Studies of Guinea Pig Tumors

I. Report of Fourteen Spontaneous Guinea Pig Tumors, with a Review of the Literature*

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SUMMARY

Fourteen spontaneous tumors of an inbred strain of guinea pigs have been described. No tumors were found in guinea pigs under 3 years of age, thus supporting the observation of Papanicolaou and Olcott (43) that spontaneous tumors occur rarely in guinea pigs which do not survive to senility. While this constitutes an incidence of only 2.4 per cent of the total population of this colony, it represents an incidence of 14.4 per cent of the animals surviving 3 years or longer.

These fourteen tumors bring the total number of reported spontaneous neoplasms in guinea pigs to 138. The latter have been tabulated as to site of origin and microscopic characteristics, and they are reported for the convenience of investigators encountering additional instances of spontaneous tumors or as a frame of reference for those studying the induction of tumors in guinea pigs.

Despite the prevalent use of the guinea pig as an experimental animal, surprisingly few spontaneous tumors have been reported in this species. Reviews dealing with this subject have been published by Heim and Schwartz (21), Maury (36), Leader (28), Warren and Gates (53), and most recently by Tamaschke (51). The reviews preceding that of Warren and Gates in 1941 were incomplete in that they did not include a number of reports dealing with spontaneous tumors of the respiratory tract (Sternberg [49], Spronck [48], Goldberg [16], and seven other spontaneous tumors observed by Woglom [54]). The most recent review by Tamaschke (51) is incomplete in that it includes only seventeen spontaneous tumors, a number far smaller than that reported by Warren and Gates 14 years earlier, although it mentions a spontaneous tumor reported by Gouyon, not mentioned in previous reviews. Since the review by Warren and Gates (53), a number of additional cases have been reported, and we have been able to assemble a total number prior to the present report of only 124 spontaneous tumors. This figure includes ten cases described in detail by Papanicolaou and Olcott (41-43) but does not include approximately 90 which these investigators collected but have not reported.1 It also does not include 23 cases of an ovarian "tumor" described by Loeb (32) and several additional ones by others (8, 11, 30) cited by Loeb. This "tumor" consists of embryonal structures, apparently of parthenogenetic origin, which should not be considered as a true neoplasm, since, as Loeb has pointed out (32), they have limited duration of life, being destroyed at an early date and replaced by connective tissue.

The rarity of spontaneous tumors in guinea pigs can be appreciated also by other reports. Thus, in three inbred families of guinea pigs at the Beltsville Agricultural Station of the U.S. Department of Agriculture, studied by Wright and Eaton (56), no neoplasms were found in 15,000 animals. Similarly, Haagensen and Krehbiel (19) have stated that in their colony of several thousand guinea pigs only two spontaneous tumors were found. Other reports indicate a somewhat higher incidence. Thus, Spronck (48) was able to collect 56 spon-

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1 Personal communication from G. N. Papanicolaou.
taneous papillary adenomas of the bronchus, and Papanicolaou and Olcott (41-43) have found about 100 tumors in a group of 7,000 guinea pigs (1.4 per cent). Congdon and Lorenz (10) have reported an incidence of leukemia of 5 per cent in an inbred strain, and Loeb (32) has reported an incidence of parthenogenetic "tumors" of at least 5 per cent in female guinea pigs. This latter lesion probably occurs with even greater frequency, since their limited duration of life with replacement by scar tissue undoubtedly results in a failure to detect many of them. Papanicolaou and Olcott (43) have attributed their relatively high incidence to the fact that many of the autopsied animals were senile, since the tumors rarely occurred in guinea pigs less than 4-5 years old.

Between the years 1941 and 1951 one of us (JBR) maintained two separate inbred strains of guinea pigs. During that period no animals were withdrawn from these colonies for experimental purposes, and they were permitted to live out their life span. In one of these strains spontaneous tumors first appeared in 1948, and in the period 1948-1951 fourteen spontaneous tumors were detected. This has been designated the tumor-susceptible strain. No tumors developed in the second strain during this period of observation, nor have any developed since 1951, although animals have been withdrawn since 1951, although animals have been withdrawn for experimental purposes. The limited duration of life with replacement by scar tissue undoubtedly results in a failure to detect many of them. Papanicolaou and Olcott (43) have attributed their relatively high incidence to the fact that many of the autopsied animals were senile, since the tumors rarely occurred in guinea pigs less than 4-5 years old.

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### MATERIALS AND METHODS

There were 4,000 live births in the tumor-susceptible colony during the period 1941-1951 and 2,000 in the nonsusceptible strain. Each animal of the two strains, on death, was perfused with 20 per cent formaldehyde and subsequently autopsied. When tumors were encountered, they were described, measured, and blocks were taken for microscopic study. The latter were embedded in paraffin, sectioned at 6 μ and stained with hematoxylin and eosin.

### RESULTS

#### Incidence of spontaneous tumors

Spontaneous tumors were detected in fourteen of the 4,000 animals (0.4 per cent) in the susceptible strain (Table 1). However, since no tumors were found in animals under 3 years of age, data reflecting this fact are perhaps more pertinent. Slightly less than 2.5 per cent of guinea pigs of the susceptible strain survived over 3 years, and of this group the finding of fourteen tumors represents an incidence of 14.4 per cent. The frequency in males surviving over 3 years was 12 per cent and in females, 13.3 per cent.

The proportion of the nonsusceptible strain surviving over 3 years was only about one-third that of the susceptible strain. The females of the nonsusceptible colony are known to be susceptible to a toxemia of pregnancy, and this would account, to some extent at least, for the smaller number of live births and for the smaller proportion of females surviving over 3 years; however, it would not account for the smaller proportion of males. For reasons not yet known, the life span of the nonsusceptible strain is shorter than that of the susceptible strain.

#### Distribution and characteristics of the tumors

Seven primary anatomic sites were represented among the fourteen spontaneous tumors. The organ most frequently involved in this strain was the uterus, where seven tumors were found. Two of the latter were benign leiomyomas, and one was a benign adenomyoma. Sarcomatous degeneration was found in the remaining four, one of which was a leiomyosarcoma, one a fibrosarcoma, one a myxosarcoma, and one a mesenchymal mixed tumor. Two tumors were found in the liver, a hepatic cell adenoma in one case, and a cavernous hemangioma in another. There was one case each of an embryonal carcinoma of the testis, a papilloma of the gall bladder, papillary pulmonary adenomatosis, a subcutaneous fibrolipoma, and a case of lymphoblastic leukemia. In none of the tumors considered histologically malignant was evidence of metastasis found.

The leiomyomas of the uterus were discrete, encapsulated tumors showing the typical pattern of intermingling bundles of elongated smooth muscle cells. Differing from the latter only in that the tumor contained endometrial glands was the single
case of adenomyoma (Fig. 1). The one tumor considered to be a leiomyosarcoma was also encapsulated grossly, and microscopically it retained a lamellated structure (Fig. 2), with the bundles compactly arranged and with little or no interstitial structure. The cells were also closely packed, and mitotic figures were fairly numerous. The tumor diagnosed as a fibrosarcoma was confined within the serosa (Fig. 3). In the latter tumor the cells were somewhat more loosely arranged and were spindle-shaped rather than straplike, as in the tumors of smooth muscle origin (Fig. 4). This was taken to be an indication that this tumor arose from the interstitial connective tissue of the uterus rather than from smooth muscle. The same interpretation was placed on the case of myxosarcoma, in which the tumor cells exhibited a even looser arrangement (Fig. 5). The latter tumor was grossly more diffuse and less well demarcated than in the foregoing cases, but had also not extended through the serosa. The tumor designated as a mesenchymal mixed tumor of the uterus differed from the myxosarcoma only in the fact that cystic endometrial glands were incorporated in the neoplastic mass (Fig. 6).

The two tumors of the liver were both considered benign. One was a typical, grossly purple, cavernous hemangioma, and microscopically showed numerous dilated vascular channels consisting of a single layer of endothelium and filled with blood. The second grossly consisted of a small white nodule measuring a few millimeters in diameter; microscopically, it showed a thin, intact fibrous capsule enclosing liver cells, with evidence of sinusoids and the usual cordlike pattern, but devoid of bile duct structures (Fig. 7). Between the capsule and the mass of liver cells there was a thin layer of large vacuolated phagocytes containing brown pigment. This was considered to be a small hepatic-cell adenoma. The gall bladder papilloma presented as a small cauliflower-like growth on gross inspection, and microscopically showed fronds and glands lined by tall hyperchromatic epithelial cells (Fig. 8). There was no evidence of invasion into muscle.

The single case of papillary adenomatosis of the lung presented grossly as two tiny white nodules in the left upper lobe. Microscopically these growths consisted of numerous papillary structures, with a core of loose connective tissue covered by a single layer of somewhat hyperchromatic cuboidal epithelium (Fig. 9).

### TABLE 2
**REPORTED SPONTANEOUS TUMORS OF THE REPRODUCTIVE TRACT**

<table>
<thead>
<tr>
<th>Tumor</th>
<th>No. cases</th>
<th>Author and year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ovary:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Embryoma or teratoma</td>
<td>1</td>
<td>Montroni, 1930, cited by Leader (28)</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>Giordano, 1931 (15)</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>Harangy et al., 1954 (20)</td>
</tr>
<tr>
<td>Uterus: Leiomyoma (gross only)</td>
<td>2</td>
<td>Present report</td>
</tr>
<tr>
<td>Fibromyoma</td>
<td>1</td>
<td>Lippschutz, 1941 (51)</td>
</tr>
<tr>
<td>Adenomyoma</td>
<td>1</td>
<td>Present report</td>
</tr>
<tr>
<td>Leiomyosarcoma</td>
<td>1</td>
<td>&quot;</td>
</tr>
<tr>
<td>Fibrosarcoma</td>
<td>1</td>
<td>&quot;</td>
</tr>
<tr>
<td>Myxosarcoma</td>
<td>1</td>
<td>&quot;</td>
</tr>
<tr>
<td>Mesenchymal mixed tumor</td>
<td>1</td>
<td>&quot;</td>
</tr>
<tr>
<td>Testis: Embryonal carcinoma</td>
<td>1</td>
<td>&quot;</td>
</tr>
<tr>
<td>Total</td>
<td>13</td>
<td></td>
</tr>
</tbody>
</table>

### TABLE 3
**REPORTED SPONTANEOUS TUMORS OF THE RETICULOENDOTHELIAL SYSTEM**

<table>
<thead>
<tr>
<th>Tumor</th>
<th>No. cases</th>
<th>Author and date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spleen: Splenoma (lymphosarcoma?)</td>
<td>1</td>
<td>Guérin and Guérin, 1925 (18)</td>
</tr>
<tr>
<td>Lymph glands: Cervical, lymphosarcoma</td>
<td>1</td>
<td>Dickson, 1915 (14)</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>Miguens, 1918 (37)</td>
</tr>
<tr>
<td>Leukemia</td>
<td>1</td>
<td>Snijders, 1926 (47)</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Heston and Deringer, 1952 (22)</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Congdon and Lorenz, 1954 (10)</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Lorenz et al., 1954 (38)</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>Present report</td>
</tr>
<tr>
<td>Total</td>
<td>13</td>
<td></td>
</tr>
</tbody>
</table>

### TABLE 4
**REPORTED SPONTANEOUS TUMORS OF THE RESPIRATORY TRACT**

<table>
<thead>
<tr>
<th>Tumor</th>
<th>No. cases</th>
<th>Author and date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bronchus: Papillary Adenoma</td>
<td>2</td>
<td>Sternberg, 1905 (49)</td>
</tr>
<tr>
<td></td>
<td>56</td>
<td>Sprock, 1907 (48)</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>Norris, 1947 (40)</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>Heston and Deringer, 1952 (22)</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Lorenz et al., 1954 (53)</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>Present Report</td>
</tr>
<tr>
<td>Adenocarcinoma</td>
<td>1</td>
<td>Goldberg, 1990 (16)</td>
</tr>
<tr>
<td>Total</td>
<td>65</td>
<td></td>
</tr>
</tbody>
</table>
The embryonal carcinoma of the left testis was detected at autopsy as a yellow-gray, irregular nodule occupying about two-thirds of that structure. Microscopically it consisted of areas of compactly arranged small cells with scanty vacuolated cytoplasm, other areas with pseudogland formations, and in a few foci papillary-like structures (Figs. 10 and 11).

Finally, the single case of leukemia was discovered at routine autopsy. Suspicion was first aroused by an enlarged liver and spleen and the diagnosis confirmed by sections. Infiltration with leukemic cells was particularly marked in the liver, spleen, kidneys, and bone marrow. The leukemic cells were characterized by large vesicular nuclei and scant basophilic, agranular cytoplasm (Fig. 12).

DISCUSSION

The frequency of 14.4 per cent found in the tumor-susceptible strain represents a minimum figure, since these were all grossly visible tumors; when examination of all the autopsied guinea pigs in this group has been completed it is possible that other microscopic tumors may be encountered. It is evident from the data in Table 1 and the characteristics of the tumors that females are more susceptible than males, and that the most striking feature in females is the susceptibility of the muscular and fibrous elements of the uterine wall to the development of neoplasms. The three tumors found in males were the papillary adenomatosis of the lung, the testicular tumor, and the hepatic-cell adenoma of the liver.

Since no grossly visible tumors were found in guinea pigs under 3 years of age, the present report supports the observation of Papanicolaou and Olcott (41-43) that in this species tumors rarely occur in animals which do not survive to senility. Although in the present study no tumors were found in the nonsusceptible inbred strain, the survival rate beyond 3 years in the latter colony was so low that the absence of tumors may have been a reflection of a shorter life span.

<table>
<thead>
<tr>
<th>Tumor</th>
<th>Site</th>
<th>No. cases</th>
<th>Author and year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fibrosarcoma, subcutaneous</td>
<td>Neck</td>
<td>1</td>
<td>Dickson, 1913 (14)</td>
</tr>
<tr>
<td>Fibrolipoma</td>
<td>Foreleg</td>
<td>1</td>
<td>Wood, 1916 (53)</td>
</tr>
<tr>
<td>Sarcoma (fibro ?)</td>
<td>Back</td>
<td>1</td>
<td>Lubarsch, 1919 (54)</td>
</tr>
<tr>
<td>Glioma (schwannoma)</td>
<td>?</td>
<td>1</td>
<td>Lubarsch, 1919 (54)</td>
</tr>
<tr>
<td>Lipomyoxyfibroma</td>
<td>Abdominal wall</td>
<td>2</td>
<td>Haagensen and Krehbiel, 1936 (19)</td>
</tr>
<tr>
<td>Neurogenic fibrosarcoma</td>
<td>Psoas muscle</td>
<td>1</td>
<td>Present report</td>
</tr>
<tr>
<td>Neurilemmoma (multiple)</td>
<td>Jaw</td>
<td>1</td>
<td>Roffo, 1925 (44)</td>
</tr>
<tr>
<td>Fibrosarcoma coexistent with liposarcoma</td>
<td>Mesentery</td>
<td>1</td>
<td>Bablet and Block, 1934 (4)</td>
</tr>
<tr>
<td></td>
<td>Chest wall</td>
<td>1</td>
<td>Kröning and Wepler, 1938 (27)</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>19</td>
<td>Papanicolaou and Olcott, 1942 (42)</td>
</tr>
</tbody>
</table>

In Table 2 are listed the reported spontaneous tumors of the reproductive tract, including those of the present study, but exclusive of the ovarian parthenogenetic "tumors" of Loeb (32). While we have added no tumors of the ovary, the group of seven uterine tumors constitutes a sizable addition to those previously reported, since only two tumors of the uterus have been reported prior to the present study. The testicular tumor found in the present study appears to be the only reported instance of a spontaneous tumor of the male reproductive system in the guinea pig.

In Table 3 are listed the tumors of the reticuloendothelial system, to which we have added only a single case of leukemia. The number of cases of spontaneous leukemia may actually be greater than that shown, since in the study of Congdon
and Lorenz (10), dealing in part with the induction of this disease by irradiation, there was evidence suggesting that the latter agent may not have been responsible for the leukemia cases which appeared in the experimental group.

In Table 4 are tabulated the tumors of the respiratory tract, to which we have again added only a single case of papillary adenomatosis of the bronchus. It is noteworthy that Grumbach (17) claims to have induced such lesions in the lungs of guinea pigs by inoculating a diphtheroid bacillus greater number of spontaneous tumors of this organ. The cavernous hemangioma and the hepatic-cell adenoma of the liver also appear to be the first reported instances of a spontaneous origin of these tumors in this organ.

In Table 5 are shown the various tumors of mesenchymal origin, not located in specific organs, which have been reported. Here we have added only a single benign fibrolipoma to the group of subcutaneous tumors.

It is evident from Tables 2 to 7 that a large number of spontaneous tumors have been observed in the guinea pig. Of the 138 such tumors reported (including the fourteen in the present study), 88 (62.4 per cent) were epithelial in origin. An additional fifteen (10.9 per cent), including the leukemias, were reticulo-endothelial in origin, and in this figure we have also included the two instances of round-cell sarcoma of the heart and of the kidney, which were, in all likelihood, lymphosarcomas. The remaining 34 (24.8 per cent) were tumors of mesenchymal origin, and this includes the cavernous hemangioma of the liver. While this compilation thus shows a predominance of tumors of epithelial origin, Papanicolaou found a large percentage of fibrous tumors in his colony.1

<table>
<thead>
<tr>
<th>Organ</th>
<th>Tumor</th>
<th>No. cases</th>
<th>Author and year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skin</td>
<td>Epithelioma adenoides cysticum</td>
<td>1</td>
<td>Haranghy et al., 1953 (20)</td>
</tr>
<tr>
<td>Eye</td>
<td>Dermoid of cornea</td>
<td>1</td>
<td>Brunschwig, 1928 (9)</td>
</tr>
<tr>
<td>Brain</td>
<td>Teratoma of pons</td>
<td>1</td>
<td>Lutz, 1910 (35)</td>
</tr>
<tr>
<td>Heart</td>
<td>Round cell sarcoma (lymphosarcoma?)</td>
<td>1</td>
<td>Bender, 1925 (6)</td>
</tr>
<tr>
<td></td>
<td>Fibrosarcoma</td>
<td>1</td>
<td>Athias, 1957 (5)</td>
</tr>
<tr>
<td>Gastrointestinal tract</td>
<td>Fibromyoma of stomach</td>
<td>4</td>
<td>Papanicolaou and Olcott, 1940 (41), 1942 (42)</td>
</tr>
<tr>
<td></td>
<td>Lipoma of stomach</td>
<td>1</td>
<td>&quot; &quot; &quot; 1942 (42)</td>
</tr>
<tr>
<td></td>
<td>Liposarcoma of intestine</td>
<td>1</td>
<td>&quot; &quot; &quot; 1942 (42)</td>
</tr>
<tr>
<td>Kidney</td>
<td>Osteosarcoma</td>
<td>1</td>
<td>Twort and Twort, 1952 (59)</td>
</tr>
<tr>
<td></td>
<td>Round cell sarcoma (lymphosarcoma?)</td>
<td>1</td>
<td>Ball and Pagnon, 1935 (5)</td>
</tr>
<tr>
<td>Endocrine system</td>
<td>Carcinoma of adrenal cortex</td>
<td>1</td>
<td>Roskin, 1930 (45)</td>
</tr>
<tr>
<td></td>
<td>Adenoma of thyroid (gross only)</td>
<td>1</td>
<td>Papanicolaou and Olcott, 1942 (42)</td>
</tr>
<tr>
<td></td>
<td>Adenoma of adrenal cortex</td>
<td>1</td>
<td>&quot; &quot; &quot; 1942 (42)</td>
</tr>
<tr>
<td>Bone</td>
<td>Osteosarcoma</td>
<td>1</td>
<td>Leader, 1937 (48)</td>
</tr>
<tr>
<td></td>
<td>Chondrosarcoma</td>
<td>1</td>
<td>Papanicolaou and Olcott, 1948 (48)</td>
</tr>
<tr>
<td>Not stated</td>
<td>Carcinoma</td>
<td>1</td>
<td>Gouyon, 1876, cited by Tamaschke (51)</td>
</tr>
<tr>
<td>Liver</td>
<td>Hepatic cell adenoma</td>
<td>1</td>
<td>Present report</td>
</tr>
<tr>
<td></td>
<td>Cavernous hemangioma</td>
<td>1</td>
<td>Present report</td>
</tr>
<tr>
<td>Gall bladder</td>
<td>Papilloma</td>
<td>1</td>
<td>Present report</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>22</td>
<td></td>
</tr>
</tbody>
</table>

isolated from the lymph nodes of patients with Hodgkin's disease; he is particularly impressed by their similarity to jagziekte of sheep, an opinion shared by Cowdry and Marsh (18). The infrequency of this tumor in our colony, however, fails to support transmission by an infectious agent.

The single instance of a papilloma of the gall bladder is also worthy of comment. This appears to be the first reported instance of a spontaneous tumor of this organ, despite the fact that the biliary tract of the guinea pig appears to be unusually susceptible to the development of induced malignancy (Kazama [25, 26], Leitch [29], Delbet and Godard [13], Schmid [46]). Perhaps more careful examination of the gall bladder would yield a variety of spontaneous tumors have been observed in the guinea pig. Of the 138 such tumors reported (including the fourteen in the present study), 88 (62.4 per cent) were epithelial in origin. An additional fifteen (10.9 per cent), including the leukemias, were reticulo-endothelial in origin, and in this figure we have also included the two instances of round-cell sarcoma of the heart and of the kidney, which were, in all likelihood, lymphosarcomas. The remaining 34 (24.8 per cent) were tumors of mesenchymal origin, and this includes the cavernous hemangioma of the liver. While this compilation thus shows a predominance of tumors of epithelial origin, Papanicolaou found a large percentage of fibrous tumors in his colony.1
REFERENCES

1. ANDERSON, C., and LUMBroso, U. Note sur une "néo-


3. ATHAR, M. Sarcome du cœur chez un cobaye après injec-
dion, dans le cerveau, de méthylcholanthrène. Compt. rend. 
Soc. de biol., 125:585-87, 1937.


5. BALL, V., and PAGNON, F.: Sarcome à cellules rondes du


7. BLITZENBAAT, C., and CAMPY, C. Un cas de tumeur marn-

8. BLANCA, A. L'ovocyte atrésique et son involution. Arch.

9. BORNSCHWIG, A. Dermoïd de Cornes en Guine Pig. Am. J. 

10. BRANCA, A. L'ovocyte atrésique et son involution. Arch.

11. BRUNSWIG, A. Dermoid of Cornes in Guine Pig. Am. J. 

12. COWDRY, E. V., and MARSH, H. The Comparative Pathol-
ysis of South African Jagziekte and Montana Progressive 

13. DELBET, P., and GODARD, H. Parthénogenèse spontà-


16. FIG. 1.—Adenomyoma of the uterus. Hematoxylin-eosin 
stain, Mag. approx. X100. The top represents the serosal sur-
fave of the uterus. In the center there is a dense, demarcated 
nodule of interweaving bundles of muscle containing a few 
epithelial glands and groups of smaller glandular 
structures.

17. FIG. 2.—Leiomyosarcoma of the uterus. Hematoxylin-eosin 
stain, Mag. approx. X100. There are bundles of smooth 
muscle coursing in several directions. Muscle fibers are com-
 pactly arranged, and there is a marked paucity of stromal con-
 nective tissue.

18. FIG. 3.—Leiomyosarcoma of the uterus. Hematoxylin-
eosin stain, Mag. approx. X100. The top represents the serosal sur-
face of the uterus. In the center there is a dense, demarcated 
nodule of interweaving bundles of muscle containing a few 
cystic endometrial glands and groups of smaller glandular 
structures.

19. FIG. 4.—Fibrosarcoma of the uterus. Hematoxylin-eosin 
stain, Mag. approx. X100. There are bundles of smooth 
muscle coursing in several directions. Muscle fibers are com-
 pactly arranged, and there is a marked paucity of stromal con-
nective tissue.

20. HAAGENSEN, C. D., and KREHBIEL, L. F. Liposarcoma pro-

21. HEIM, F., and SCHWARTZ, P. Die Spontantumoren der 
Meerschweinchen. In: R. JAFFE, Anatomie und Pathologie 
der Spontanerkrankungen der kleinen Laboratoriumstiere, 

22. HESTON, W. B., and DERINGER, M. K. Induction of Pul-
monary Tumors in Guinea Pigs by Intravenous Injection of 
Methylcholanthrene and Dibenzanthracene. J. Nat. 

23. JONES, F. S. A Transplantable Carcinoma in the Guinea 
Fig. J. Exper. Med., 22:211-18, 1916.

24. KATARE, T. Demonstration verschiedener Geschwulste bei 
(cited by Leader).

25. KALAMA, Y. Thèse sur la production spontanée de 

26. KERNING, F., and WEPLER, W. Ein histologisch beach-
tenswerter Tumor des Meerschweinchens. Ztschr. f. 

27. LEADER, S. A. Osteogenic Sarcoma of Femur in Guinea 

28. LEIDTCH, A. Gall Stones and Cancer of the Gallbladder: An 

29. LEVITZWER, B., and COTTY, L. La parthénogenèse dans 
l'ovaire des mammifères et le problème de l'origine des 

30. NEPSCHUTZ, A. Spontaneous Fibromyoma in a Female 

31. NEBERG, L.; GYORGYAY, F.; ANTALFFY, A.; and MERIE, 

32. LOEB, L. The Parthenogenetic Development of Eggs in the 

33. LIPINSKII, A. L'ovocyte atrésique et son involution. Arch.

34. LUBARSCH, 0. Ueber spontane Impfsarkome bei Meersch-

35. LUTZ, B. Ein Teratom am Kleinhirnbrückenwinkelbeim 

Paris: J. Aubert et Cie, 1931.

37. MIGUENZ, C. Sarcoma espontáneo transplantable en el 

38. MILLER, C. L. Experimental Production of Carcinomas in 
the Guinea Pig by Injection of Carcinogenic Substances. 

39. MILLER, C. L. Experimental Production of Carcinomas in 
the Guinea Pig by Injection of Carcinogenic Substances. 

40. MILLER, C. L. Experimental Production of Carcinomas in 
the Guinea Pig by Injection of Carcinogenic Substances. 

41. MILLER, C. L. Experimental Production of Carcinomas in 
the Guinea Pig by Injection of Carcinogenic Substances. 

42. MILLER, C. L. Experimental Production of Carcinomas in 
the Guinea Pig by Injection of Carcinogenic Substances. 

43. MILLER, C. L. Experimental Production of Carcinomas in 
the Guinea Pig by Injection of Carcinogenic Substances. 

44. MILLER, C. L. Experimental Production of Carcinomas in 
the Guinea Pig by Injection of Carcinogenic Substances. 

45. MILLER, C. L. Experimental Production of Carcinomas in 
the Guinea Pig by Injection of Carcinogenic Substances. 

46. MILLER, C. L. Experimental Production of Carcinomas in 
the Guinea Pig by Injection of Carcinogenic Substances. 
Fig. 5.—Myxosarcoma of the uterus. Hematoxylin-eosin stain, Mag. approx. ×100. The tumor is composed of loosely arranged stellate cells which can be seen causing a separation of muscle bundles.

Fig. 6.—Mesenchymal mixed tumor of the uterus. Hematoxylin-eosin stain, Mag. approx. ×100. The connective tissue element of this tumor is similar to that seen in Figure 5. At the upper left margin there is a cystic endometrial gland.

Fig. 7.—Hepatic cell adenoma of the liver. Hematoxylin-eosin stain, Mag. approx. ×100. At top and bottom edges can be seen the capsule of the nodule. Hepatic cells are arranged in cords, but there is a total absence of bile duct structures.

Fig. 8.—Papilloma of the gall bladder. Hematoxylin-eosin stain, Mag. approx. ×100. The upper part of the photomicrograph shows a papillary-glandular arrangement of epithelial structures. Serosa is at the lower edge.
FIG. 9.—Papillary adenoma of the bronchus. Hematoxylin-eosin stain, Mag. approx. ×100. In the center there are numerous papillary fronds covered by cuboidal epithelium. Along the right edge are pulmonary alveoli.

FIG. 10.—Embryonal carcinoma of the testis. Hematoxylin-eosin stain, Mag. approx. ×100. The photomicrograph shows glands and compactly arranged small cells with scanty cytoplasm.

FIG. 11.—Same tumor as Figure 10. Hematoxylin-eosin stain, Mag. approx. ×100. Papillary structures are seen covered by hyperchromatic cuboidal epithelium.

FIG. 12.—Liver with leukemic infiltration. Hematoxylin-eosin stain, Mag. approx. ×100. Hepatic cords are evident, with marked vacuolization of hepatic cells. There are several nodular leukemic infiltrations, as well as thin chains of leukemic cells.
42. ———. Studies of Spontaneous Tumors in Guinea Pigs. II. Tumors of the Stomach and Intestine. Arch. Path., 34:218-28, 1942.
Studies of Guinea Pig Tumors: I. Report of Fourteen Spontaneous Guinea Pig Tumors, with a Review of the Literature

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