RHABDOMYOSARCOMA OF THE SKELETAL MUSCLES

ARTHUR PURDY STOUT, M.D.

NEW YORK, N. Y.

FROM THE SURGICAL PATHOLOGY LABORATORY, COLLEGE OF PHYSICIANS AND SURGEONS, COLUMBIA UNIVERSITY AND THE DEPARTMENT OF SURGERY, PRESBYTERIAN HOSPITAL, NEW YORK, N. Y.

IN 1854, over 90 years ago, Weber described a localized enlargement of the tongue of a 21-year-old man. This was excised but later reappeared. It was made up of striated muscle cells in all stages of differentiation from adult to embryonal forms. Although this is not called a neoplasm by Weber there can be little doubt that it was a rhabdomyosarcoma. During the intervening years there have been published many studies of striated muscle tumors. One can learn from them that these are tumors of very variable gross characteristics, rate of growth and appearance, that they affect both sexes, all ages from the newborn infant to the octogenarian, that they grow at enormously variable rates of speed and develop in animals as well as man [rats and mice (Haagensen and Krehbiel; Morpurgo; Nettleship); fish (Kolmer); birds (Peyron); cow (Prochazka)]. They have been found in certain definite systems and regions of the body. These are more particularly the genito-urinary system (bladder, kidney, prostate, testis, spermatic cord, uterus, vagina, round ligament and ovary), the heart, upper respiratory and alimentary tracts, the orbit, and sporadic examples have been found in the lung, breast, esophagus, suprarenal and brain. In addition, the writer has been able to locate reports of 107 cases which have developed in the striated muscles and other soft parts of the body. From the clinical point of view this is the more interesting group because many of them develop in situations where they can be subjected to attempts at curative therapy. Therefore, it is of very considerable importance to learn the biologic characteristics as well as the gross and microscopic features of these tumors so that they may be recognized as early as possible and the best form of treatment employed. When the writer undertook to learn what he could from published work, he found that there have appeared a number of magnificently illustrated studies of the neoplastic myoblast by Glasunow, Montpellier, Peyron, Roskin, Temofeevskiy and Wolbach which make it relatively easy for those who use good technical practices to recognize the growth microscopically provided the tumor demonstrates some evidence of differentiation. But when one tries to find out about the biologic habit of the tumor and especially about the efficacy of treatment, the astonishing fact emerges that apparently no statistical investigation has been published—at least in the more easily accessible journals. Bick, Burke, Landois and Lenormant have each produced studies of tumors arising in voluntary muscles but without any attempt to distinguish between the various histologic types. Geschickter, Gordon Taylor, Moulonguet and Pollosson, and Rakov have studied groups of rhabdomyosarcomas but without furnishing enough details to enable one to make much use of them for statistical purposes. Shanin's paper

is in Russian, and the English abstract lacks essential details. De and Tribendi give valuable details of 13 cases and Jőnsson has produced a splendid monograph in English from the material of the Radiumhemmet, in Stockholm, with the necessary clinical data of 39 cases of rhabdomyosarcoma of the peripheral voluntary muscles, each one of which was diagnosed by Reuterwall. All of the writers mentioned have realized the extremely malignant nature of the rhabdomyosarcoma but not even Jőnsson, who had the information at his disposal, studied it statistically and made use of it to emphasize his conclusions.

The writer has, therefore, tabulated the published cases and added 14 unpublished ones at his disposal, making a total of 121 cases for analysis. Before this analysis is presented, it seems necessary to discuss the histology, classification and nomenclature of these tumors so that it may be perfectly clear what is meant by the name used and what tumors are included.

In this paper the intention has been to present the tumors that are definitely made up of cells which, in whole or in part, have some of the characteristics of rhabdomyoblasts and which have arisen in the striated muscles (exclusive of heart muscle) or immediately adjacent to them. The rhabdomyoblastic tumor cell is very variable in size but in general it is rather large and it assumes one of three different shapes. It is either rounded, strap-shaped with two or more nuclei arranged in tandem, or racquet-shaped with a single nucleus at one expanded, rounded end, and a tapering body extending outward from this for a variable distance. The cytoplasm is generally somewhat acidophilic, and sometimes markedly so. It is often granular. If the tumor material is well-fixed and stained with either Masson's trichrome stain containing acid fuchsin, Haidenhain's hematoxylin or (if Zenker fixation is used) with the phosphotungstic acid-hematoxylin stain, either cross-striations, longitudinal myofibrils or some vague suggestion of their formation should be distinguishable in the majority of cases. It is usually not easy to find this differentiation even with very good preparations and one must be willing to make a painstaking search with high magnification. But the search is rewarding if successful, for the diagnosis can then be made with complete assurance. One or the other of these differentiating features was found in nine of the 14 new cases here recorded. In embryonic myoblasts or myoblasts from adult striated muscle *in vitro* (Pogogeff and Murray), the formation of cross-striations and longitudinal myofibrils is markedly variable; they appear, disappear and reappear within a cell sometimes rapidly and sometimes after long intervals. Moreover, the cross-striations often do not completely traverse the elongated strap-like cells. Reproduction of these vagaries is found in tumor myoblasts (Figs. 5, 7, 10 and 11). The tumor cells are sometimes vacuolated and it has been generally accepted that the material in the vacuoles is glycogen, since Marchand demonstrated this in 1885. Glycogen determinations have not been done in any of the new cases reported here. When there are many vacuoles in cells of giant size, they are sometimes peripherally arranged with delicate cytoplasmic strands separating them and radiating outward from near the nucleus to the capsule. Such cells have been called spider or spider-web

cells. But even if one is unable to demonstrate cross-striations and fibers the other histologic features will usually suffice to make the diagnosis. Jőnsson reported that he did not find them in a single one of his 39 cases of rhabdomyosarcoma. The photomicrographs, however, are sufficient to enable one to accept his cases as authentic, especially when one is assured that they were all studied by Olle Reuterwall. It should be noted that the rhabdomyosarcomas may not show these characteristics in all parts. One may encounter fibrous areas, as in Case 14 of this series, which show no characteristic features (Fig. 13). Such a vagary may be found in many tumors of specific cell origin and in the opinion of the writer simply represents the ability of such cells to assume the guise and function of fibroblasts.

The question arises as to whether or not any of the striated muscle cell tumors of skeletal muscle can be considered benign like those which develop in the heart muscle. The latter are highly specialized relatively well-differentiated growths which are considered congenital malformations by many since they are frequently associated with tuberous sclerosis and kidney tumors and cysts. In the other muscles, however, while a relatively high degree of differentiation, as in Case 9 (Fig. 5), may indicate slow growth, it is no guaranty that it may not infiltrate so that complete removal will be difficult as in Case 11 (Fig. 9). Therefore, while it can be surmised that a tendency to differentiate may be a favorable sign all of these peripheral tumors are malignant to some degree and should, therefore, be classified as rhabdomyosarcomas.

It is impossible to avoid reference in this connection to three other varieties of muscle tumors. Abrikossoff's myoblastic myoma, otherwise known as the granular cell myoblastoma, has been very generally accepted as a tumor of immature myoblasts. Howe and Warren, using the name myoblastoma for them, have indicated that they should be segregated as a group separate from the rhabdomyosarcomas. The writer is willing to agree with this for the present, at least, for the exact nature of these tumors is not yet settled. Tissue culture studies by M. R. Murray in this laboratory have so far failed to prove beyond peradventure the myoblastic nature of these cells. The writer is not in entire agreement with all Howe and Warren have to say about malignant granular cell myoblastomas, for he believes they have included with them some rhabdomyosarcomas; an action which in his opinion serves to confuse rather than to clarify (Ravich, Stout and Ravich).

In addition to the granular cell tumors there have been described some tumors which seem to partake of the characteristics of both smooth and striated muscle cells and others in which it seems impossible to decide whether they are smooth or striated muscle cell tumors. This question has been extensively debated by Roskin, Montpellier, and others. The most confusing pictures are furnished by some uterine tumors in which both smooth and striated muscle cells are found (Lochrane). The writer has not encountered such cases arising in the skeletal muscles and he doubts if there can be many in which such equivocal conditions exist. He is inclined to simplify his nomenclature of the muscle tumors to the following terms: Smooth muscle

cell tumors—leiomyoma, leiomyosarcoma; striated muscle cell tumors—granular cell myoblastoma (benign and malignant types); rhabdomyoma of the heart muscle; rhabdomyosarcoma; undifferentiated myosarcoma (this term to be used only when it is impossible to place the tumor in any of the other groups). Most of the granular cell tumors and the heart rhabdomyomas are benign, while all of the other striated muscle cell tumors are either definitely or potentially malignant. The tumors, for instance, which arise in the genitourinary system of infants and very young children rarely metastasize but they demonstrate stubborn infiltrative growth, and even most radical surgical procedures have failed to eradicate them.

The tumors with which the rhabdomyosarcoma is most easily confused are liposarcomas and fibrosarcomas. The liposarcomas commonly form bizarre giant cells but the nuclei are very apt to be pyknotic and lipoid droplets are always demonstrable in some part of the growth. It is sometimes mistaken for a fibrosarcoma because the cells are often elongated and connective tissue fibers are usually present between them. But the presence of bizarre giant cells in the writer's opinion definitely removes the growth from the fibrosarcoma class and means that it is in fact derived from some other specialized cell such as the lipoblast, osteoblast, rhabdomyoblast, Schwann cell, *etc.* The differential diagnosis of peripheral soft part tumors is always a challenge to the diagnostic acumen of the pathologist.

Etiologic Factors.—There is a very slight preponderance of males. Among 114 patients whose sex is recorded, there were 62 males and 52 females. The age variation is extreme, as Graph I shows, with the preponderance in the fifth and sixth decades. The mean age was 42.1 years at the time of diagnosis. Of the 116 cases whose age is known, 46 were below the mean. There are no facts suggesting immunity or higher susceptibility in any race or geographic area. Trauma of some degree is mentioned in the histories of 14 tumors or 11.5 per cent (Table Cases 1, 11, 16, 19, 32, 43, 55, 70, 87, 88, 90, 110, 111, 120). This would hardly seem a figure of significance.

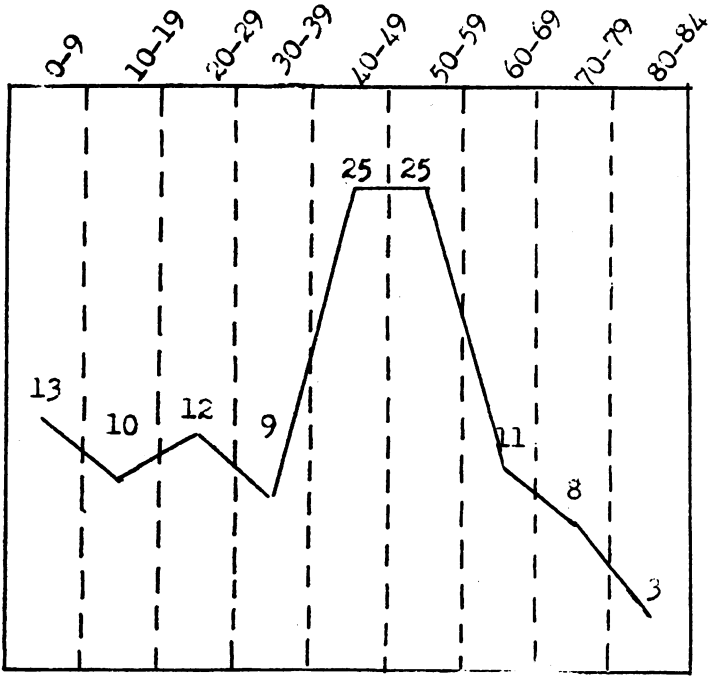
Site of Origin.—In almost every case the tumor developed either within or attached to a peripheral striated muscle. Since Case 78 had two apparently independent tumors in the thigh and axilla and Case 100 tumors in both arms, the distribution of 123 tumors from the 121 cases will be recorded. Lower extremity: 52 cases (thigh 33, leg 18, foot 1); upper extremity: 17 cases (arm 9, forearm 7, and hand 1); trunk: 31 cases (back 11, chest 8, buttock 6, groin 4, abdominal wall 2); head and neck: 19 cases (tongue 10, neck 6, head 3); diaphragm: 3 cases; psoas muscle 1. As is the case with other malignant tumors of the soft parts and bones, the thigh and leg are the favored sites of origin.

Duration of Disease.—In 48 cases the total duration of disease is known from the onset of symptoms until death. The mean is 30.25 months, with the extremes of two months (Case 90) and 162 months (Case 20). If two extremely long survival cases are omitted (Cases 20 and 93), the mean for the remaining 46 is only 24.9 months. There are, however, several other cases of very long duration of the tumor in which the total duration is not

known. Since they are referred to later in this paper attention will be directed only at this point to Case 38, with a reputed duration of 50 years. It is evident that one must be very cautious in predicting the probable duration of one of these tumors.

GRAPH I

Age Distribution of 116 Cases of Rhabdomyosarcoma of Muscles and Soft Parts



Mean Age—42.1 years. Variation 0–84

Symptoms.—Commonly the only symptom is tumor which in 88.5 per cent developed without any history of antecedent trauma and often without pain or interference with function. Increase in size is sometimes rapid and sometimes extremely slow and a considerable bulk may be attained although not as a rule the massive proportions of many liposarcomas. The deep situation and muscular involvement produce a moderately firm deep-seated mass, which is of very limited mobility. Sometimes growth of the tumor compromises the overlying skin and the tumor fungates. This may also happen after biopsy. The appearance is shown in Figures 3 and 12.

Gross Characteristics.—The tumor tissue varies greatly in its hardness because of the great variation in the amount of collagen in it. Generally it is rather soft, somewhat reddish and may be mottled with various tints of red and cream from hemorrhage and necrosis. It is often circumscribed but always infiltrates surrounding tissues, although it is not always possible grossly to demonstrate this.

TABLE I

RHABDOMYOSARCOMA

REPORTED AND PERSONAL CASES

Author	No.	Sex	Age	Site	Dur* A.T.	Excision 1	2	3	4	5	6	7	13	Ampu-tation	Other Op.	Pre-op. Rad.	Post-op. Rad.	Rad. Alone	Re-cur.	Met-as.	Dead	Alive Tumor	Alive ∓ T.	Total Dur. Mos.
Ammunategui	1	F	5	Glut. max.		+													+	+	+			
Ardoin	2		3	Temp. mast.		+													+		+(6)			6
Benison (Case 7)	3	F	23	Coraco-brach.	7									+inter-scap.	+ (biop.)	+							+(0)	
Bérard	4	M	2	Back		+									+(pal)				+		+(18)			
Billroth	5	F	Ad.	Arm	6	+	+	+											+			+(18)		
Bolanos	6	F	12	Tongue	12	+									+(biop.)	+							+(0)	
Buhl																								
(1)	7	F	28	Sacral		+													+			+(0)		
(2)	8	M	50	Chest		+													+			+(0)		
Burgess	9	F	19	Thigh, muscle																+	+			Few
Cappell (6)	10	M	60	Tongue		+	+	+									+		+	+	+			48
Charache	11	M	44	Thigh	6	+											+		+	+	+			12
Danciger & Warren	12	M	2	Gastroc.																+	+			18
De & Tribendi																								
(1)	13	F	46	Thigh		+	+										+		+	+	+			43
(2)	14	M	13	Axilla	12	+																	+(48)	
(3)	15	M	38	Hand	60	+								+			+		+		+(24)			84
(4)	16	F	20	Back muscles	11	+	+	+									+		+			+(96)		
(5)	17	M	39	Thigh	3	+											+					+(3)		
(9)	18	M	50	Arm																	+			24
(11)	19	M	48	Thigh	144									+						+		+		
(12)	20	M	45	Tongue	108	+	+	+									+		+		+			162
(13)	21	M	11	Leg	36									+									+(0)	
De Castro-Freire	22		½	Tongue	6	+																	+(0)	
Desmarest & Masson	23	M	80	Thigh	3	+																	+(0)	
Engelbreth-Holm	24	M	75	Neck																+	+			24
Fitzwilliams	25	M	62	Thigh	3									+ hind-qrtr.									+(0)	
Frank, *et al.*	26	F	40	Neck	132	+	+										+		+				+(36)	
Fuginami	27	M	50	Leg	120									+									+(0)	
Genevet																								
(1)	28	M	32	Leg		+															+(3)			
(2)	29	F	50	Thigh		+															+(6)			
(3)	30	F	22	Leg																				

TABLE I—*Continued*

RHABDOMYOSARCOMA
REPORTED AND PERSONAL CASES

Author	No.	Sex	Age	Site	Dur* A.T.	Excision 1	2	3	4	5	6	7	13	Ampu-tation	Other Op.	Pre-op. Rad.	Post-op. Rad.	Rad. Alone	Re-cur.	Met-as.	Dead	Alive Tumor	Alive ∅ T.	Total Dur. Mos.
Geschickter																								
(2)	31	M	63	Forearm		+													+			+(36)		
(3)	32	M	17	Leg	2									+									+(132)	
(4)	33	F	44	Sacral		+	+										+		+	+		+		
Glasunow																								
(3)	34	M	74	Thigh	12	+	+												+				+(0)	
(4)	35	M	32	Leg	7									+		+							+(0)	
(5)	36	F	18	Thigh	24									+(dis-art.)	+				+	+		+		
Halley	37	M	40	Calf	60	+											+			+				
Harper & Feder	38	M	75	Neck	600	+													+			+		
Johan Jönsson	39	F	44	Arm	5	+	+												+				+(0)	
(1)	40	F	65	Back	6	+	+	+									+		+		+(116) No tumor			
(2)	41	F	55	Thigh	2	+	+									+	+		+	+	+			53
(3)	42	M	78	Groin											+(pal.)			+			+			15
(4)	43	F	45	Gluteal														+			+			
(5)	44	M	47	Leg		+	+												+		+(60)			
(6)	45	F	44	Chest		+	+	+	+	+	+	+							+		+(38)			
(7)	46	M	57	Arm	24	+								+(dis-art.)			+		+	+	+(22)			46
(8)	47	M	55	Thigh		+	+										+		+		+(suicide)			
(9)	48	F	48	Thigh	6	+											+		+	+	+(16)			22
(10)	49	M	57	Thigh	1									+(dis-art.)			+		+	+	+(5)			6
(11)	50	F	36	Thigh	24										+(pal.)			+	+	+	+(26)			50
(12)	51	F	64	Leg	3	+											+		+	+	+(11)			14
(13)	52	M	57	Thigh, gluteal	10													+	+		+(4)			14
(14)	53	M	56	Leg	1	+								+			+		+	+	+(7)			8
(15)	54	M	80	Leg	1½													+	+		+(34½)			36
(16)	55	M	48	Knee	8									+		+					+(2)			10
(17)	56	F	28	Chest	2	+										+	+						+(71)	
(18)	57	F	59	Leg	7									+		+				+	+(19)			26
(19)	58	F	52	Abd. wall	1½	+	+										+		+	+	+(6)			7½
(20)	59	F	57	Thigh	3													+	+		+(34)			37
(21)	60	F	48	Thigh	3													+	+	+	+(15)			18

TABLE I—*Continued*

RHABDOMYOSARCOMA

REPORTED AND PERSONAL CASES

Author	No.	Sex	Age	Site	Dur* A.T.	Excision 1	2	3	4	5	6	7	13	Ampu-tation	Other Op.	Pre-op. Rad.	Post-op. Rad.	Rad. Alone	Re-cur.	Met-as.	Dead	Alive Tumor	Alive - T.	Total Dur. Mos.
(22)	61	F	63	Groin	6													+	+		+(3)			9
(23)	62	F	45	Thigh	24	+										+			+	+	+(18)			42
(24)	63	F	57	Gluteal	3	+											+		+		+(26)			29
(25)	64	F	16	Thigh		+	+										+		+	+	+(7½)			
(26)	65	M	78	Back	1	+	+	+	+								+		+			+(49)		
(27)	66	M	77	Groin	18	+										+					+(art-scleros. (8)			
(28)	67	F	52	Thigh	1	+	+										+		+	+	+(78)			79
(29)	68	F	41	Abd. wall	4	+											+		+			+(30)		
(30)	69	M	69	Gluteal	3	+											+		+	+	+(12)			15
(31)	70	F	28	Thigh	10	+										+	+					+(24)		
(32)	71	M	48	Forearm	18	+	+										+		+	+	+(10)			28
(33)	72	M	30	Thigh	5½	+										+	+			+	+(12)			17½
(34)	73	F	47	Back	1	+											+						+(18)	
(35)	74	M	46	Thigh	18	+											+						+(18)]	
(37)	76	F	52	Leg	6									+		+					+(p. op.)			
(38)	77	F	53	Thigh	4	+	+										+		+	+		+(27)		
(39)	78	F	58	Thigh and axilla	44 36	+											+						+(12)	
Kirschbaum (1)	79	M	47	Diaphragm																+	+			3½
Lepage	80	M		Submax.		+	+												+				+(84)	
Ligas	81	M	53	Thigh	5	+																	+(0)	
Lino	82	F	24	Tongue		+																	+(0)	
MacCallum																								
(1)	83	M	59	Arm	1	+	+	+						+(dis-art.)					+	+	+(pul. emb.)			5½
(2)	84	F	70	Leg	12	+													+		+(46)			58
Marchand	85		4	Gluteal																				
Von Meyenburg	86	M	57	Tongue		+	+												+		+			13+
Muller	87	M	48	Thigh										+(dis-art.)									+(0)	
Ono	88	M	24	Forearm	1	+	+							+					+				+(0)	
Oswald	89	M	36	Neck	36±	+													+	+	+(4)			
Peery & Smith	90	M	14	Diaphragm	2															+	+			2
Pendl	91	M	0	Tongue	2	+																	+(0)	
Rakov																								
(7)	92	F	47	Arm		+	+	+	+	+	+								+			+(132)		

TABLE I—*Continued*

RHABDOMYOSARCOMA

REPORTED AND PERSONAL CASES

Author	No.	Sex	Age	Site	Dur* A.T.	Excision 1	2	3	4	5	6	7	13	Ampu-tation	Other Op.	Pre-op. Rad.	Post-op. Rad.	Rad. Alone	Re-cur.	Met-as.	Dead	Alive Tumor	Alive ē T.	Total Dur. Mos.
(12)	93	F	48	Arm		+	+	+	+	+	+	+	+	+(inter-scap.)					+	+	+(12)			144
Ribbert																								
(1)	94			Temporal		+																	+(0)	
(2)	95	M	boy	Face		+													+			+		
Richmond																								
(1)	96	M	45	Thigh	36	+											+		+	+	+(8½)			44½
(2)	97	F	59	Thigh	9									+	Biop.						+(P.O.)			
Rutz	98		0	Tongue	5	+																	+(0)	
Ryan	99	F	51	Diaphragm	2															+	+			4¼
Scott-Carmichael	100	M	56	Arm (bilat.)	3	+																	+(4)	
Stulz, *et al.*	101	M	66	Forearm	12	+	+												+				+(0)	
Targett	102		0	Neck	6	+	+												+				+(6)	
Thomas	103		4½	Tongue	12	+	+	+	+	+	+								+		+(8)			20+
Tourneux & Gouzi	104	F	21	Psoas		+																		
Warnery	105	F	7½	Back																				
Weber	106	M	21	Tongue		+													+			+(0)		
Wolbach	107	F	4	Back	1½	+													+		+(4)			5½
Columbia Univ.																								
(1)	108	M	22	Thigh	4									+(dis-art.)	Biop.	+				+	+(2)			6
(2)	109	M	21	Leg	8									+	Biop.	+				+	+(3)			15
(3)	110	M	47	Thigh	7										Biop.			+	+		+			16
(4)	111	F	19	Leg	1	+	+	+						+					+	+	+(35)			49
(5)	112	F	35	Back	5										Biop.			+	+			+(8)		
(6)	113	M	75	Gluteal	6										Biop.			+	+	+	+(8)			14
(7)	114	F	63	Forearm	9										Biop.						+			39
(8)	115	M	56	Thigh											Biop.						+(4)			
(9)	116	F	33	Arm	¼	+																	+(60)	
(10)	117	M		Forearm	12	+									Biop.				+			+(6)		
(11)	118	F	15	Back	5±	+	+ (25)																+(51)	
(12)	119	M	53	Axilla	½										Biop.							+(0)		
(13)	120	M	69	Chest wall	5	+	+ (6)										+				+(12)			
(14)	121	F	66	Foot	32	+								+(14)					+				+(0)	

* Duration before treatment.

All duration figures are recorded in months.

Spread.—The insidious character of the local invasive spread of the tumor is indicated by the high incidence of local recurrence after treatment, 108 cases received some kind of an attempt at curative treatment. Local recurrence was noted in 66, or 61 per cent. Spread also takes place through the blood and lymphatic systems. Thirty-eight patients are known to have had metastases. The site of these was as follows: Lungs 23, lymph nodes ten, skin and subcutaneous tissues eight, pleura seven, bones five, liver three, kidney, suprarenal mediastinum and pericardium two each; pancreas, ovary and brain, one each. Metastases were generalized in only five cases.

Duration of Tumor before Treatment.—This is recorded in 84 cases, and the mean duration for these is 23.2 months. But five cases had an inordinately long duration of from nine to 50 years before treatment was undertaken. If these are omitted, the other 79 cases had a mean duration of 10.7 months, with a variation from a few days to five years.

Treatment.—Reference to Table I will show that many different ways of dealing with these tumors have been employed. These have consisted principally of simple excision, amputation and, to a less extent, radiotherapy. Often two or all three methods have been employed. In so far as *radiotherapy* is concerned, it has been used as the sole method of treatment in 12 cases, without any good results. In all the tumor persisted and in ten the patient is known to have died. Preoperative radiation was used in 14 and postoperative radiation in 35 patients. Since operations were also performed, one cannot know whether or not the radiation had any important effect. It seems very questionable that it did. Postoperative radiation was used in Case 40 and failed to prevent a local reappearance of the tumor. When this was removed by electrocoagulation the patient then remained free of tumor for nearly ten years before dying of complications following a fracture. In Cases 66, 73, 74 and 78, the patients were symptom-free for eight, 18, 18 and 12 months after excision and radiotherapy but there is no further information about them and the periods are too short to be significant. Stewart found that the few rhabdomyosarcomas treated by radiotherapy at the Memorial Hospital were resistant. We may conclude that the tumor is certainly little affected by ordinary doses. Whether or not huge doses pushed to the limits of tolerance would accomplish anything more important remains to be determined.

The first treatment of 80 cases was an attempt at local excision of the tumor. Twelve of these were not followed and five more were without evidence of tumor less than five years (at 48, 8, 18, 12 and 4 months). Only two remained well five or more years. Case 56 had a tumor of the chest wall below the clavicle which grew rapidly for two months and was treated by excision with pre- and postoperative radiotherapy. When last seen, 71 months after operation, she was symptom-free. Case 116 had a small tumor excised from within the triceps muscle only one week after the tumor was found. Five years afterwards there was no evidence of recurrence. Of the remaining 63 patients all had recurrence or metastases and 36 had subsequent operations, either further excisions (to the number of 13 in Case 93) or amputation or both. Of these all but three are dead or were last seen with tumor persisting.

Case 26 had a 6 x 5 cm. tumor in the neck deep to the muscles for 11 years. It had eroded the vertebrae and reached the spinal canal, producing pressure symptoms. Excision was incomplete and after one month a second excision was done supplemented by radium in the wound and postoperative roentgenotherapy. Three years later there was no evidence of recurrence. Case 102 was also in the neck and was congenital. It was incompletely removed from its deep situation and a second excision was carried out one month later. Six months after the second operation the child was well. Case 118 is Case 11 reported in this paper. Twenty-five months after removal of the primary tumor from the rhomboideus muscle a recurrence was excised, and 51 months after the second operation she was well. With these should be mentioned Case 40 who died of injuries and was without evidence of persistence nine and two-thirds years after the last of three attempts to remove a tumor of the back.

Primary amputation or amputation after biopsy was carried out 16 times. Seven were not followed, two died as a result of the operation, six had recurrences or metastases and only one had a good result. This is Case 32, which had a primary amputation for a tumor of the leg and was reported well 11 years later.

Of the 13 remaining cases, there was either no treatment or there is none recorded.

There are several cases of long survival with the tumor persisting which should be noted. Tumor persistence of nine years is noted in Cases 16 and 20, ten years (Case 27); 11 years (Case 92); 12 years (Case 19); 13⅔ years (Case 20); 14 years (Case 26); and 50 years (Case 38). It is quite evident, therefore, that rhabdomyosarcoma may persist for a very long time without killing.

From the above data it will be appreciated that it is impossible arbitrarily to select the best form of treatment, since of four long survivals without evidence of persisting tumor one (Case 32) was treated by primary amputation alone; one (Case 116) by simple excision alone; one (Case 56) by simple excision with pre- and postoperative radiotherapy; and one (Case 40) by excision and postoperative radiotherapy followed by two subsequent excisions of recurrences. It is manifest, however, that in a very large number of cases the first procedure was an inadequate excision and one should be able to cure this neoplasm more often if it is attacked earlier and in a more radical manner. Long study of cases of malignant tumors of the peripheral soft parts and bones has convinced the writer that they should not be attacked by blind removal before obtaining definite knowledge of their nature by biopsy. If the tumor is treated without knowledge of its nature one runs the hazard of removing too much or too little; usually the latter. A small biopsy removed with the minimum amount of trauma will furnish the information necessary for proper action and of itself will do no harm. In the case of the rhabdomyosarcoma, treatment should certainly be radical with removal of a large block of surrounding uninvolved tissues. This may or may not mean amputation.

CASE HISTORIES

Case 1.—(Table No. 108): M. C., male, Jewish presser, age 22, was first seen at the Presbyterian Hospital, October 14, 1921. He had noted a swelling the size of a hen's egg on the inner aspect of the right thigh for three months, which appeared without history of injury. It was hard, freely movable, and painless until two weeks before admission. It increased rapidly in size so that on admission the circumference of the right thigh was 48 cm. in comparison with 39 cm. for the left. The swelling of the thigh was diffuse and extensive measuring 24 x 14 cm. Wassermann reaction negative. Roentgenograms showed a soft-part tumor without bony involvement. Aspiration yielded only blood. October 21, 1921, a biopsy was taken which was diagnosed as a malignant sarcoma. The wound did not heal well because the tumor grew up into it. The patient refused amputation. A small amount of low voltage roentgenotherapy was given to the thigh and to the chest after roentgenograms of the lungs, November 2, 1921, showed shadows suggestive of pulmonary metastases. A secondary metastatic mass appeared on the anterior surface of the right leg. Because of pain and ulceration the patient consented to disarticulation of the right hip November 15, 1921. The pulmonary metastases enlarged rapidly, and he died January 9, 1922.

Grossly (S. P. 26812) the tumor was 32 cm. in length with a maximum thickness of 8 cm. where it ulcerated through the skin. It was soft orange-pink with areas of hemorrhage. It involved the vastus medialis muscle but not the bone. In the leg anteriorly were two secondary subcutaneous nodules of similar appearance.

Microscopic: Very large strap cells with hyperchromatic nuclei often in tandem arrangement. Occasional rounded giant forms. Much blood pigment. No longitudinal or cross-striations and no vacuolated spider cells seen. Cytoplasm moderately acidophilic. (No special stains available.)

Case 2.—(Table No. 109): R. L., white American farmer, age 21, was admitted to the Presbyterian Hospital, July 16, 1932. He had noticed, by chance, a painless, egg-sized swelling of the lateral side of the right calf at the midpoint of the leg eight months before. Five months before it began to be painful after he had been walking. Fifteen days before a biopsy was taken elsewhere and called a mixed cell sarcoma. Examination showed a 6 x 8 x 12 cm. mass in the outer part of the right gastrocnemius muscle. Roentgenotherapy was begun July 18, 1932, and carried on sporadically until October 15, 1932. Large fields were used (15 x 20, 20 x 20, and 15 x 15 cm.), 180 to 200 KV; 50 cm. A. S. D. and filtration 0.55 Cu. plus 1, mm. Al. A total of about 8,520 r was given through the various fields to the leg. Toward the end of this period two nodules appeared in the popliteal space which were biopsied November 17, 1932, and proved to be metastases. The extremity was amputated through the midthigh November 23, 1932. Following this he had a great deal of pain in the right groin and right lower quadrant with enlarged tender inguinal nodes. Roentgenograms of spine and chest showed no evidence of metastases. Cordotomy for relief of pain was contemplated, but before this could be arranged the level of the pain had ascended so high that this was abandoned. He died at home, February 11, 1933.

Gross (S. P. 49920) (Fig. 1): The tumor measured 7 x 8.5 cm., it lay within the gastrocnemius and soleus muscles. The cut-surface was grayish mottled with red areas of hemorrhage and yellow areas of necrosis. There were four other separate nodules in these muscles and others in the tibialis anticus and the popliteal space.

Microscopic: The tumor is much altered by the radiation which has produced widespread degeneration, necrosis and fibrosis. Where the cells have escaped they appear as large strap forms with nuclei in tandem, acidophilic cytoplasm and occasionally well-defined longitudinal intracellular fibers. No cross-striations discovered. Many cells are vacuolated. Rare giant cells but no spider forms.

Case 3.—(Table No. 110): R. P., a colored dining-car waiter, age 47, first came to the Presbyterian Hospital April 12, 1934. Four years before he hurt his left thigh by stepping into a coal pit, resulting in pain in the medial thigh muscles. Ten months

before he struck the same thigh against a dining-car table. Pain began seven months before, and swelling was first noticed one month later. Gradual increase of symptoms causing some limp. Examination showed a 15 x 20 cm. hard mass in the middle of the left thigh apparently in the vastus medialis muscle (Fig. 2). Not tender and only slightly movable. Wassermann reaction and roentgenograms of thigh and chest negative.

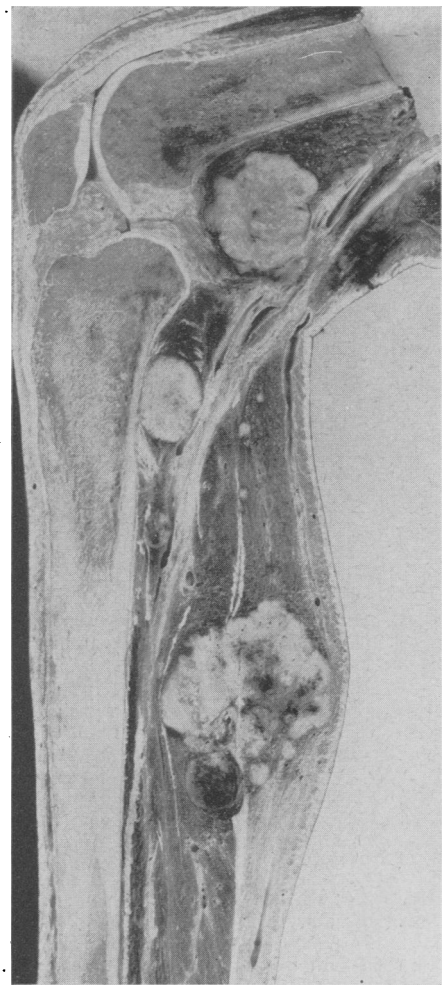


FIG. 1.—Case 2 (Table No. 109) : Rhabdomyosarcoma of gastrocnemius muscle showing secondary nodules.

He was admitted and a biopsy done April 26, 1934. This showed a pale elastic tumor mass deep to the vastus medialis which exuded serous fluid when the biopsy cut was made. The inguinal and femoral nodes were not enlarged. He was treated by a large radium pack with 43 tubes containing from 5 to 12.5 mg. radium totalling 350 mg. The pack was left on for seven days and a dose equivalent to 50,000 r given. This was done May 5, 1934 to May 11, 1934. It was supplemented by 2300 r of high voltage high filtration roentgenotherapy given through anterior and two lateral ports sporadically from April 30, 1934, to October 1, 1934. The mass decreased in size somewhat but never disappeared.

Evidence of spread or metastasis was never obtained but the pain returned, grew much worse, and he died at home February 21, 1935.

Microscopic.—(S. P. 54161): Rather large irregularly-shaped cells with finely granular acidophilic cytoplasm. No longitudinal or cross-striations. Some strap forms with nuclei in tandem arrangement. No giant cells but some cells with vacuoles.

Case 4.—(Table No. 111): M. L., a white American secretary, 19 years old, Eighteen months before coming to the hospital she bruised her right knee but was able to continue work. Four months later she noticed a swelling over the right shin at the site of a spot which she often used to push in the lower drawer of a filing cabinet. It was the size of a quarter and not discolored. A physician excised it in his office one month later. It recurred in two months and was again locally excised. This wound never healed, and after three months it was excised for the third time four months before admission. This wound also failed to heal, and when admitted there was a multinodular fungating growth elevated 2 cm. above the surface and measuring 11 cm. vertically and 7 cm. transversely (Fig. 3). Roentgenograms showed no lung metastases. December 9, 1937, a supracondylar amputation was done through the lower third of the thigh. She remained well until March 1, 1939, when evidences of lung metastases appeared. Roentgenograms, July 15, 1939, showed a large mass in the left upper lobe. Two months later this had doubled in size but the girl felt relatively well and remained active until September, 1940. A large recurrent tumor mass then appeared above the amputation site and metastatic nodules in the mammary and clavicular regions. She died at home, November 16, 1940, 35 months after amputation.

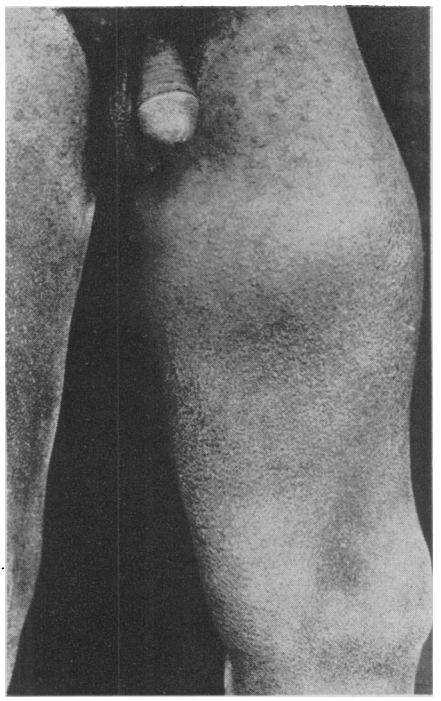


FIG. 2.—Case 3 (Table No. 110): Rhabdomyosarcoma of vastus medialis muscle.

Gross (S. P. 65768) (Fig. 3): The tumor involved the tibialis anticus, extensor longus digitorum and peroneus longus muscles. It was pinkish in color with hemorrhagic areas, and had a maximum thickness of 4 cm. Two popliteal lymph nodes showed no tumor.

Microscopic (Fig. 4): The tumor is composed of bundles of large spindle and strap cells with moderately acidophilic cytoplasm, sometimes granular and sometimes showing longitudinal striations. Cross-striations are demonstrated with difficulty because they rarely traverse the cell completely. Giant cells are occasionally present, some of which are vacuolated.

Case 5.—(Table No. 112): L. W., a Jewish woman, age 35, was admitted to the Urologic Department of the Presbyterian Hospital, complaining of five months back pain more severe on the right side. It grew constantly worse, with loss of 15 pounds weight. Examination showed an elastic nonfluctuant mass to the right of D 10 and D 11. It was rigidly attached to the ribs. Roentgenograms showed erosion of the eleventh rib posteriorly. She was transferred to the Fracture Service, and explored December 28, 1937. The tumor was grayish-white with dark hemorrhagic areas. The muscles were infiltrated and the ribs surrounded with tumor penetrating inside the thoracic cage. It

extended transversely from just to the right of the midline to the posterior axillary line. Biopsy was taken and roentgenotherapy started January 3, 1938, and continued to February 3, 1938. The factors were: 200 KV, 25 MA, TSD 50–80 filters varied from 0.5 to 2 mm. Cu. The fields were direct posterior and right and left tangential varying from 10 x 20 to 15 x 15 cm. Twenty-seven daily treatments totaling 400 r direct and 3,000 r to each of the two tangential fields. The treatment had little effect and the

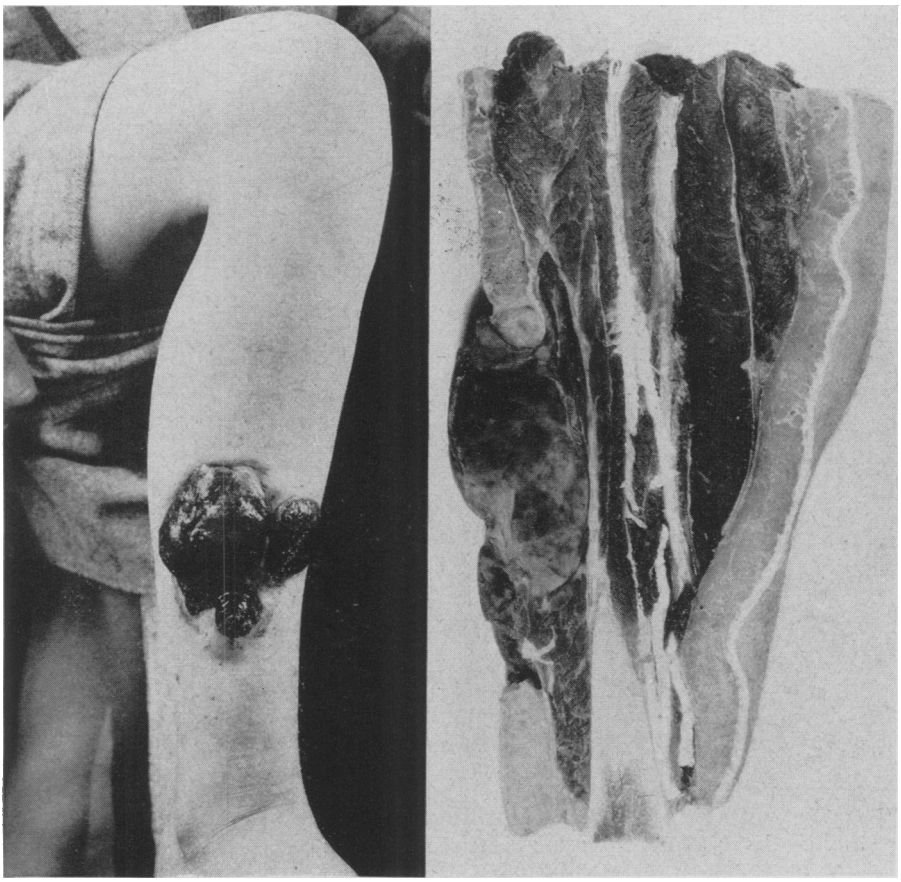


FIG. 3.—Case 4 (Table.No. 111): Rhabdomyosarcoma of leg muscles.

last note stated that eight months after operation she had gone down hill rapidly and would probably soon be dead.

Microscopic (S. P. 65925) (Fig. 5): There are bizarre and strap cells with many longitudinal fibers best shown with Heidenhain's hematoxylin and phosphotungstic acid. Acidophilic intracellular granules sometimes suggest an abortive attempt to form cross striations. There are a few giant cells but no spider forms. There is a well developed connective tissue framework.

Case 6.—(Table No. 113): W. S., white, male, age 75. Six months before admission, without known cause, an area of soreness developed below the flexion crease between the right thigh and buttock. One month before a mass was noted. It lay just caudad to the right ischial tuberosity, measured about 8 x 6 cm., and was apparently deep to the fascia. Roentgenograms of chest and skeleton were negative. Aspiration was done November 14, 1938, yielding soft, gray bloody tissue. Roentgenotherapy was started November 12, 1938, and estimation of the size of the mass at this time was 12 x 14

cm. The factors were: 200 KV, 25 MA, 50 TSD, filter 1 mm. Cu plus 1 mm. Al. The fields were superior delivered in the kneeling position through the buttock receiving 3,000 r, and two lateral fields each of which received 2,000 r. Treatments continued daily from November 12, 1938, to December 22, 1938. Evidence of pulmonary metastases developed April 24, 1939, and he died July 4, 1939.

Microscopic (S. P. 68906): The few tumor cells present in the small biopsy are for the most part irregularly rounded and very variable in size with occasional multinucleated giant cells. Some of these have marginal vacuolation of the cytoplasm producing the so-called "spider" effect. No longitudinal or cross-striations are recognized. The cytoplasm is slightly acidophilic and without granules.

Case 7.—(Table No. 114): D. F., an Austrian Jewish widow, age 63. Fourteen years before this woman had had a right radical mastectomy for carcinoma, without axillary metastases. She was apparently cured of this. Nine months before her second

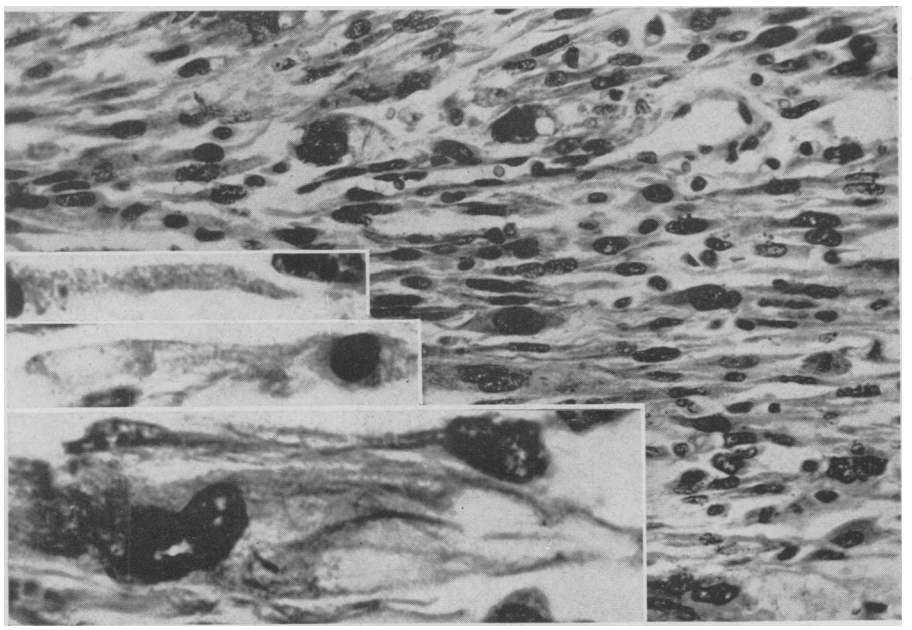


FIG. 4.—Case 4 (Table No. 111): Photomicrograph (x 410 and x 1240). Heidenhain's hematoxylin stain. The insets in the lower left corner show two strap cells with poorly defined cross-striations and two other cells with longitudinal myofibrils.

admission to the Presbyterian Hospital a painful swelling appeared on the outer aspect of the right forearm just caudad to the olecranon. It seemed to lie in the forearm muscles, was about 13.5 cm. in diameter and roentgenograms showed that it had eroded the outer condyle of the humerus probably by pressure. It was biopsied May 3, 1939. The woman refused all forms of treatment. The tumor slowly increased in size, ulcerated at the site of biopsy (Fig. 6) and she died at home approximately two and a half years after biopsy. Whether or not there were metastases is unknown.

Microscopic (S. P. 70542): The tumor is made up of bizarre large cells, amorphous usually but with strap syncytia formed occasionally. Giant forms are present but no spider cells. The cytoplasm is acidophilic and usually nongranular. Vague cross-striations are shown in some of the giant cells (Fig. 7).

Case 8.—(Table No. 115): M. A., a male, age 56. The only history available states that this man had a mass beneath his thigh muscles (*sic*) which was thought to be an hematoma. It was biopsied in October, 1916. In four months he was dead.

Microscopic (P & S 3689): The tumor is made up of masses of large cells of extremely varied shape, including occasional strap forms with nuclei in tandem, and more giant cells with several nuclei near the center of the cell and vacuoles in the cytoplasm. The cytoplasm is sometimes granular. Very little fibrous framework. No longitudinal or cross-striations seen but the preparation is poor and there are no special stains.

Case 9.—(Table No. 116): Mrs. J. B., a white, American female, age 33. By chance the patient felt a lump in the right posteromedial brachial region and the next day consulted Dr. R. N. Schullinger. It was painless, rounded, and could be moved from side to side, but not from above downward. It was excised from within the belly of the triceps muscle March 3, 1932. Five years later there was no evidence of recurrence.

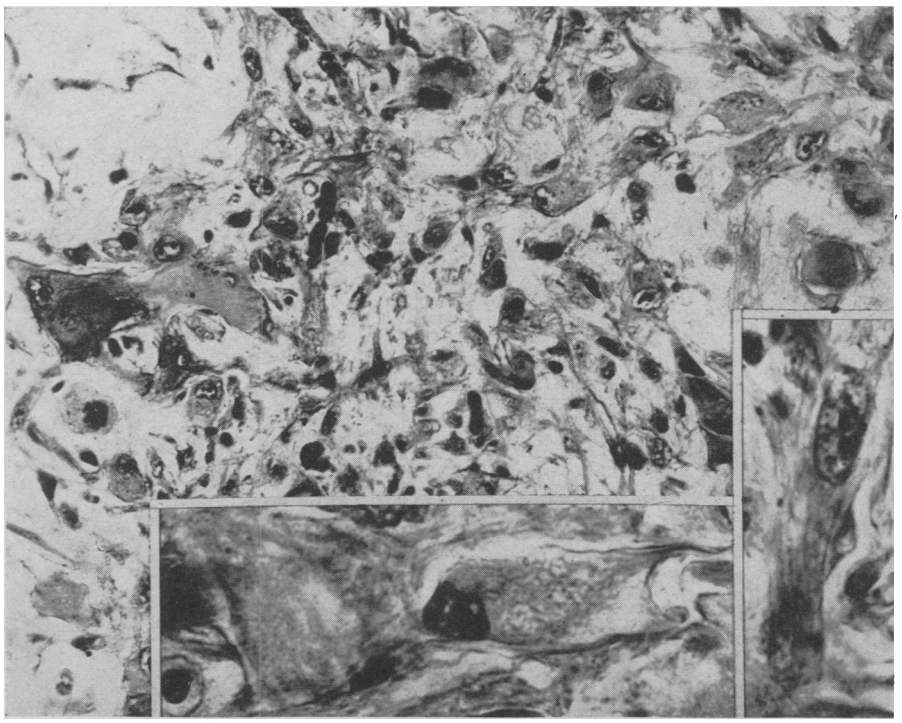


FIG. 5.—Case 5 (Table No. 112): Photomicrograph of rhabdomyosarcoma of back muscles. Heidenhain's hematoxylin stain (x 410 and x 1240). The highly magnified cell to the right shows longitudinal myofibrils and the two cells below contain granules which have an arrangement suggesting imperfect cross-striations.

Gross (S. P. 12245): A pallid, firm, pear-shaped encapsulated tumor 2 x 1 x 1 cm. The cut-surface showed a glistening white appearance with one small area of hemorrhage.

Microscopic (Fig. 8): Most of the tumor cells are small, amorphous or rounded cells with vacuolated cytoplasm. Scattered at intervals are larger rounded cells with strongly acidophilic cytoplasms which frequently show cross-striations. No longitudinal striations are seen. The nuclei are for the most part small and they do not have the sharply accentuated chromophilic markings of the more malignant and less well-differentiated rhabdomyoblastomas.

Case 10.—(Table No. 117): L. W., a male, age not stated. Eighteen months before a growth first appeared beneath the skin of the forearm. After one year it was excised but it soon reappeared, and in six months it measured 9 x 6 x 3 cm. Its surface was ulcerated. A biopsy was taken June 14, 1933, by Dr. R. N. Schullinger. The subsequent course is not known.

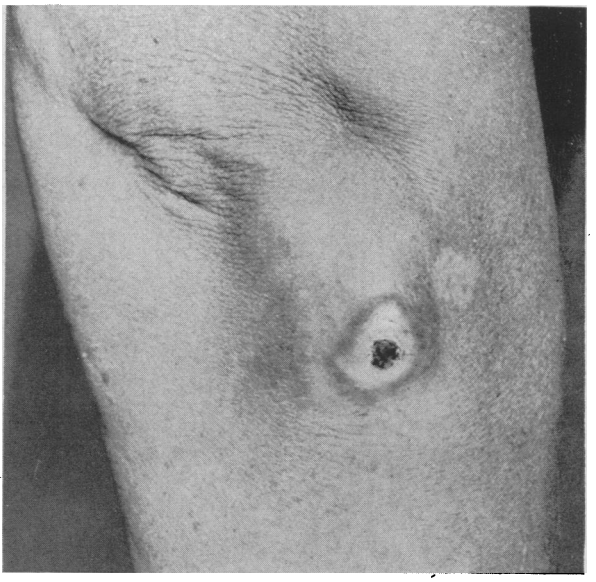


FIG. 6.—Case 7 (Table No. 114): Rhabdomyosarcoma of forearm showing biopsy site.

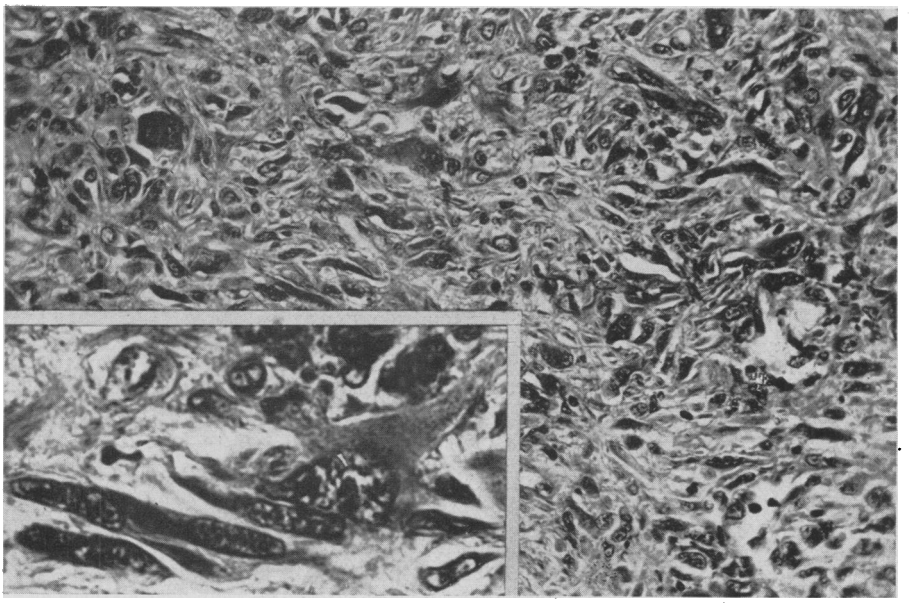


FIG. 7.—Case 7 (Table No. 114): Photomicrograph (x 410 and x 1260). Masson's acid fuchsin trichrome stain. The highly magnified inset in the lower left corner shows a strap cell with nuclei arranged in tandem and a giant cell with cross-striations faintly shown.

Microscopic (P & S 12931): The biopsy is very small and from the surface. It shows a very edematous tumor in which the cells are widely separated. They are usually elongated and either have the nucleus at one end or two or more nuclei in tandem. Occasional small giant cells are seen. The cytoplasm is strongly acidophilic and either edematous or vacuolated. No definite longitudinal or cross-striations are seen.

Case 11.—(Table No. 118): F. H., a white, American schoolgirl, age 15 years. About six months before treatment she first complained of vague pain in the left shoulder region. Some three months later a lump appeared in this area and gradually increased in size. It was excised by Dr. William C. White at the Roosevelt Hospital, New York, February 3, 1939. It was 7 cm. in diameter and lay within the rhomboideus major muscle. Two years later there was a recurrence in the scar of about the same size as

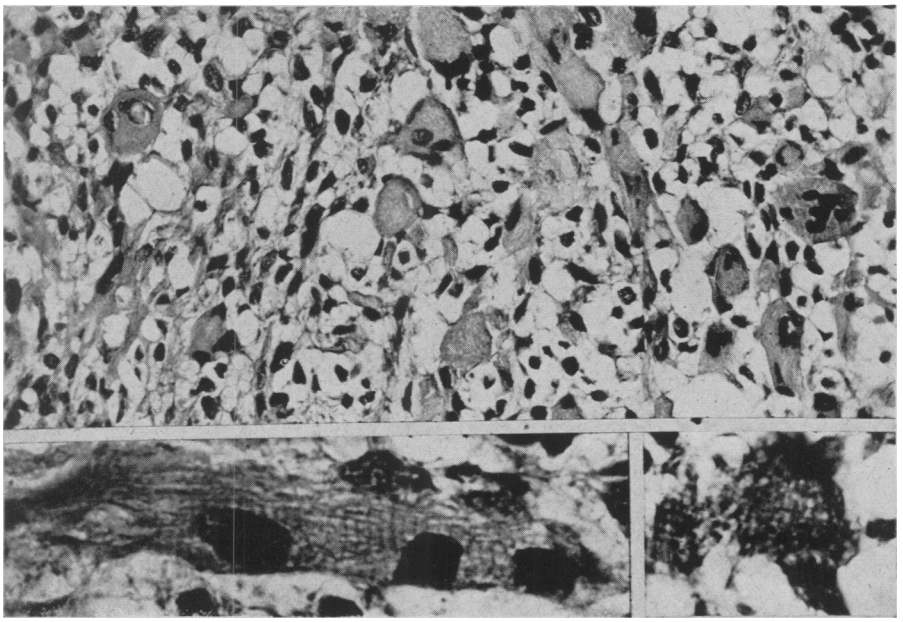


FIG. 8.—Case 9 (Table No. 116): Rhabdomyosarcoma of triceps muscle. Photomicrograph (x 410 and x 1260). Masson's acid fuchsin trichrome stain. An area showing many giant cells and much vacuole formation. The highly magnified insets below show the clearly defined longitudinal and cross-striations in some cells.

the original tumor. This was widely removed, the excision including both rhomboid muscles. Roentgenograms of the chest at this time were negative. Doctor White reports that the girl was married in January, 1945, and was well at the beginning of June, 1945, 76 months after the first operation and 51 months after the second. Both of the specimens were examined by Dr. W. W. Brandes, pathologist of the Roosevelt Hospital, who recognized the neoplasm as a rhabdomyosarcoma.

Microscopic (P & S 16658): The original tumor shows long tapering cells with strongly acidophilic cytoplasm sometimes showing cross-striations but no longitudinal fibers. These are collected into bundles and interlarded with occasional rounded cells of somewhat larger size with acidophilic cytoplasm but no cross-striations (Fig. 9).

Case 12.—(Table No. 119): A male, age 53. Two weeks before he noted masses in the right axilla which measured 2 x 4 cm. A biopsy was taken in April, 1939, at the Clifton Springs Sanitarium, at Clifton Springs, N. Y., and the section was submitted to this laboratory by Dr. W. C. Sternbergh, at that time connected with the Radiologic Department of the sanitarium.

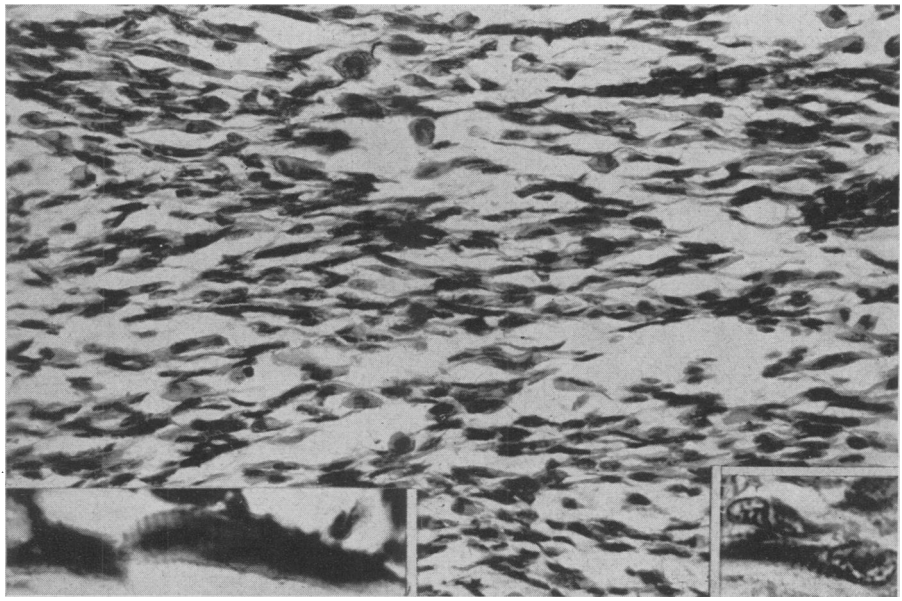


FIG. 9.—Case 11 (Table No. 118): Rhabdomyosarcoma of rhomboideus muscle. Photomicrograph (x 410 and x 1260). Masson's acid fuchsin trichrome stain. The highly magnified insets below show two tumor cells with clearly defined cross-striations.

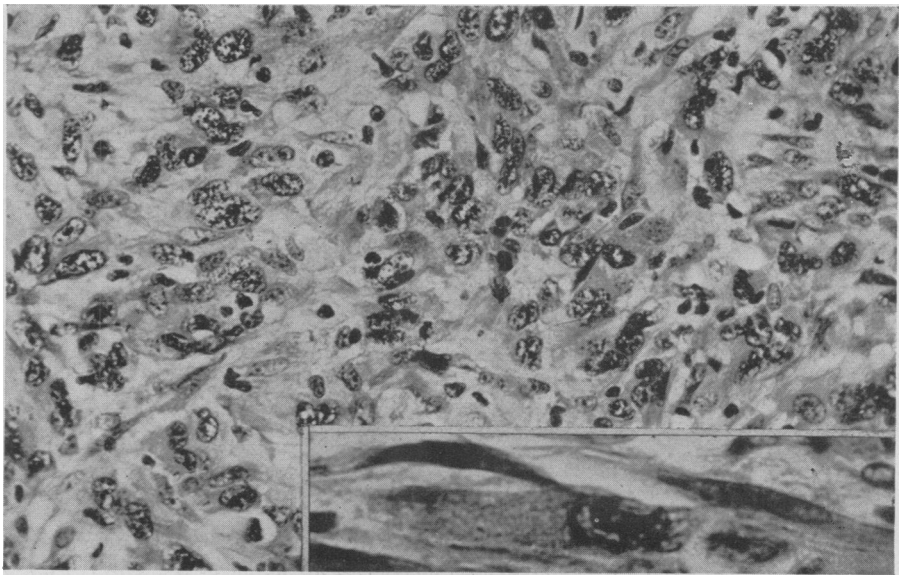


FIG. 10.—Case 12 (Table No. 119): Rhabdomyosarcoma of axilla. Photomicrograph (x 410 and x 1260). Masson's acid fuchsin trichrome stain. The highly magnified inset below shows two cells with faint poorly defined cross-striations.

Microscopic (P & S 16699): The tumor is made up of many very large amorphous to rounded syncytial masses with one or more large hyperchromatic nuclei and clearly defined nuclear markings. Some are vacuolated. Strap cells are also present but uncommon. Rather vague cross-striations but no definite longitudinal fibers are found. The cells have cytoplasm which varies from neutrophilic to strong acidophilic (Fig. 10).

Case 13.—(Table No. 120): M. G., a 69-year-old male Mexican. Eleven months before admission, following a strain from lifting a heavy object, a mass appeared in the right anterior axillary line. After five months it was the size of an orange and was excised. It recurred in the scar and when removed the second time it measured 8.5 x 5.5 x 7 cm., and could be moved over the fourth, fifth and sixth ribs. Fifty milligrams of radium

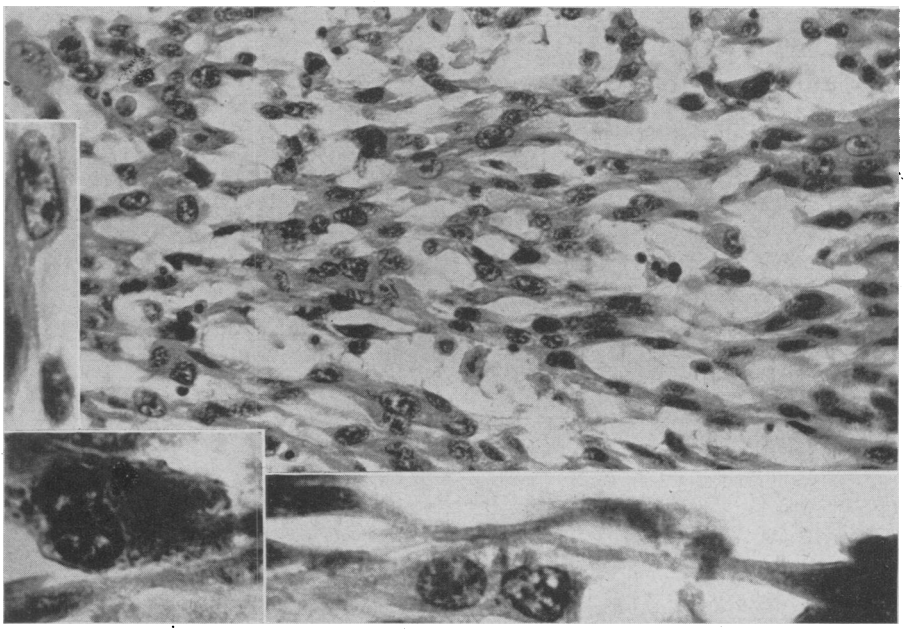


FIG. 11.—Case 13 (Table No. 120): Rhabdomyosarcoma of anterior chest wall muscles. Photomicrograph (x 410 and x 1260). Masson's acid fuchsin trichrome stain. The highly magnified cells below and to the left show strap cells and a giant cell with faintly defined cross-striations.

was put in the wound. When cut open the tumor was soft, light pinkish-gray with darker areas of necrosis. He died six months later. The material was submitted by Dr. A. O. Severance of the Nix Laboratories, San Antonio, Texas.

Microscopic (S. P. 17403): The tumor is made up of long slender strap cells with strongly acidophilic cytoplasms and some giant cells of small size. Cross-striations are demonstrated with difficulty (Fig. 11), but no longitudinal fibers are found.

Case 14.—(Table No. 121): M. R., a female, age 66. Two years and eight months before operation she noticed a small purple nodule on the medial aspect of the right foot at the arch. It grew slowly beneath intact skin. It was only occasionally painful. It was locally excised, but recurred three months later and continued to grow for 11 months, forming a large fungating ulcerated mass (Fig. 12). This time the foot was amputated at the Ellis Fischel State Cancer Hospital, Columbia, Mo. I am indebted to Dr. Lauren V. Ackerman, Director of the Hospital, for the gross photograph and the sections.

Microscopic (S. P. 23294): The tumor is made up largely of long slender cells resembling fibroblasts which grow in bundles accompanied by well-developed collagen and

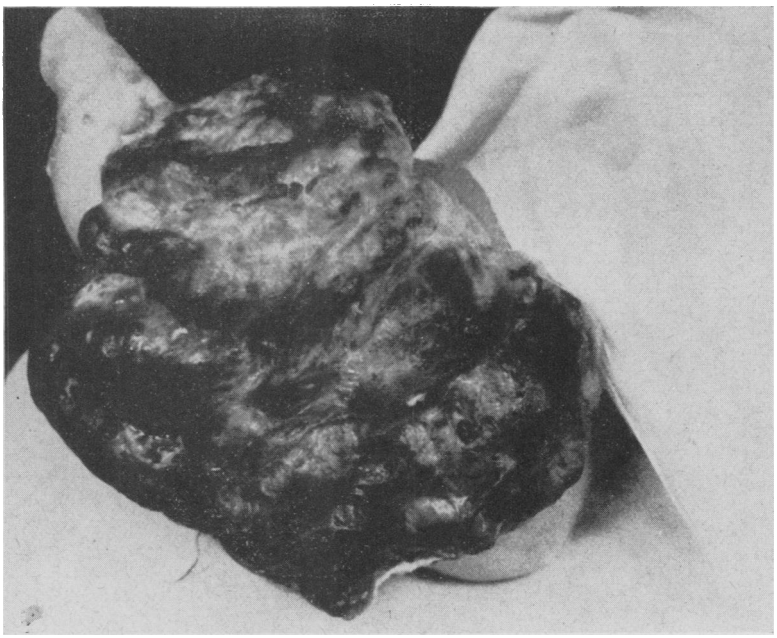


FIG. 12.—Case 14 (Table No. 121) : Rhabdomyosarcoma of the foot.

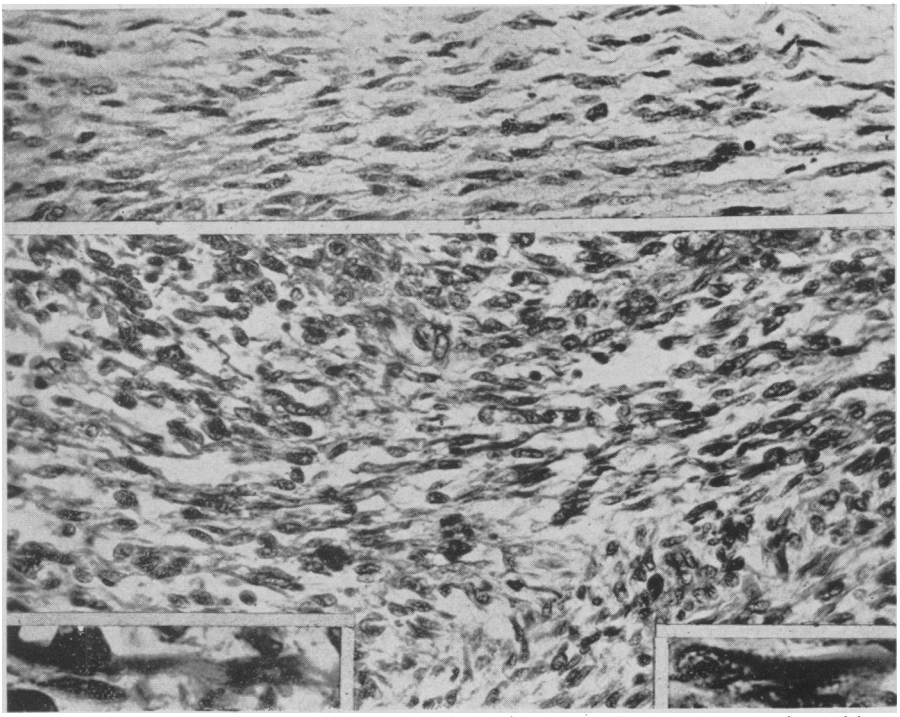


FIG. 13.—Case 14 (Table No. 121) : Photomicrograph (x 410 and x 1260). Masson's acid fuchsin trichrome stain. At the top is shown the fibrosarcoma-like area, below the less fibrous area with many strap cells. The highly magnified cells at the bottom with cross-striations were found in the latter area.

reticulin fibers. In one area there are fewer connective tissue fibers, the cells are more plump, and sometimes rounded. With Masson's trichrome stain it is possible to recognize that the cytoplasm of some of these cells is strongly acidophilic and that there are clearly defined cross-striations in a few of the small, plump, elongated cells and racquet-shaped forms. With the other stains used (eosin methylene blue and phosphotungstic acid hematoxylin) these features are so inconspicuous that they could very easily pass unnoticed (Fig. 13).

Summary. This study shows that, perhaps because it is so rare or so seldom recognized, painfully little information has accumulated in the past 90 years about rhabdomyosarcoma of the peripheral muscles. It is very difficult to form any clear mental picture of a tumor so variable that in one instance the clinical course from onset of symptoms until death was only two months (Case 90), while in another the tumor still persisted after 50 years (Case 38). Microscopically, the tumor is characterized by the presence of strap and racquet-shaped cells in which it is sometimes possible in good preparations to demonstrate cross-striations and longitudinal myofibrils, and by giant cells with peripherally arranged vacuoles causing the cell to resemble a spider or spider web. The cytoplasm of all these cells is more or less strongly acidophilic. Grossly, the tumors are found in or adjacent to striated muscles in various parts of the body but most commonly in the thigh and leg. The size is very variable but they seldom reach very great dimensions. The consistency also is variable but as they do not have a very high content of collagen, they are not apt to be extremely hard. Invariably, they infiltrate insidiously and metastases through the blood and lymphatic channels are not uncommon (31.5 per cent), with the lungs as the most favored repository. Records of only four symptom-free five-year survivals are reported among the 121 cases, 108 of which received treatment. One of these was treated by amputation alone, one by excision alone, and the other two by excision and radiotherapy. It should be noted, however, that long survivals of from nine to 50 years, with persisting tumor, are reported. If this tumor is to be cured more often, it is evident that extensive removal of the primary growth must be done earlier and more drastically with greater sacrifice of grossly healthy tissues about the growth. This need not always mean amputation. The writer feels very strongly that tumors of the soft-parts and bones should not be attacked without preliminary biopsy. If this is done carefully there should be no danger of tumor metastasis. Armed with a knowledge of the nature of the growth the most advantageous therapeutic procedure can then be selected.

BIBLIOGRAPHY

Ammuntegui, G.: Sarcomas primitivos de los musculos. Semana méd., **21**, 639, 1914.

Ardoin, G.: Sarcome rhabdomyoblastique de la région tempero-occipitale. Bull. Assoc. franc. p. l'étude du cancer, **18**, 255, 1929.

Benison, R. L.: Sarcoma of Muscles. J. Internat. Coll. Surg., 3, 460, 1940.

Bérard: Tumeur embryonnaire du muscle strié. Lyon méd., 77, 52, 1894.

Bick, E. M.: Skeletal Muscle Sarcoma. ANNALS OF SURGERY, **99**, 949, 1934.

Billroth, T.: Über eine eigentümliche Geschwulst der Muskeln (myoma cysticum). Virchows Arch. f. Path. Anat., **9**, 172, 1856.

Bolănos, J. M., and Despaigne, E.: Contribution al estadio de los rhabdomiomas de la lengua. Bol. Liga contra el Cancer, 6, 97, 1931.

Buhl, L.: Wahres, rezidivierendes Myom. Ztschr. f. Biol.. 1, 263, 1865.

Burgess, A. M.: Malignant Rhabdomyoma with Multiple Metastases. J. Med. Research, 29 (N. S. 24), 447, 1914.

Burke, E. M.: Sarcoma of the Soft Tissues. Am. J. Cancer, 35, 234, 1939.

Cappell, D. F., and Montgomery, G. L.: On Rhabdomyoma and Myoblastoma. J. Path. & Bact., 44, 517, 1937.

Charache, H.: Traumatic Rhabdomyosarcoma of the Thigh. Am. J. Surg., 32, 530, 1936.

Danciger, J. A., and Warren, J.: Rhabdomyosarcoma Case Report. J. Pediat., 19, 223, 1941.

De, M. N., and Tribendi, B. P.: Skeletal Muscle Tissue Tumor. Brit. J. Surg., 28, 17, 1940.

De Casto Freire: Rabdomioma congenito de extremodade anterior da lingua. Tip. do Comercio, Lisboa, 1922 (cited by Lino).

Desmarest, E., and Masson, P.: Sarcome du muscle biceps fémoral chez un homme de 80 ans. Ablation sous anesthésie rachidienne. Guérison. Bull. Soc. Anat. de Paris, 14, 449, 1912.

Distefano, G.: Istogenesi e classazione dei rabdomiomi benigni e maligni. Tumori, 10, 293, 1936.

Engelbreth-Holm, J.: Tumorer udgaaende fra tvaerstribet muskulatur. Hospitalstid, 79, 905, 1936.

Fitzwilliams, D. C. L.: Hindquarter Amputation for Sarcoma. Proc. Roy. Soc. Med., 31, 9 and 548, 1938.

Frank, L. W., Enfield, C. D., and Miller, A. J.: Rhabdomyosarcoma of the Neck. ANNALS OF SURGERY, 104, 431, 1936.

Fuginami, A.: Ein Rhabdomyosarkom mit hyaliner Degeneration (cylindrom) im willkürlischen Muskel. Virchows Arch. f. Path. Anat., 160, 203, 1900.

Genevet: Étude anatomo-pathologique du rhabdomyome en général et en particulier du rhabdomyome malin. Thèse de Lyon, 1900.

Geschickter, C. F.: Tumors of Muscle. Am. J. Cancer, 22, 378, 1934.

Glasunow, M.: Über unreife, begrenzt und destruierend wachsende Rhabdomyoblastome. Frankfurt. Ztschr. f. Path., 45, 328, 1933.

Gordon Taylor, G.: On Sarcoma of the Muscles and the Connective Tissue Spaces of Limbs. Brit. J. Surg., 28, 1, 1940.

Haagensen, C. D., and Krehbiel, O. F.: The Morphology of the Sarcomas Produced by 1:2:5:6-Dibenzanthracene. Am. J. Cancer, 26, 368, 1936.

Halley, G.: Rabdomiosarcoma. Tumor primitivo del miembro inferior izquierdo y tumor metastásico de la región inguinal izquierda. Bol. Liga contra el cáncer, 16, 383, 1941.

Harper, H. Y., and Feder, J. M.: Rhabdomyosarcoma: Report of Case Presenting Unusual Features, with Reference to Age, Race, Site of Origin and Manner of Growth. Surgery, 6, 76, 1939.

Howe, C. W., and Warren, S.: Myoblastoma. Surgery, 16, 319, 1944.

Johan, B., Jr.: Ein Rhabdomyosarcoma chondro-myxomatosum des Oberarmes. Frankfurt. Ztschr. f. Path., 22, 50, 1919.

Jônsson, G.: Malignant Tumors of the Skeletal Muscles, Fasciae, Joint Capsules, Tendon Sheaths and Serous Bursae. Acta Radiol., Supp. 36, pp. 1–304, 1938.

Kirschbaum, J. D.: Myosarcoma of the Diaphragm. Am. J. Cancer, 25, 730, 1935.

Kolmer, W.: Partieller Riesenwuchs in Verbindung mit grossen Rhabdomyon bei einer Schleie (Tinca tinca). Virchows Arch. f. Path. Anat., 268, 574, 1928.

Landois, F.: Über die primären Muskelsarkome. Berl. klin. Wchnschr., 49, 2055 and 2274, 1912.

Lenormant, C.: Sur les sarcomes des muscles. Schweiz. med. Wchnschr., 68, 449, 1938.

Lepage, R.: Un cas de Rabdomyome des Regions Maxillaires et sublinguales. J. de méd. de Paris, 54, 690, 1934.

Ligas, A.: Rabdomioma maligno del quadricipite femorale. Arch. ital. di chir., 58, 365, 1940.

Lino, G.: Contributio allo studio dei tumori rari della lingua; della istogenesi del rhabdomioma. Tumori, 14, 373, 1928.

Lochrane, C. D.: Rhabdomyosarcoma of Corpus Uteri. Proc. Roy. Soc. Med., 26, 1429, 1933.

MacCallum, P.: Rhabdomyoma of the Extremities. Australian & New Zealand J. Surg., 2, 296, 1933.

Marchand, F.: Uber ein Geschwulst aus quergestreiften Muskelfasern mit ungewohnlichen Gehalte an Glykogen in einigen fötalen Geweben. Virchows Arch. f. Path. Anat., 100, 42, 1885.

Meyenburg, H. von, in Henke und Lubarsch: Handb. d. Spez. Path. Anat. u. Histol., ix/1, 1929, p. 468 ff.

Montpellier, J.: Les rhabdomyomes. Caractères généraux et variétés anatomo-cliniques. Bull. Assoc. franc. p. l'étude du cancer, 18, 538, 1929.

Morpurgo, B.: Mioblastomi. Arch. per le sci. med., 59, 229, 1935.

Morpurgo, B.: Künstliche Erzeugung eines sehr atypischen myoblastoms der Zunge bei einer weissen Ratte. Centralbl. f. allg. Path. u. Path. Anat., 63, 1, 1935.

Moulonguet, P., and Pollosson, E.: Sarcomes des Muscles et des coulées conjonctives des membres. J. de Chir., 52, 501, 1938.

Muller, H. R.: Traumatic Rhabdomyosarcoma Following Successive Fractures of the Femur. J. Cancer Research, 2, 393, 1917.

Nettleship, A.: Spontaneous Mouse Rhabdomyosarcoma. J. Nat. Cancer Inst., 3, 563, 1943.

Oro, K.: Über ein bösartiges myoblastenmyom ausgehend von muskulaturen der Beugeseite des linken Vorderarmes veranlasst durch Trauma. Tr. Soc. Path-Jap., 24, 571, 1934.

Oswald, W.: Rhabdomyosarkom des Hals mit ausgedehnter Metastasierung. Frankfurt. Ztschr. f. Path., 55, 60, 1941.

Peery, T. M., and Smith, W. A.: Rhabdomyosarcoma of Diaphragm. Am. J. Cancer, 35, 416, 1939.

Pendl: Über ein congenitales Rhabdomyome der Zunge. Ztschr. f. Heilk., 18, 457, 1895.

Peyron, A.: Sur l'Évolution Neoplasiques des fibres musculaires striées dans le sarcome infectieux des Oiseaux. Bull. Assoc. franc. p. l'étude du cancer, 10, 23, 1921.

Peyron, A.: Les Tumeux des Muscles. Atlas du Cancer, Septiéme fascicule. Félix Alcan, Paris, 1929.

Pogogeff, I. A., and Murray, M. R.: Regeneration of Adult Mammalian Skeletal Muscle *in vitro*. Science, 101, 174, 1945.

Prochazka, G.: Rhabdomyoma in a Cow Fetus. časop. lék. česk., 64, 1476, 1925.

Ravich, A., Stout, A. P., and Ravich, R. A.: Malignant Granular Cell Myoblastoma Involving the Urinary Bladder. ANNALS OF SURGERY, 121, 361, 1945.

Rakov, A. I.: Malignant Rhabdomyoblastomas of Skeletal Musculature. Am. J. Cancer, 30, 455, 1937.

Ribbert: Beiträge zur kenntnis des Rhabdomyoma. Virchows Arch. f. Path. Anat., 130, 249, 1892.

Richmond, S. M.: Rhabdomyosarcoma of Skeletal Muscle: With Report of 2 Cases. Texas State J. Med., 35, 407, 1939.

Roskin, G.: La cellule myomateuse et quelques problémes relatifs à la cellule musculaire. Bull. Assoc. franç. p. l'étude du cancer, 23, 172, 1934.

Rütz, A.: Angeborenes Rhabdomyom der Zunge. Med. Klin., 22, 1072, 1926.

Ryan, E. J.: Rhabdomyosarcoma of the Diaphragm. Cleveland Clin. Quart., 6, 304, 1939.

Sabrazès, and Peyron, A.: Persistence de la différenciation contractile (double striation) sur les éléments Néoplasiques en voie de metastase dans les Rhabdomyomas. Compt. rend. Soc. de biol., 92, 617, 1925.

Scott-Carmichael, E.: Primary Sarcoma of Both Biceps Muscles. Brit. Med. J., 1, 15, 1913.

Shanin, A. P.: Early Diagnosis of Sarcoma of Skeletal Musculature. Sovetskiy Vrach. Zhurnal, August 30 (No. 16), 1201, 1936.

Stewart, F. W.: Radiosensitivity of Tumors. Arch. Surg., **27**, 979, 1933.

Stulz, E., Diss, A., and Fontaine, R.: Myxosarcome de l'aventbras, d'origine musculaire. Bull. et mém. Soc. Anat., **20**, 429, 1923.

Targett, J. H.: Congenital Myxosarcoma of the Neck Containing Striped Muscle Cells. Trans. Path. Soc., London, **43**, 157, 1892.

Temofeevskiy: Question of the Capacity of Cells of Malignant Neoplasms for Differentiation; Culture of Malignant Rhabdomyoblastoma. Vrach., delo **20**, 569, 1938.

Thomas, E.: Un cas de rhabdomyosarcome de la langue. Ann. méd-chir. de l'Hop. Sainte-Justine, Montréal, **3**, 135, 1940.

Tourneux, J. P., and Gouzi, J.: Tumeurs malignes du psoas. Toulouse méd., **33**, 443, 1932; also Presse méd., **40**, 862, 1932.

Warnery: Du rhabdomyome des muscles striés. Thèse de Bâle, 1918.

Weber, C. O.: Anatomische Untersuchung einer hypertrophische Zunge nebst Bemerkungen über die Neubildung quergestreifter Muskelfasern. Virchows Arch. f. Path. Anat., **7**, 115, 1854.

Wolbach, S. B.: Centrioles and Histogenesis of Myofibril in Tumors of Striated Muscle Origin. Anat. Rec., **37**, 255, 1928.

Wolbach, S. B.: Malignant Rhabdomyoma of Skeletal Muscle. Arch. Path., **5**, 775, 1928.

ANNOUNCEMENT

UROLOGY AWARD

UROLOGY AWARD.—The American Urological Association offers an annual award "not to exceed $500" for an essay (or essays) on the result of some specific clinical or laboratory research in Urology. The amount of the prize is based on the merits of the work presented, and if the Committee on Scientific Research deem none of the offerings worthy, no award will be made. Competitors shall be limited to residents in urology in recognized hospitals and to urologists who have been in such specific practice for not more than five years. All interested should write the Secretary, for full particulars.

The selected essay (or essays) will appear on the program of the forthcoming meeting of the American Urological Association, to be held at the Netherland Plaza, Cincinnati, Ohio, July 22-25, 1946.

Essays must be in the hands of the Secretary, Dr. Thomas D. Moore, 899 Madison Avenue, Memphis, Tennessee, on or before July 1, 1946.

Committee on Scientific Research

JUDSON B. GILBERT
ANSON L. CLARK
MILEY B. WESSON, *Chairman.*