of the body, rarely in certain other parts, and have never been reported from a number of regions. The features which characterize the appearance of the tumors in their various locations seem of sufficient importance to warrant separate discussion.

**The Extremities:** It will be seen at once that almost all of the tumors appear on the anterior aspects of the upper extremities and the posterior aspects of the lower extremities. This is because the larger nerve trunks are found on these flexor aspects, and the majority of tumors reported have been attached to the larger nerve trunks. It will also be noted that the greater number are congregated near the principal flexion creases—the elbow, wrist, and knee. There are very few, however, near the ankle and none in the foot. The hand must be involved much more frequently than is indicated by the chart, for 9 of
the 16 cases occurred in our own series, which is manifestly an absurdly high proportion. The clinical diagnosis was made correctly in only one of these 9 cases; the others were called ganglion, lipoma, fibroma, neurofibroma, myxoma, giant-cell tumor or cyst. No doubt a great many supposed simple fibromas and ganglia are in reality nerve sheath tumors which go unrecognized. It is a remarkable fact that 11 out of 15 cases in our series involved the right hand and wrist. It is a temptation to suppose that this has some significance until one refers to Diagram II, showing all reported cases, with the distribution more evenly divided between the two sides.

The Neck: The tumors appear in the various parts of the neck depending upon the nerves from which they arise. They have been found attached to the cervical sympathetic (Amano, Figi, Freifeld, and Lebert); to the spinal accessory nerve (Cohn); to the vagus (Sekiguchi and Oije, and Serafini); to spinal nerve roots, extending as hour-glass tumors into the neck (Bing and Bircher, Boerner, Dowse, Elsberg, Flatau and Sawicki, Guleke (1926), Heurtaux, Jura); to trunks of the cervical plexus (our Cases XVIII and XXVII) and brachial plexus (Sommer); to subcutaneous nerves (our Case XXXII) and to nerves deep to the submaxillary salivary gland (our Cases XI and XXXVII).

The Face and Scalp: The scalp cases have all been subcutaneous and were generally diagnosed clinically as cysts or fibromas. The majority of the facial tumors were also subcutaneous. One tumor was in the parotid gland (Larghero Ibarz), one in the facial nerve with destruction from suppuration of the middle ear and mastoid (Schröder 1931), and there was a tumor of the four posterior cerebral nerves with extension into the retroparotid space (Schröder 1929).
Trunk: There have been remarkably few tumors on the trunk, which is an interesting observation when one remembers that the trunk is a common site for the skin nodules of multiple neurofibromatosis. The tumors described were either subcutaneous (Bogetti, Derman, Di Natale, Erb (1923), Hille, our Case XIX), intramuscular or deep to the muscles (Erb (1924), our Cases VIII and XVII), attached to branches of the brachial plexus in the axilla (Freifeld, Gatch and Ritchey, Klose and Schneider, Ott, Schmidt and Delbanco), hour-glass tumors from dorsal spinal nerve roots projecting into the muscles of the back (Coenen, Naegeli, Guleke 1916), or attached to the round ligament in the inguinal region (Blondin).

Eye and Orbit: The 9 reported cases involving the eye and orbit are: retina (Elschnig); limbus of the cornea (Kyrieleis); upper orbit (Landolt, Leroux and Mawas; Rodriguez Villegas and Damel); lower orbit (Cornil and Jeandelise; Pescatori; Seghieri); posterior orbit (Cohen; Focosi; Reverdin and Grumbach). The symptoms were those characterizing slowly growing encapsulated masses in the region indicated.

Upper Respiratory and Alimentary Tracts: The tumors in these regions are scattered and relatively uncommon except in the tongue and sublingual tissues, where 10 have been found. They have appeared in all parts of the tongue from the tip to the base (Bonnet-Roy, Borchardt (1927), Caponetto, Ciantini, Froboese, Guillot and Moulguet, Kaiserling, Krumbein (Tempel), Malan, our Case VII). Each of the three laryngeal cases was in the aryepiglottic fold (Holmgren and Bergstrand, Souchanek, Vail). The palate cases were all in the hard palate (Masson (Pannetont), Bonnet-Roy, our Case XLII); the tumor varied from 2 to 4 cm. in diameter. A retropharyngeal case has be
described by Askanazy and a retrotonsillar case by Figi; our Case XXIII was nasopharyngeal. Crucichier reported a probable case in which the tumor sprang from the second branch of the trigeminus, passed through the sphenopalatine foramen, and projected into the nasal cavity, where it was mistaken for a polyp. Weinhold described a probable case in which the tumor was found in the maxillary sinus and sprang from a nerve in its wall. Our Case XL, with a malignant sarcoma of the nasal cavity and antrum, also had microscopic tumors in a nerve found among the tissues removed from the antrum (Fig. 9). Finally Askanazy found a typical tumor of the bronchus in a case with multiple neurofibromatosis.

Gastro-intestinal Tract: The great majority of the tumors reported have involved the stomach. It is extremely difficult to determine just how many of these are truly nerve sheath tumors. We have accepted 35 cases (Abadie and Argand; Cabot case 18283; Carnot's case 2; Denecke; Djørup and Okkels; Gosset, Bertrand and Charrier; Goyena, Bianchi and Caeiro; Harild; Iceton, Poate and Tebbutt; Jeanneney; König; Lardennois; Leriche (1929); Leroux and Guérin; Lhermitte and Leroux (3 cases); de Massary and Walsers; Nordlander (2 cases); Oettinger, Duval, and Moutier; Patel; Pauchet, Mornard and Hirschberg; Picard; Picquet; Princeceau and Chavannez; Rastouil; Ritter: Ronzini; Santy; Shouldice; Tixier; our own Cases IV, XVII and XXX). There are 7 more cases reported which seemed so doubtful for one reason or another that there are not included (Bécart and Gaehlinger; Bonorino Udaondo and Brachetto-Brian; Brodin, Lardennois and Tédesco; Carnot's cases 1 and 3; Goyena and Bianchi; Lockwood). These stomach tumors were usually on the anterior surface, distributed

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**Fig. 4.** Case XXVIII: Encapsulated Tumor Bisected to Show the Soft Tissue Composing It, Mottled with Hemorrhage and Areas of Degeneration
as shown in the chart. They were either submucous, projecting into the stomach, subserous and pedunculated if they grew to a large size, or intramural. Sometimes they formed hour-glass tumors having both intragastric and extragastric projections (our Case XXX). In the intestine the reported cases are very few. Delagénière, and Lemonnier, and Peycelon, described tumors in the first part of the duodenum (the cases of Denecke and of Picard were too doubtful to be accepted). In addition there have been 3 cases in the rest of the small intestine (König.

Leriche (1911), Nordlander), one in the cecum (Lhermitte and Lerouj) and one in the appendix (Peritz). There have been no authentic cases in the rest of the colon or in the rectum.

Intrathoracic and Retroperitoneal Regions: Within the thorax most of the tumors have been found in the posterior mediastinum. A majority of these have been extradural hour-glass tumors coming from within the spinal canal (Berblinge; Borchardt (1926) 2 cases; Dandy 4 cases; Guleke (1924, 1926); Harrington; Heuer's case 14; Knutsson's case 2; Mager). There are also tumors which arise from the sympathetic or intercostal nerves and develop inside the thorax (Harrington: Hustin, Coquelet and Renders; Knutsson; Laube; Lecène; Rouffart-Marin and Rouffart-Thiriar). In the same fashion there occur extradural hour-glass tumors from within the spinal canal which develop in the retroperitoneum (Virchow) and other tumors which develop in the sheaths of retroperitoneal (Eichhoff (Korbsch); Pescatori) and pelvic nerves. The latter may appear in strange places. The tumor
in Erb's case, attached to the obturator nerve, projected into the obturator canal and also beneath Poupart's ligament; Frank's case, in which the tumor was attached to branches of the sacral plexus, was mistaken clinically for ectopic gestation; in Krekel's case (also described by Krumbein) the tumor lay behind the rectum pressing against it; that in Moreau and Van Bogaert's case was attached to the crural nerve in the pelvis, and that described by Panè lay behind the bladder and prostate.

**Pathology**

These tumors develop in the epineurium or the perineurium, and their subsequent position in respect to the nerve depends very largely upon the size and complexity of the nerve involved. If it is a small nerve the tumor usually expands the perineurium, which thus forms its capsule. The undamaged nerve is left as an inconspicuous thread which is generally missed by the surgeon unless he makes a particular search for it and is found only if it happens to pass through the part chosen for the microscopic preparation. If a larger nerve trunk is involved, compounded of several smaller elements, the tumor may be found as an excrescence from the side, leaving the nerve elements practically undisturbed, or it may be found inside of the main trunk with several or all of the branches spread out over its surface and in considerable disarray. Whereas the first type tends to be rounded unless its shape is altered by surrounding structures, the second type is more apt to be fusiform. The nerve bundles, as such, are never found inside of the tumor capsule, but irregular slender tanged neurites usually pass into the superficial part of the tumor lying immediately beneath the capsule (Fig. 15). Apparently they do not penetrate deeply and are
never found all through the growth. The capsule is often well supplied with blood vessels which, however, do not usually penetrate into the growth in many areas, so that if the capsule is split and the tumor shelled out of it there may be but few vessels to ligate. There is no rule about this, however, for some operations have been almost bloodless and others have required the ligature of many vessels. In our experience the tumors have varied from microscopic dimensions to a maximum diameter of 6 cm. In the literature there are reports of some tumors much larger than this, most of which have developed in

situations where expansion has been relatively easy, such as the mediastinum (Lecène), the retroperitoneal and pelvic tissues (Frank, Paso), or the stomach (Picquet). The great majority of these growths, however, remain relatively small over long periods of years.

The tumors are always encapsulated except in the case of some of the visceral lesions which seem to have limited powers of infiltrative growth. They are usually rather soft and fluctuant, which no doubt accounts for the frequency with which they are called lipomas and cysts. When seen fresh at the time of removal, with the capsule intact, the

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**Fig. 7. Case XI: Showing Two Tumors in the Right Forearm, One in the Palm of the Hand, and One in the Leg**

The third forearm tumor had been previously excised. The patient had also several microscopic tumors in the antral region (Fig. 9) and a fibrosarcoma of the nasal cavity and max
have a pink, yellow, or pearl gray aspect. The cut surface bulges sometimes but not very frequently. Its consistency is generally soft, and it may be tinged a salmon pink or vary through paler shades to pearl gray. It is sometimes flecked with yellow. Frequently tiny or larger degeneration cysts are seen filled with fluid of various shades of color from straw to red and brown. Often there are tiny but visible blood vessels dotting the surface, and hemorrhages are also frequent. Areas in the same tumor tissue have been described as translucent and as opaque. Rarely the growth is pallid, firm, and fibrous.

From the gross aspect one would expect considerable variation in the microscopic appearance of the intracapsular tissues, and this is indeed the case, but essentially we may agree with Antoni that there are two main types, which he has called types A and B.

*Type A tissue* has a relatively orderly arrangement. It is composed of long fibers which are slender and blackened by any of the silver methods for staining connective tissue. They may be either straight or serpentine, and both forms may have branches at the ends, but the important feature is that they are not wrapped about every cell, as is the case with the ordinary fibroblastic tumor, but pass between the cells without deviation (Fig. 13). The cells have elongated nuclei with somewhat blunted ends and elongated, branched, and anastomosing cell bodies, thus tending to form a syncytium. One of the most charac-
Characteristic features of the Type A tissue is a tendency for the wire-like reticulin fibers to be massed in certain places in close parallel array in such a fashion that the cell nuclei come to lie in orderly alignment at the opposite extremities of the group of fibers (Fig. 14). In ordinary stains this produces the effect of a band devoid of cells, at either end of which is a row of nuclei (Fig. 12). This is the so-called palisading of nuclei. This arrangement is an attempt at orientation which one never finds in ordinary fibrous growths, although it is sometimes simulated by smooth muscle fibers and nuclei. Masson has pointed out that this differentiation of tissues sometimes proceeds further to the reproduction of structures which resemble the framework of the Wagner Meissner tactile corpuscle without its axis cylinders. These structures are isolated cylinders curved and bent so as to have a tortuous course, with the fibers passing at right angles across the cylinder and the nuclei aligned along the margins with their long axes at right angles to it (Fig. 17). Another but much rarer form of differentiation is the whorl of cells and fibers similar to that seen in the meningioma (Fig. 17). In some tumors there is no cylinder formation and only a suggestion of palisading. Rarely there may be no palisading at all. Another uncommon change which sometimes occurs is the presence of broader collagen bands among the fine wire fibers—a sort of fibrosis of the tissue. Possibly this is a sign of aging. The Type A tissue sometimes becomes completely necrotic, maintaining its fibrillar architecture but with complete disappearance of cells. A commoner change is the reduction in number of the reticulin fibers so that some areas may lack these entirely.
The Type B tissue has a quite different appearance. In it there is no orientation of fibers or cells or any attempt at differentiation of tissue. Instead, the cells and fibers run every which way, completely at haphazard. Moreover, it is very loose-textured due in part to intercellular fluid which separates cells and fibers, and often to the collection of fluid degeneration products into microscopic rounded cystic spaces—the so-called microcystic degeneration (Figs. 12 and 16). Microcystic degeneration may affect Type A tissue also, but it does not do so regularly. The fibers are commonly reticulin wire fibers of the type found in Type A tissue. Collagen bands are rarely found. It is the absence of collagen bands and of axis cylinders and the presence of microcystic degeneration which cause this Type B tissue to differ from the tissue composing the usual neurofibroma of von Recklinghausen (Fig. 11). The cells are widely separated and tend to form a reticulum due to the anastomosis of their protoplasmic processes. This feature, however, is not everywhere apparent. The fluid in the tissue spaces is not mucin, for in only one of all the tumors examined was it tinted by Mayer’s mucicarmine. Masson follows Antoni in believing that the type B tissue is a degenerative phenomenon and represents a jellification of the Type A tissue.

The tumors are made up of Type A and Type B tissues in varying amounts. There may be large masses of A tissue separated by insignificant layers of B tissue, or the A tissue may be found only as rare islands in the loose-textured B tissue—all different combinations are found. Although there is no separation between the two tissues and
they are continuous at their junction, the transition from one type to the other is so abrupt that it is arresting and apparent at first glance. Only very rarely is a tumor found in which both types of tissue are not present in some degree.

The vascularization of the tumors is of some interest. The vessels are usually quite numerous but tend to be very unequally distributed, so that one area may have many and another none at all. The vessels are capillaries and not infrequently they are widely dilated and sometimes thrombosed. Hemorrhages are of frequent occurrence and one often finds old phagocytosed blood pigment. The most striking change, however, is the formation of dense collagen sheaths about the vessels, which must convert them into rigid and probably impervious tubes (Fig. 16). Thus, although there are many capillaries in which blood circulates, they are probably useless for nutrition, and this may account in part for the common degenerative changes.

Contrary to the experience with the spinal nerve root tumors, lipoid is not often found in phagocytic cells. In only one of our cases and in the cases of Guérin and Boutron, and Lihermitte and Leroux (1920) was there an appreciable amount found in foam cells. All the rest of our cases showed no foam cells and in those stained with Scharlach R there was either no lipoid or only a microscopic amount.

**Symptomatology**

The symptoms are usually not striking aside from the presence of the mass. In our 50 cases pain was a complaint in only 13, and in 19 the mass was tender. When an important nerve trunk is involved there may be sensory disturbances, especially pain and paresthesia corresponding with the distribution of the affected fibers, but this does not always occur. Motor disturbances are rare and do not amount to more than a complaint of weakness in the affected part (Gouverneur and Leblanc, our Case III). The mass is usually discrete, soft and movable, but with limitations. If the nerve is small, the lump will seem freely movable except for a point of deep attachment. If it lies within a nerve trunk, it will be movable from side to side but not in the direction of the long axis of the nerve. Not infrequently it gives a sense of vague or definite fluctuation. In three cases the tumor was transilluminated and transmitted the light in each case. This was due no doubt to the extensive degenerative changes, with microscopic and gross cyst formation. This sign may be of use in the differential diagnosis, in excluding the commoner solid tumors.

In many situations, particularly the ones that are less accessible, there are few symptoms other than those due to the presence of a smooth, soft, rounded or nodular mass averaging 2 to 4 cm. in diameter. In the orbit the globe is displaced; in the nasopharynx and aryepiglottic folds cough and interference with respiration or phonation are the usual

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1 Lihermitte and Leroux (1920) and Borchardt (1926) describe this as hyalinated thickening.
symptoms; while in the tongue, palate, and pharynx there are no symptoms except those of the mass. The stomach cases do not have specific symptoms which would enable one to distinguish this tumor from other benign growths. The small ones cause no symptoms. The larger ones may interfere with the functioning of the pylorus; those projecting into the lumen not infrequently ulcerate so that very severe hemorrhages may be frequent and by x-ray there may be seen a smooth, rounded filling defect with a punched out crater at its summit. In the stomach these tumors may reach a very large size so as to be easily palpable through the abdominal wall. The intestinal cases have either bled and so called attention to themselves or else have been found by chance.

**Fig. 11. Characteristic Appearance of the Tissue Composing a Neurofibromatous Nodule**

Rods of dense broad collagen fibers run in various directions set in a looser textured matrix. There is no microcystic degeneration. Hematoxylin-cosin stain.

The hour-glass tumors starting inside of the bony spinal canal and projecting through its interstices to appear in the neck, the muscles of the back, the mediastinum, and retroperitoneal region, may cause symptoms of pressure on the cord, as may the tumors which start in the posterior mediastinum and project into the bony canal. The tumors in the neck and back eventually become palpable, but those in the posterior mediastinum can be visualized by x-ray only if they attain a sufficient size. In the pelvis the tumors have formed masses which simulated ectopic gestation or tumor of the rectum, or which disturbed the function of the bladder. When the vagus or sympathetic nerves of the neck and mediastinum have been involved, the symptoms have sometimes but not always been suggestive of irritation of those nerves.
Diagnosis

In only 11 of our 50 cases was a clinical diagnosis of tumor attached to a nerve made. The diagnoses suggested in the other cases covered a wide range, including fibroma, lipoma, papilloma, myxoma, sebaceous cyst, dermoid cyst, mucous cyst, ganglion, cervical rib, submaxillary sialadenitis and submaxillary tumor, metastatic nodule, giant-cell tumor, fibrosarcoma, myosarcoma, lymphosarcoma, polyp, tuberculous lymph node, and organized hematomata. In the literature still other diagnoses may be found. As a matter of fact, the diagnosis will not often be made if there are no disturbances of nerve function. It may be suspected if there are present evidences of von Recklinghausen's disease,

![Figure 12: Case XX: A Tongue of Type A Tissue, with a Band of Fibers Incompletely Separating Two Rows of Palisaded Nuclei, Separates Masses of Type B Tissue (Hematoxylin-Eosin Stain)](image)

if the tumor lies beneath the skin or mucous membrane and is movable except for one point of deep attachment, or movable from side to side but not in the long axis of the course taken by nerves in the part involved, and if it is vaguely cystic and transilluminates. In its deeper manifestations it cannot be differentiated from other benign tumors and cysts which may be found in the part involved. If it is inaccessible to palpation and there are no nervous manifestations, it is impossible to differentiate it from other benign tumors.

There are very few solitary tumors of nerve sheaths other than the neurilemoma. We have encountered one pure solitary encapsulated neurofibroma which could not have been differentiated grossly before removal. There has been reported also by Gavioli a tumor which was apparently a pure fibroma. Although lipomas occur in von Recklinghausen's disease in the skin, they do not seem to grow in the sheaths of nerves. Therefore, if one encounters an encapsulated soft tumor at-
tached to or incorporated within the course of a nerve, it is relatively safe to assume that it is a neurilemoma.

**TREATMENT**

In our cases the tumor was excised, with the inner layers or all of its capsule and, in specific instances, with some additional surrounding tissue. The latter cases included the gastric, intra-oral and submaxillary tumors. In many of the cases in which no nerve was seen at operation and its presence was unsuspected, the nerve was removed with the capsule and was seen in the microscopic preparations. This never had any untoward results, as the nerves were small and unim-

![Image](image-url)

**Fig. 13. Case XX: Long Straight Wire-like Reticulin Fibers Passing between the Cells Without Being Wrapped about Them (Laidlaw's Silver Reticulin Stain)**

portant. When the tumor lies within an important nerve trunk whose fibers are spread out in the tumor's capsule, it has sometimes been difficult to separate the capsule without injuring some of the nerve fibers, and in these cases there has been temporary impairment of function or sensory disturbances (Cases III, V, VI, XI, XVIII, XXVII, XXIX, XXXIV). Usually this disappears after a period of months or years, and any permanent damage is rare if the continuity of the whole nerve is preserved. Among the reported cases there have been several in which the whole nerve has been sacrificed, but in our opinion this is unnecessary. In several of our cases it seemed very probable that some of the tumor and its capsule had been left behind, but in no instance has there been any evidence of a local reappearance of the growth. There have been some reports of reappearances of neurilemomas after excision. Only one of these, reported in two papers by Lhermitte and Leroux (1920), and Desmarests, Lhermitte and Leroux
(1921), seems to be authentic. An ulnar nerve tumor, which was a neurilemoma with some atypical cells, reappeared in the nerve at the site of excision fifteen years and four months, respectively, after two excisions, and at the third operation there was reported some invasion of the adherent muscle. Reappearing cases are also reported by Albot and Jehiel in the ulnar, Buford and Davis in the sciatic, and Fleming and Marvin in the sciatic. In none of these, however, is the evidence convincing that the original tumor was a neurilemoma. Supposed malignant changes in neurilemomas are reported by Bertrand and Brandes, Denecke, Fittipaldi, Hume, and Guleke (1916). Again we must reject all of these cases, except possibly that of Guleke, because, although most of them are tumors of nerves, the report does not make it clear that they are neurilemomas and not neurofibromas, which are well-known to suffer malignant change with alarming frequency.

From this evidence it seems safe to advise that every effort be made to avoid unnecessary injury to important nerve trunks, even at the risk of failing to remove all of the tumor.

**Case Reports**

**Case I:** Male, twenty-eight. Duration five years. The tumor was situated on the outer side of the right index finger over the proximal phalanx, was apparently encapsulated and fluctuant. There was no pain but some tenderness. *Clinical diagnosis:* Fibroma. *Excision,* Feb. 26, 1914. The tumor was encapsulated, measured 2.5 × 1.5 cm., had a yellowish tinge, was soft but not cystic. No nerves were seen. Result: Wound healed. Patient not followed. *Microscopic:* Tissue chiefly Type A, with marked palisading and wire fibers. Some necrosis of Type A tissue. Very little Type B with microcystic degeneration. Large vascular spaces; some vessels with collagen sheaths. No nerves seen in capsule. No mucin. Lipoids not determined.

**Case II:** Female, thirty-eight. Duration one year. A soft painless swelling was found on the dorsum of the right hand, which had gradually increased in size. It was deeply attached and x-ray showed two old fractures of the right ring finger metacarpal. There were no tumors elsewhere on the body. *Clinical diagnosis:* Fibrolipoma. *Excision,* July 15, 1918. The tumor was encapsulated and was deeply attached to the third and fourth metacarpal bones, extending between them to the palm. It measured 4 × 3 × 1.5 cm. It was soft but not cystic and there were gritty points on the cut surface. Result: Wound healed. Patient not followed. *Microscopic:* Tissue chiefly Type A with marked palisading. Very little Type B, with moderate microcystic degeneration. Many large vascular spaces. Wire fibers, mucin and lipoids not determined. No nerves seen in capsule.

**Case III:** Female, forty-two. Duration eighteen months. The patient first noticed that the left leg began to tire easily and feel weak. A small mass was observed in the popliteal space shortly afterward. This did not increase in size but was always tender.

Since completing this paper there has been found in the hospital records a genuine example of the persistence of a neurilemoma following excision. The patient was a male twenty-six years old when his symptoms first began. One year later an encapsulated tumor was removed from within the ulnar nerve in another city; twenty-eight months later the tumor had reappeared in the nerve and was again dissected out, sparing the nerve. This attempt also failed to cure him and eight months later the tumor and a portion of the nerve were resected and the nerve was rejoined in front of the elbow. Ten years have elapsed since that operation; function is restored and there has been no further trouble. The tissue from the first operation was not available, but the tissue removed at the second and third operations showed a characteristic neurilemoma composed chiefly of Type A tissue with wire fibers and rare palisading and small scattered areas of Type B tissue.
and when pressed it caused numbness and burning sensations to shoot up and down the leg. For five months there had been pains in the hip and ankle, coming in attacks with free intervals. There was no history of injury. At examination a mass 2 × 1 cm. was felt in the external part of the left popliteal space. It could be moved only from side to side; when it was pressed, a sharp pain and tingling sensation radiated down the inner side of the foot to the great toe. The left foot felt colder to the patient, but actually there was no difference in temperature. There was diminished tactile and pain sense on the inner aspect of the left foot and toe. Diagnosis: Fibroma of internal popliteal nerve. Excision, Oct. 30, 1919. The tumor was attached to a nerve which the operator thought was the external popliteal, but which was almost certainly the internal popliteal. It was enucleated and was dissected out of the sheath. Some of the nerve fibers entering its poles were cut. Result: Some anesthesia persisting on the inner side of the left great toe for a year. Patient alive fourteen years after operation. Microscopic: Somewhat more Type B tissue with marked microcystic degeneration than Type A. Very little palisading, and wire fibers inconspicuous. No large vessels, no hemosiderin, and no mucin. Lipoid not determined. Many nerve bundles in capsule. Many collections of lymphocytes.

CASE IV: Male, forty-two, with a hypernephroid tumor of the left kidney. At exploration there was found on the anterior wall of the midportion of the stomach a pedunculated mass 1.5 cm. in diameter, with a 5 mm. pedicle. Excision, April 26, 1921, as a possible metastasis from the kidney tumor. Death eighteen months later. Microscopic: Tumor almost altogether made up of Antoni Type A tissue with only suggestions of palisading and wire fibers. No mucin, blood pigment or nerve trunks. Many vessels in groups but none dilated and no collagen sheaths. A little Type B tissue with microcystic degeneration. Lipoid not investigated. A somewhat doubtful case.

CASE V: Female, fifty-nine. Five years before, the patient struck her right elbow an insignificant blow. A mass appeared in the region of the right external epicondyle

Fig. 14. CASE XXXI: A DOUBLE ROW OF NUCLEI IS SEPARATED BY A BAND OF RETICULIN WIRE FIBERS BLACKENED BY SILVER (LAIWLAW'S SILVER RETICULIN STAIN)

This demonstrates the arrangement of cells and fibers in palisading.
and steadily increased in size, with tenderness for the past three years. It was painful after a rheumatic attack, after a hard day's work, and with change of weather. The mass lay just above the right external epicondyle of the humerus. It was hard, tender, elastic, encapsulated, and movable except for a deep attachment. There was no radiation of the pain on pressure. Another soft mass was felt on the posterior aspect of the left elbow region, which was thought to be a lipoma. Clinical diagnosis: Neurofibroma, lipoma or ganglion. Excision, June 11, 1921. The tumor was soft and encapsulated; it measured 4.5 x 3.5 cm., and was attached to the musculospiral nerve deep to the pronator radii teres muscle. The nerve was not recognized at first and was clamped but not divided. The cut surface had a yellowish tinge. Result: The paralysis caused by clamping the musculospiral nerve was overcome by freeing the nerve from scar tissue Nov. 18, 1921. Thirty-five months after this second operation function and sensation were normal and there was no evidence of tumor. Microscopic: Tumor composed of about two-thirds Type B tissue with a moderate degree of microcystic degeneration. Type A tissue shows only occasional palisading. Wire fibers, mucin and lipid not determined. Many blood vessels with collagen sheaths. Moderate number dilated. Many lymphocytes throughout. Nerve bundles not seen in capsule.

CASE VI: Female, forty-two. Duration three years. The patient first noticed a small lump anteriorly just at the bend of the left elbow. It increased slowly without pain except that hard pressure caused a tingling to run down the forearm to the thumb. Examination showed a non-tender firm mass 3 x 4 cm. anterior to the internal condyle of the left humerus. It was freely movable except for a point of deep attachment. Clinical diagnosis: Neurofibroma of median nerve. Excision, Sept. 30, 1922. The tumor was smooth, rounded, grayish, encapsulated, 3 cm. in diameter, and attached to the median nerve, whose fibers spread out over its capsule. Some of the sensory fibers to the thumb were cut during removal but were resutured. Result: No return of tumor eight months after operation; sensation normal in the thumb. Microscopic: Somewhat more Type B tissue with marked microcystic degeneration than Type A. Palisading and wire fiber formation marked in places. Some giant nuclear forms. Meningioma-like whorl formation. Mucin and lipid formation not determined. Many vessels, some with collagen sheaths. Large vascular spaces not numerous. Nerve fibers not seen in capsule. Some structures resembling Wagner-Meissner tactile corpuscles.

CASE VII: Male, twenty-six. Duration eight years. There was a tumor of slow onset and growth in the tip of the tongue, causing slight slurring of speech. It was not painful, but was occasionally tender. It transilluminated, measured 3 x 1.5 cm., and was diagnosed clinically as a mucous cyst. A wedge-shaped piece of tongue with the solid tumor was excised May 28, 1924. The cut surface appeared firm and pallid. Result: No reappearance ten years later. Microscopic: Tissue largely Antoni Type A with very little Type B tissue and rare microcystic degeneration. Wire fibers numerous, but no good palisading. Vascular spaces numerous but not dilated. Tumor not definitely encapsulated, as groups of striated muscle fibers are found within it in a few places. No mucin. Lipoid not determined. (Not a characteristic case.)

CASE VIII: Male, twenty-two. Duration unknown. An encapsulated tumor, 2 cm. in diameter, lay beneath the left pectoralis major muscle a short distance above the areola and resembled a lymph node. Excision, June 1, 1927. The tumor was solid with punctate hemorrhagic spots on cross section. Result: No reappearance after eighteen months. Microscopic: About equal parts of Type A and Type B tissues. Marked microcystic degeneration. Palisading rarely well defined. Wire fibers, mucin and lipid not determined. Blood vessels numerous, many with collagen sheaths, some dilated, occasional thrombosis. Small nerve twig in capsule. Phagocyted blood pigment and scattered lymphocytes present.

CASE IX: Female, twenty-two. Duration life. Just lateral to the right angle of the mouth was a movable tumor 1 x 0.5 cm. It was subcutaneous and not tender. Clinical diagnosis: Sebaceous cyst. Excision, June 6, 1927. The tumor was encapsulated and no definite attachments were noted. There was no gross cystic degeneration. Result: Wound healed. Patient not followed. Microscopic: Type A tissue forming almost the entire tumor, with marked palisading and organoid arrangement of structures. Some
microcystic degeneration. Rare moderately dilated vessels. No collagen sheaths. Mucin, wire fibers and lipoid not determined. Scattered lymphocytes. No nerve bundles seen in capsule.

**Case X**: Male, twenty-two. Duration several years. In the occipital region of the scalp was a 1.5 cm. subcutaneous nodule which had increased in size for the past few months. It was thought to be a sebaceous cyst and was shelled out Aug. 12, 1927. It was an encapsulated solid tumor except for a small central cavity filled with blood and numerous hemorrhagic areas about this. Result: Wound healed. Patient not followed. Microscopic: Major portion composed of Type A tissue with well developed palisading in some areas. Type B tissue inconspicuous and microcystic degeneration not marked. Wire fibers numerous; phagocyted lipoid and hemosiderin present; mucin not determined. Numerous dilated blood vessels; no collagen sheaths. Scattered lymphocytes. No nerve bundles seen in capsule.

**Case XI**: Female, thirty-nine. Duration three to four years. There was a 3 × 3 cm. mass in the right submaxillary region which was not tender nor painful. It was thought to be a submaxillary sialadenitis. Excision, Aug. 27, 1927. The tumor was encapsulated, 4 cm. in diameter, and lay deep to the submaxillary gland, which was partly eneircled by the anterior end of it. It was posterior to the digastric muscle and lay against the mylohyoid muscle and the internal jugular vein. Part of the submaxillary gland was excised with the tumor. On section it was partly hard and partly soft and jelly-like. In the center were a number of hemorrhagic areas and vesicular spaces. Result: Slight paralysis of the right side of the lower lip, which cleared up. No return of tumor twenty-three months after operation. Microscopic: Tissue largely Type A with poorly defined palisading. Very little microcystic degeneration. Many large vascular spaces; no collagen sheaths. Several hemorrhages, and about these phagocyted hemosiderin and lipoid. Wire fibers present. Mucin not determined. No nerves seen in the capsule.

**Case XII**: Female, twenty-four. Duration nine weeks. Following a hard blow and treatment of the area with iodine, the patient noticed a swelling on the volar surface of the right forearm, 7 cm. above the wrist. With motion of the hand or fingers pain radiated
from the tumor into the third and fourth fingers and upward to the elbow. The mass had increased steadily in size. It measured $3.5 \times 2.5$ cm., was movable laterally but not vertically, and was tender. \textit{Clinical diagnosis:} Fibroma or lipoma. \textit{Excision, Nov. 21, 1927.} The tumor lay encapsulated in the median nerve and could be enucleated without dividing any nerve fibers. It was $3.5$ cm. in diameter and the cut surface looked like a raw potato, without any areas of degeneration or hemorrhage. \textit{Result:} Seventy-seven months after operation, no reappearance of the growth. \textit{Microscopic:} Three-fourths of the tissue of Type A, with wire fibers and palisading poorly developed. Microcystic degeneration in some areas. Some broad collagen fibers. Blood vessels numerous in the central areas, some with thick collagen sheaths, and some dilated. One degeneration cyst. Mucin and lipoid not determined. Scattered lymphocytes, some collected in groups. No nerve bundles seen in capsule.

\textbf{Case XIII:} Female, thirty-four. Duration four years. There was a subcutaneous lump in the parietal region of the scalp, which was $2$ cm. in diameter, not painful or tender, considered clinically a sebaceous cyst. \textit{Excision, July 17, 1928.} The tumor was encapsulated, rounded, $1$ cm. in diameter, soft, and the cut surface looked yellowish, mottled with hemorrhagic areas. \textit{Result:} Wound healed. Patient not followed. \textit{Microscopic:} Type A tissue preponderating in some areas; in others Type B. Microcystic and gross degeneration marked, with hemorrhages, phagocyted blood pigment, and numerous dilated blood vessels, many with thick collagen sheaths. Palisading well developed in some areas, with wire fibers. Mucin and lipoid not determined. No nerve bundles seen in capsule.

\textbf{Case XIV:} Female, fifty-two. Duration two years. Four years before observation the patient was hit; there was no ecchymosis at the site of the tumor, which appeared two years later in the left thigh near the groin. It gradually increased in size until it was $6$ cm. in diameter. It was firm, painless, and subcutaneous. \textit{Clinical diagnosis:} Fibroma or organized hematoma. \textit{Excision, Oct. 8, 1928.} The tumor was encapsulated; it lay in the subcutaneous fat and a small nerve ran into its capsule (cutaneous branch of the femoral). The cut surface was firm and grayish without areas of degeneration or hemorrhage. \textit{Result:} No return of the tumor and no symptoms six months after operation. \textit{Microscopic:} Type A tissue predominating, although there is plenty of Type B tissue with marked microcystic degeneration. Type A tissue shows only a suggestion of palisading. Instead it tends to form interlaced bundles with fibers wrapped about each cell, as in the fibrosarcoma. No mucin; occasional wire fibers. Rare dilated vessels; no collagen sheaths. Nerves not seen in capsule. Lipoid not determined. (An atypical form.)

\textbf{Case XV:} Female, twenty-one. Duration unknown. An encapsulated tumor, $1.2$ cm. in diameter, was \textit{excised} from the upper lip, May 24, 1929. It was considered clinically a lipoma. The cut surface was yellowish. \textit{Result:} Wound healed. Patient not followed. \textit{Microscopic:} Tissue largely of the A type with well developed palisading. Some microcystic degeneration. The other features could not be determined, as the slides were lost.

\textbf{Case XVI:} Female, twenty-eight. Duration twelve years. Following a sprain a tumor appeared on the dorsal surface of the right thumb. It was soft, painless, freely movable, and had grown slowly to a size of $5 \times 2 \times 3$ cm. \textit{Clinical diagnosis:} Lipoma. \textit{Excision, June 28, 1929.} The tumor was encapsulated and extended down to the dorsal tendon sheath. The cut surface was pale but mottled brownish red. \textit{Result:} Wound healed. Patient not followed. \textit{Microscopic:} Most of tumor composed of Type A tissue. Small intervening areas of Type B with microcystic degeneration. Wire fibers marked. Palisading not clearly defined. Several groups of blood vessels, some dilated; only a few vessels with thick collagen sheaths. Central hemorrhage with phagocyted blood pigment. No mucin. Lipoid not determined. Nerve bundles not seen in capsule.

\textbf{Case XVII:} Female, sixty-three. The first tumor in this patient was found by chance during an \textit{exploratory operation, Feb. 17, 1930,} for carcinoma of the rectum and fibromyoma of the right ovary. It was suspected of being a metastasis from the rectal carcinoma. It was $1.3$ cm. in diameter and lay in the anterior wall of the antral portion of the stomach just above the greater curvature. It was submucous and the cut surface
was pink. Later the rectum was removed by abdomino-perineal proctectomy. Three years later two small, slightly tender nodules were discovered by a nurse, during massage, in the left scapular region. They were considered either fibromas or cysts and were excised March 22, 1933. These were encapsulated and soft, with hemorrhagic areas. They measured $3 \times 2$ cm. and $5 \times 3$ mm. respectively. They were close together in the substance of the trapezius muscle. One year and five months later there appeared four skin nodules in the skin of the knee, leg, ankle and mammary region. These were neurofibromata and were excised Aug. 16, 1934. None of these tumors has reappeared. Microscopic: (1) Stomach: Major portion of tissue Type A, interspersed with small areas of microcystic degeneration and Type B tissue. Palisading is not clearly defined but the Type A tissue is bent into a characteristic wrinkled ribbon pattern. Wire fibers rare,

![Image](https://via.placeholder.com/150)

**FIG. 16.** CASE XX: GROUPS OF CAPILLARIES WITH THICK COLLAGEN SHEATHS SEEN IN THE CENTER, SURROUNDED BY TYPE B TISSUE SHOWING MARKED MICROCYSTIC DEGENERATION

At the right is a larger degeneration cyst. Hematoxylin-eosin stain.

but present. Some meningioma-like whorls. No mucin or dilated vessels. Lipoid not determined. Not encapsulated but infiltrating. No nerve bundles seen. (Unusual variation.) (2) Back: Equal division of Type A and Type B tissue with palisading well developed, wire fibers, microcystic degeneration. Numerous vessels, many with collagen sheaths; occasionally dilated. No blood pigment seen and mucin and lipoid not investigated. A nerve fiber found in the capsule.

**CASE XVIII:** Male, twenty-three. Duration two years. The patient, who was an epileptic, had for two years known of a mass in the supraclavicular portion of the posterior triangle of the left side of the neck. For nine weeks pressure had caused a tingling sensation to run down the arm. There was no muscular weakness. **Clinical diagnosis:** Neurofibroma of brachial plexus. **Excision,** July 16, 1930. The tumor measured $4 \times 6$ cm. and was attached to the outermost cord of the brachial plexus. It lay within the nerve sheath and widened it. When it was excised the capsule was left. The cut surface was markedly softened, showing mottling with yellowish and hemorrhagic areas and several areas of cystic degeneration. **Result:** Fifty-three months after operation the affected arm was not quite as strong as the other and there was a soft swelling in the scar but no definite evidence of reappearance. **Microscopic:** Tumor largely made up of
Type B tissue with very extensive microcystic and also gross degeneration and necrosis. Many large vascular spaces, some thrombosed, some with thick collagen sheaths. Wire fibers well developed in some areas but often no fibers seen. No real palisading present but occasionally suggested. Mucin and lipoid not determined. Marked variation in nuclear size with giant forms. Some phagocyted hemosiderin. No nerve bundles seen in capsule. Rare lymphocytes.

CASE XIX: Male, thirty-three. Duration life. There was a pedunculated tumor, 5 × 2.5 cm., in the left anterior axillary fold at the border of the pectoralis major muscle. It was lobulated, painless, movable, transilluminated, and had dilated skin veins over its surface. Clinical diagnosis: Dermoid cyst or neurofibroma. Excision, Oct. 9, 1930. No nerves were seen. The tumor was encapsulated and measured 4 × 3 × 2 cm. The cut surface was firm, without degeneration or yellow color. Result: Wound healed. Patient not followed. Microscopic: All of the tissue of Type A, with extensive microcystic degeneration, many well developed wire fibers but no true palisading. No mucin, lipoid or dilated vascular spaces found. No collagen sheaths around vessels. No nerve bundles in capsule. No lymphocytes.

CASE XX: Male, forty-nine, colored. Duration thirty-five years. The tumor had been stationary until six years before the patient was seen. Since that time it had slowly increased in size. There were no other similar nodules. On the internal aspect of the left knee, just above and medial to the tibial tuberosity, was a small, firm, non-tender, freely movable nodule 2 cm. in diameter. Clinical diagnosis: Fibroma. The tumor was shelled out Oct. 10, 1930. It was encapsulated, yellowish, measured 1.7 × 1.4 × 1 cm., and on cut section showed a mottled pink, yellow and white surface with small punctate hemorrhagic areas. Result: Wound healed. Patient not followed. Microscopic: Somewhat more Type B than Type A tissue. Very extensive microcystic degeneration; occasional differentiated palisading. Many blood vessels, some dilated, some with thickened collagen sheaths. No mucin. Rare cells with phagocyted lipoid or blood pigment; many wire fibers. Nerve bundle found in capsule.

CASE XXI: Male, twenty-six. Duration ten years. On the right forearm, just below the antecubital fossa, was a swelling near the lateral side, about 3 × 4 cm. It was freely movable, soft, and suggested a lipoma or fibroma. It was neither painful nor tender. Excision, Nov. 21, 1930. The growth was encapsulated and somewhat lobulated, measuring 3.5 × 2.5 cm. The cut surface had a whorled appearance without degeneration but with numerous fine blood vessels. Result: No reappearance of the growth after twenty-one months. Microscopic: More than half of the tissue of Type A with well developed palisading and wire fibers. Moderate microcystic degeneration in Type B tissue. Mucin and lipoid not investigated. Many dilated blood spaces; many vessels with collagen sheaths. Some hemorrhage and phagocytosis of blood pigment. Rare scattered lymphocytes. No nerve bundles seen in capsule.

CASE XXII: Male, fifty-four. Duration thirty years. The growth appeared following burning of the left leg with steam. It had been quiescent until the past two years, during which it began to increase in size and became painful in damp weather. For three months it had been tender. The growth lay in the middle of the right calf, was circumscribed, movable, slightly tender, the size of a golf ball. Clinical diagnosis: Myosarcoma. Excision, May 15, 1931. The tumor was encapsulated, measured 4.5 × 4 cm., and lay in the substance of the gastrocnemius muscle. The cut surface showed a soft grayish tissue mottled with yellow flecks and many hemorrhagic spots. Result: No nervous disturbances noted. No evidence of tumor after twenty-nine months. Microscopic: Almost all of the tissue Type B with very rare islands of Type A showing small groups of wire fibers, but no real palisading. A great deal of microcystic degeneration; many blood vessels, most with thick collagen sheaths; a few scattered cells with phagocyted lipid and hemosiderin. No mucin and no nerve bundles in the capsule.

CASE XXIII: Male, fifty-six. Duration two weeks. The complaints in this case were difficulty in breathing through the nose and cough. A hard, cystic mass, 3 × 2 cm., was found in the right nasopharynx behind the posterior pillar and attached to it. Clinical diagnosis: Fibroma. Excision, June 24, 1931. The tumor was encapsulated and somewhat nodular. The cut surface appeared grayish, speckled with yellow flecks and two
hemorrhagic areas. Result: Patient not followed. Microscopic: Two-thirds of the tissue Type B with extensive microcystic degeneration, partly mucoid. Only a few wire fibers in the Type A tissue and only suggestions of palisading. A few scattered lymphocytes; no enlarged vessels; no phagocyted hemosiderin and no nerve bundles in the capsule. The tumor lies in the submucosa immediately beneath the mucosal covering.

Case XXIV: Female, twenty-four. Duration three years. There was a firm, nontender, pea-sized mass beneath the skin on the radial side of the dorsum of the right wrist, apparently deeply attached. Clinical diagnosis: Ganglion. Excision, Aug. 26, 1932. The tumor was encapsulated, measured 1.5 × 1 cm., and had an apparent pedicle which was ligated. The cut surface was grayish, speckled with small hemorrhagic spots. Result: Patient seen at twenty-seven months for another complaint; no note made about wrist. Microscopic: Most of the tissue Type A with well developed palisading and many wire fibers. Type B tissue in small strips and patches; shows microcystic degeneration. Many large vascular spaces, some thrombosed. Some vessels with thick collagen sheaths. A few phagocytic cells with lipoid or with hemosiderin. A bundle of nerves in the capsule.

Case XXV: Male, sixty-eight. Duration three years. There was a lump in the right thenar eminence which had been painless until three days before admission, when pain radiated into the thumb and up the arm. Hot soaks relieved it. The growth was 1 cm. in diameter, subcutaneous, moved with the adductor muscles, and was considered a ganglion. Excision, Sept. 27, 1932. The tumor was encapsulated, attached to the fascia covering the medial head of the adductor pollicis muscle, and had large vessels in its capsule. The capsule was incised and the tumor shelled out. No vessels were ligated.

**FIG. 17. CASE VI: DEMONSTRATING THE MARKED ORGANOID DIFFERENTIATION FOUND IN SOME TUMORS**

In this picture most of the cells and fibers are arranged in a whorl resembling those seen in meningiomas. Across the face of it there passes a tortuous structure which is strongly reminiscent of an elongated Wagner-Meissner tactile corpuscle. Note that immediately below this in the outer rim of the whorl is a spindle-shaped condensation of fibers with palisaded nuclei at either end of it. Hematoxylin-eosin stain.
and no nerves seen. The cut surface showed homogeneous grayish tissue speckled with small hemorrhagic spots. Result: Wound healed. Patient not followed. Microscopic: Most of the tissue Type A with many well developed wire fibers and definite palisading. Type B tissue shows much microcystic degeneration and there has been some necrosis of the Type A tissue. Many large vascular spaces, some thrombosed. Some vessels with thick collagen sheaths. Phagocytosis of hemosiderin and intracellular lipoid, especially in the necrotic areas. No mucin seen and no nerve bundles found in the capsule.

Case XXVI: Male, twenty-four. Duration three years. A slowly growing non-tender nodular mass was situated within the hairline of the right temporal region. It was freely movable, measured 1.5 cm. in diameter, and was subcutaneous with deep attachments. Clinical diagnosis: Dermoid cyst. Excision, Nov. 11, 1932. The tumor lay beneath the frontalis muscle, was encapsulated, and was deeply attached by some fibrous strands. The cut surface showed a mottled light brown to yellow surface with several small vacuolated areas. Result: Wound healed. Patient not followed. Microscopic: Most of the tissue Type A with many wire fibers and much imperfectly developed palisading. Type B tissue shows a little microcystic degeneration and there has been some necrosis of Type A tissue. Many blood vessels, some dilated, and occasionally thrombosed. Phagocytied pigment found, but no mucin. Lipoid not determined. No nerve bundles found in the capsule.

Case XXVII: Female, forty-one. Duration three years. The trouble began as pain in the right neck. After a year a swelling appeared, and the pain radiated down the arm and forearm along the course of the ulnar nerve. It had grown worse in recent months. The patient gave a lifetime history of jacksonian epileptic attacks. There was a very tender mass, 3 X 4 em., in the region of the lower part of the right sternomastoid muscle. The swelling was vague, and as x-ray showed an elongated seventh cervical transverse process, it was thought that this was the cause of the brachial plexus symptoms. Neurological examination showed hyperesthesia to pain over the entire arm surface, more acute over the surfaces supplied by the ulnar, anti-brachial cutaneous and intercosto-brachial nerves. There was also hyperesthesia over the right chest extending down to the fifth intercostal space in front and the fourth dorsal vertebra behind. Above it extended to the hair line. Clinical diagnosis: Tumor of fourth branch of cervical plexus. Operation, March 6, 1933. A tumor 2.25 X 1.5 em. was found within the fifth cervical nerve, making a fusiform swelling. It was dissected out without much damage to the nerve fibers which passed through its capsule. The tumor was encapsulated and was composed of soft reddish tissue flecked with yellow and having gross cystic areas of degeneration filled with cloudy brownish fluid. Result: Postoperatively weakness and, at times, pain in the right arm and neck persisted, but after fifteen months the pain had largely disappeared and only some weakness of the arm remained. Microscopic: Most of the tissue Type B with very extensive microcystic degeneration. A few islands of Type A tissue with wire fibers and incomplete palisading. Many vessels, some dilated and occasionally thrombosed; some with collagen sheaths about them. Much intracellular lipoid and some blood pigment. At the pointed end of the tumor are a number of normal neurites. Extending in among the peripheral tumors cells are a number of extremely delicate, thin, tanged neurites without definite arrangement. No mucin. Some scattered lymphocytes.

Case XXVIII: Female, fifty-three. Duration twenty years. Swelling of the thenar eminence of the right hand followed an attack of pains in many joints, called "gout." This swelling was at first the size of a pea, and painless. Gradually it increased in size and became painful on pressure. It was now the size of a plum and occupied the upper inner part of the right thenar eminence. The skin over it was purplish and it fluctuated. There were also a small tumor on the dorsum of the right wrist, multiple syringoeysts-adenomas of the neck, and an hemangioma on the face. Clinical diagnosis: Schwannoma. Excision, April 28, 1933. The tumor measured 3 X 2 em., was subcutaneous and encapsulated; no nerve connection could be found. The cut surface was grayish or mottled red and yellow, with large areas of hemorrhage and apparent degeneration. Result: At nine months no evidence of reappearance. Microscopic: Most of the tissue Type A, although there is some Type B with microcystic degeneration. Palisading is marked and
there are some structures resembling imperfect Meissnerian corpuscles. Many wire fibers, but more collagen fibers. Blood vessels numerous, many dilated and many with collagen sheaths. Many hemorrhages and much blood pigment but no mucin or lipoid. Neurites found in the capsule and passing in among the superficial parts of the tumor.

**Case XXIX**: Male, thirty-eight. Two years' duration. A lump was discovered by chance on the medial aspect of the volar surface of the right arm just above the medial epicondyle of the humerus. After a year it began to grow and became tender when hit, the pain radiating to the back of the forearm and also down the volar surface to the wrist, but never into the hand. The brachial artery was displaced outward. The tumor was $7.5 \times 3.5$ cm. and was diagnosed clinically as a perineural fibroblastoma of the median nerve. *Operation*, May 22, 1933. The tumor was encapsulated and lay within the median nerve, forming a fusiform swelling. It was composed of very friable bluish-red soft tissue, and a cavity containing 10 c.c. of thin brown fluid. The medial fibers of the nerve ran through and inside of its capsule. It was dissected away from the nerve fibers, and the procedure necessitated the tying of many blood vessels. A subcutaneous fibromyoma of the left medial knee region was excised at the same time. Result: At the end of a year there was still sensory and motor disturbance from damage to the median nerve but no pain and no sign of tumor. *Microscopic*: Tumor composed of large masses of Type A tissue and smaller areas of Type B tissue between them, showing microcystic degeneration. Many dilated vessels; large pseudocysts due to necrosis; many hemorrhages with phagocyted blood pigment. Rare vessels with thick collagen sheaths. No mucin nor lipoid found. Many wire fibers and much imperfect palisading of nuclei. Also many tiny structures resembling imperfect Meissner tactile corpuscles. Neurites in the capsule, some passing in among the superficial tumor cells.

**Case XXX**: Female, fifty. This patient suffered from anemia and weakness for two months and from dyspepsia and gas after food for years. There was vomiting for two weeks before admission. An attack of jaundice had occurred many years ago. X-ray and fluoroscopy showed a filling defect in the fundus of the stomach along the lesser curvature, supposedly on the posterior wall, which was diagnosed as a benign polypoid tumor. At operation a dumb-bell tumor was found high in the stomach on the anterior wall, projecting into the lumen and also outward on the peritoneal side. *Local excision*, July 20, 1933. From mucosal to serosal surface was 5 cm. The larger mass was submucosal. The cut surface was firm and pallid, with an ulcer in the submucosal mass and a hemorrhagic zone in the subserosal mass. Result: At 15 months no evidence of tumor. *Microscopic*: Tumor composed almost entirely of Type A tissue with microcystic degeneration, both wire and collagen fibers, and vague suggestions of palisading. No true Type B tissue. No dilated or thick-walled vessels. Some areas faintly tinged with mucin. No hemosiderin. Lipoid not determined. No encapsulated. No nerve bundles seen. (Atypical case.)

**Case XXXI**: Male, thirteen. Duration unknown. In the middle of the anterior surface of the right arm was a rounded, movable, subcutaneous nodule. The skin was freely movable but the mass was deeply fixed. There was no pigmentaton and no other nodules were found. *Clinical diagnosis*: Fibroma. *Excision*, Dec. 28, 1933. The nodule was encapsulated and soft, measuring $10 \times 5$ mm. The nutrient vessels were ligated. The cut surface was grayish. Result: Eleven months after operation there was no local return but a similar nodule had appeared subcutaneously in the left lateral abdominal region. *Microscopic*: Almost all of the growth composed of Type A tissue with wire fibers and highly developed palisading everywhere. Very little Type B tissue, with microcystic degeneration. No mucin or lipoid seen. One tiny nerve twig seen in the capsule. No enlarged blood vessels.

**Case XXXII**: Female, twenty-two. Duration eight years. The tumor in this case was noticed by accident. It gave no pain except when struck. It increased slowly in size but produced no symptoms. It was a rounded, hard, mass, measuring 3 cm., in the subcutaneous tissues of the left supraclavicular region, 2 cm. above the outer half of the clavicle. *Clinical diagnosis*: Fibroma or tuberulous lymph node. *Excision*, Feb. 23, 1934. The mass was ovoid, encapsulated, soft, and measured $3.5 \times 2.5$ em. It shelled out easily, and some vessels were attached to the antero-inferior pole. No nerves
are mentioned. The cut surface showed lakes of shining pallid gelatinous material alternating with pink and yellow areas and flecks of hemorrhage. The appearance was that of thyroid tissue. Result: No return after seven months. Microscopic: Major portion of the tissue Type A, but with palisading well developed in only a few areas. Much of the tissue degenerated; large areas where there are very few cells. Much microcystic degeneration. Wire fibers not found everywhere. Many dilated vascular spaces, some with thrombosis and some of the vessels with thick collagen sheaths. Hemorrhages and phagocyted pigment seen, but no lipoid or mucin. Many neurites in the capsule; some of the smaller fibers passing in among the superficial tumor cells.

Case XXXIII: Female, adult. History unknown. There was a mass 1 cm. in diameter on the volar radial side of the right wrist which was freely movable and thought to be a ganglion. It was subcutaneous, flattened, and overlay the radial artery. Excision, April 12, 1934. The tumor was encapsulated, had no pedicle, and measured $1 \times 0.5$ cm. No hemostasis was required. The cut surface was pale gray with one hemorrhagic area beneath the capsule. Result: Wound healed. Patient not followed. Microscopic: Most of the tissue Type A with many wire fibers, much differentiated palisading of nuclei, and a little microcystic degeneration in the Type B tissue. No mucin, lipoid, or blood pigment seen. Vessels not dilated, but many of them with thick collagen sheaths. One area of hemorrhage. No nerve bundles found in the capsule.

Case XXXIV: Female, thirty-eight. Duration eleven years. The swelling, in the right calf, remained the size of a marble for nine years and then began to increase in size until it was three times its original diameter. For three weeks there had been pain radiating to the heel. There was a subcutaneous, ovoid, semifluctuant mass, measuring $4 \times 2$ cm., over the lateral border of the right Achilles tendon, 10 cm. above its insertion. Clinical diagnosis: Neurinoma or neurofibroma. Excision, June 6, 1934. The growth was encapsulated, pear-shaped, with the point down, and the fibers of the sural nerve were frayed out over its surface. The nerve was resected with the tumor and the cut ends injected with alcohol. The cut surface showed a glistening, somewhat mottled pinkish-yellow tissue with a few hemorrhagic flecks. Clear fluid exuded from the cut surface. Result: After eight months the local soreness noted for a time after operation had disappeared and there were no signs of tumor. Microscopic: Tumor made up of almost equal parts of Type A and Type B tissue. Much microcystic degeneration, many wire fibers, palisade formation in some areas, much gross degeneration, many dilated blood vessels, some with thick collagen sheaths, and rare scattered lymphocytes. No mucin or phagocyted blood pigment. Lipid not determined. Many nerve fibers in the capsule and a number of small twigs passing in among the superficial tumor cells.

Case XXXV: Male, fifty-nine. Duration eight years. The lump appeared in the right posterior thigh just above the popliteal space and gradually tripled in size. It seemed subcutaneous, and pressure over it produced paresthesia running down along the course of the posterior tibial nerve. Clinical diagnosis: Perineurial fibroblastoma. Operation, July 5, 1934. An egg-shaped, soft, elastic, encapsulated tumor, $6 \times 4.5$ cm., was found in the upper end of the popliteal space and small nerve bundles and blood vessels were attached to the upper and lower poles. It was resected with nerves and blood vessels. The cut surface was composed of soft, glistening pink tissue with alternating yellowish opaque areas. Result: No return of growth after five months. Microscopic: Most of the tissue of Type A, with many wire fibers, but very rare and imperfect palisading of nuclei. Enormous numbers of phagocytic cells loaded with lipid in all parts of the growth. Microcystic degeneration, but very little Type B tissue. Many vessels, some widely dilated, many with thick collagen sheaths. No mucin or phagocyted pigment. Scattered lymphocytes found. Many nerves in the capsule and a few neurites passing in among the superficial tumor cells beneath the capsule.

Case XXXVI: Female, thirty-two. Duration eight years. There was a small painful subcutaneous tumor $8 \times 5$ mm., 8 cm. above the left internal malleolus. A few months before operation a second $5 \times 3$ mm. tumor appeared 1 cm. above the same malleolus. Clinical diagnosis: Multiple neurofibromas. Excision of both tumors, Sept. 13, 1934. Both were subcutaneous and attached by several filaments to the surrounding tissue. From the upper one a tiny pearly white ovoid body escaped during excision.
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(This was not saved. It may have been a Pacinian body.) The cut surfaces of both tumors were grayish with central areas tinged with yellow. Result: Wound infected but finally healed after two months. Patient not followed after this. Microscopic: Both nodules of the same architecture: large quantities of Type B tissue with some microcystic degeneration and small central groups of Type A tissue with marked palisading and some wire fibers. The picture is unusual because of the number of thick collagen fibers both in the Type B tissue and associated with the wire fibers. No mucin or pigment. Lipoid not determined. No enlarged blood vessels; their sheaths only slightly thickened. Small nerve bundles seen in the capsule.

CASE XXXVII: Female, fifty-six. Duration seven years. A slight swelling was first noticed under the right mandible with slow increase for five years and more rapid for two years. There were no other symptoms. The mass was freely movable, ovoid, 6 cm. in diameter, occupying the right submaxillary region extending outward into the neck and backward toward the base of the tongue. It gave a vague sense of fluctuation. In the left submaxillary region was a 3 cm. swelling. Clinical diagnosis: Tumor of submaxillary gland. At operation, Sept. 22, 1934, an encapsulated tumor, 5 × 4 cm., was found lying deep to the submaxillary gland and not connected with it. It was superficial to the hyoglossus muscle and underneath the floor of the mouth. No pedicle was noted. The cut surface showed hemorrhage and degeneration with cavitation toward the center and pinkish tissue elsewhere. Result: No evidence of return after three months. Microscopic: Most of the tissue of Type A with many wire fibers and rare palisading. Type B tissue showing marked microcystic degeneration. Many dilated vascular spaces, some thrombosed; sheaths inconspicuous. No mucin or pigment seen. Lipoid not investigated. Nerve bundles in the capsule.

CASE XXXVIII: Female, sixty-three. Duration ten years. There was a tumor on the dorsum of the right hand over the second and third metacarpal bones. During the past three years it had grown larger, extending gradually over the carpus. It was deeply attached, cystic, measured 4 × 3 cm., and the proximal part was slightly tender. There was some limitation of motion at the wrist due to bulk. Clinical diagnosis: Lipoma or ganglion. Excision, Nov. 30, 1934. The tumor was encapsulated, subcutaneous, and attached to the periosteum of the second metacarpal bone. No nerves were seen. The cut surface was mottled pale gray and yellow. Result: Wound healed. Patient not followed. Microscopic: Equal amounts of Type A and Type B tissues, with marked wire fibers, well differentiated palisading and microcystic degeneration. Vessels are not numerous; only a few dilated and some with thick collagen sheaths. No mucin or blood pigment seen and only an occasional cell containing lipoid. No nerve bundles seen in the capsule.

CASE XXXIX: Male, fifty-four. Duration over eight years. There was a soft tumor the size of an egg in the left popliteal space, which had grown slightly. It was painful only if struck. It measured 6 × 3.5 cm., and manipulation caused some pain to radiate down the lateral aspect of the leg. There was one small café-au-lait spot in the middle of the back. Clinical diagnosis: Neurofibroma or neurilemoma. At operation, March 4, 1935, the tumor was found to the outer side of the left popliteal space in the course of the short saphenous nerve (N. cutaneus surae lateralis), about 6 cm. distal to its origin from the external popliteal nerve. It was resected with the nerve. It was encapsulated. The cut surface showed grayish-brown soft tissue with numerous tiny blood vessels, small yellowish areas, and others semitranslucent. Result: Wound healed. Microscopic: Quantities of Type A and Type B tissues vary very greatly in different parts of the tumor with perhaps more of the Type B. Wire fibers frequent and microcystic degeneration marked. Palisading rare but usually well developed when found. No mucin seen. Some phagocytized pigment; lipoid not investigated. Numerous blood vessels, some dilated and many having collagen sheaths. A few collections of lymphocytes. Nerve bundles seen in the capsule.

CASE XL: Female, sixty. As long as she could remember, the patient had three subcutaneous tumors on the ulnar side of the flexor surface of the right forearm, and one on the dorsal surface of the right leg over the Achilles tendon. There was also a nodule in the right palm, the size of a pea. There were no café-au-lait spots or other
skin lesions. One of the arm nodules was removed, June 21, 1924. A slowly growing "cyst" in the right cheek had been removed in 1906. In 1918 the patient had a radical operation on the right antrum for infection. She recovered from this and remained well until 1931, when a tumor appeared in the nasal cavity. This was excised and proved to be a sarcoma. In March 1935, the tumor reappeared and a second extensive operation for removal was performed. Microscopic: Sections of some of the nerves removed at the last radical antrum operation show that there are characteristic nerve sheath tumors attached to them. They consist almost exclusively of Type A tissue with wire fibers and palisading; no microcystic degeneration, no enlarged blood vessels, no pigment or mucin. Lipoid was not investigated. The nerves themselves show thickening of the sheaths and the tortuosity characteristic of von Recklinghausen's disease. The tumor from the forearm has a nerve in its capsule and is composed of equal parts of Type A and Type B tissues. There are many wire fibers, incomplete palisade formation, microcystic degeneration and dilated blood vessels with collagen sheaths. No mucin or blood pigment is present. Lipoid was not investigated. The Type B tissue has more broad collagen bands than wire fibers, making it resemble the tissue of the simple neurofibroma.

CASE XLI: Male, nineteen. Duration seven years. A reddened, soft, non-tender swelling on the roof of the mouth had grown slowly and was painless until three months before, when it became somewhat painful. It measured 4 cm. in diameter and was in the midline of the posterior part of the hard palate, extending onto the soft palate. It was submucous and was excised, Dec. 1, 1933, by Dr. F. K. McCaffrey at the Fordham Hospital, through whose kindness it came to the author. Result: Wound healed. No return after three months. Microscopic: About equal parts of Type A and Type B tissues. Type A tissue well differentiated, with wire fibers and tortuous strands of palisaded cells. Much microcystic degeneration in the Type B tissue. No large vessels and no thickened vascular sheaths. Mucin and lipoid not investigated. No pigment seen. The surface of the growth must have been ulcerated, as there is a very marked inflammatory reaction along one side of the growth. No nerve bundles seen in the capsule.

CASE XLII: Male, twenty-seven. Duration one year. A small, rounded, painful and tender mass, 1.3 cm. in diameter, was just palpable on the dorsal surface of the right calf. Excision, May 15, 1911. The tumor was encapsulated and attached to a branch of the internal saphenous nerve. Result: Patient not followed. Microscopic: Type A tissue preponderating, with marked palisading and well developed wire fibers. Type B tissue showing microcystic degeneration. Not many vessels, and no thick collagen sheaths seen. No hemosiderin seen. Mucin and lipoid not investigated. Many vessels, some dilated, one thrombosed, some with collagen sheaths. A good sized nerve in the capsule.

CASE XLIII: Female, fifty. Tumor on ankle. No history recorded. Excision, May 26, 1915. The tumor was encapsulated and measured 1.5 X 0.5 cm. Result: Patient not followed. Microscopic: Tumor composed largely of Type A tissue with imperfect palisading. No blood pigment seen. Mucin and lipoid not investigated. Many vessels, some dilated, one thrombosed, some with collagen sheaths. A good sized nerve in the capsule.

CASE XLIV: Female, thirty-six. Duration seven years. A small tumor appeared on the dorsum of the left wrist. It grew to the size of a marble and was tender to pressure. Excision, April 3, 1916. The tumor was encapsulated, subcutaneous, and measured 1.5 X 1 cm. Result: Patient not followed. Microscopic: Tumor has more A tissue with good palisading and wire fibers than it has of B tissue with its microcystic degeneration. Many vessels, many widely dilated and many showing thick collagen sheaths. Hemosiderin seen. Lipoid and mucin not investigated. No nerve bundles seen in the capsule.

CASE XLV: Female, forty-four. Duration eight years. There was a tumor in the palm of the right hand with recent rapid growth and pain extending from the mass to the fingers. Clinical diagnosis: Giant-cell tumor. Excision, Sept. 2, 1916. The tumor was encapsulated, 2 cm. in diameter, and the cut surface appeared pallid. Result: Patient not followed. Microscopic: Most of the tissue of Type A with marked palisading and structures suggesting Wagner-Meissner tactile corpuscles; sharply contrasted