

Original Articles and Case Reports

A SURVEY OF SIX HUNDRED AND THIRTY SIX TUMOURS FROM DOMESTICATED ANIMALS

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Two former reports (1), (2) dealing with the classification of tumours found in Canadian animals have been made. This third report deals with information relating to 636 neoplasms examined from January, 1951 to September, 1955. The classification employed was intentionally broad. No practical purpose would be served in segregating lesions into the smallest subdivisions. Of the 636 specimens, 447 were bovine, 28 porcine, 6 ovine, 14 equine, 51 avian, 83 canine, and 7 were from the feline subject. With few exceptions specimens of the bovine, porcine, ovine and avian tumours were collected by officers of the Health of Animals Division stationed at abattoirs in various areas of the Dominion. The horse, dog and cat neoplasms were submitted by private practitioners.

In a previous report (2) it was pointed out that detailed pertinent information usually cannot be obtained during routine meat inspection as time does not permit a detailed examination and description of gross material. With these omissions the determination of the origin of a tumour from histological study only, is difficult, sometimes impossible. This is the reason why certain tumours are recorded in this laboratory as "undetermined origin". Admittedly a few specimens could not have been classified if all pertinent information had been available, since they were aberrant to recognized types. These were submitted to other pathologists who were unable to agree on a precise determination.

A tabulated summary of classification appears in Table I. When thought necessary supporting remarks are made in the text.

BRONCHOGENIC CARCINOMA

These tumours can be pleomorphic and assume the appearance of a variety of tissues, lymphoid, epidermoid, mucinous, spindle cell, "oat cell" as well as the more orthodox form.

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Thirty-six or approximately 9% of the bovine tumours belonged to this classification. The majority had metastasized in the bronchial and mediastinal lymph nodes also the pleura. In a few instances secondary growths were reported present in the liver and kidney.

The porcine specimen was that of "oat cell" type, metastasis had not occurred.

Equine lesions involved the lungs, and mediastinal lymph nodes.

The tumour from a canine subject was not reported to occur in other organs than the lung tissue.

CARCINOMA OF THE MAMMARY GLAND

The equine tumour was of the infiltrating simplex type; secondary lesions were present in the lung and kidney.

Eleven or approximately 13% of the 83 dog tumours originated from the mammary gland. All specimens were from females and the average age was 9.5 years. Nine of the growths were of the infiltrating papillary type; one had the appearance of a mucoid adenocarcinoma and one a myoepithelial carcinoma.

The two feline specimens were infiltrating papillary in type.

CARCINOMA OF THE KIDNEY

The bovine lesion involved one kidney only, metastasis was not reported.

Two of the 4 equine tumours had metastasized; one in the lung and renal lymph node, the other in the renal lymph node only. The average age of the horses was 11 years.

TABLE I

Classification	Bovine	Porcine	Ovine	Equine,	Avian	Canine	Feline
CARCINOMA							
<i>The lung</i>							
Bronchogenic	36	1		1		1	
<i>The mammary gland</i>							
Infiltrating papillary				1		11	2
Mucoid adenocarcinoma						1	
Myoepithelia						1	
<i>The kidney</i>	1			4	5		1
<i>The liver</i>							
Hepato cell	4	1			1		
Cholangiocell	17		3		3	3	
<i>The gut</i>	1					1	
<i>The pancreas</i>						1	
<i>Sebaceous glands</i>						2	

TABLE I (Continued)

Classification	Bovine	Porcine	Ovine	Equine	Avian	Canine	Feline
SQUAMOUS CELL CARCINOMA	107	1			2	4	
BASAL CELL CARCINOMA						1	
MELANOCARCINOMA	2					1	1
CARCINOMA OF UNDETERMINED ORIGIN	8						
ADENOCARCINOMA	1				2	2	1
ADENOCARCINOMA OF UNDETERMINED ORIGIN	9						
HYPERNEPHROMA	9	1					
EMBRYONAL NEPHROMA (Wilm's tumor) of kidney	4	6			15		
GRANULOSA CELL TUMOR	11						
SEMINOMA						2	
SERTOLI CELL TUMOR						1	
PHEOCHROMOCYTOMA	2						
THYMOMA	4						
ADENOMA	3		1		2	14	
NEVI	2						
VERRUCA	1	1		1		2	
MESOTHELIOMA	29		1				
FIBROSARCOMA	10	2	1	1	5		1
GIANT CELL SARCOMA	2	1					
CHONDROSARCOMA	3					1	
OSTEOGENIC SARCOMA	1					1	
HISTIOCYTIC SARCOMA	1						
MAST CELL SARCOMA						4	
NEUROFIBROSARCOMA						1	
LYMPHOSARCOMA	142	13		1		3	1
RETICULUM CELL SARCOMA	12	1		1		1	
LEUCOSIS COMPLEX					11		
EQUINE SARCOID				3			
HISTIOCYTOMA Contagious (venereal tumor)						16	
FIBROMA	9				4	4	
CHONDROMA				1			
OSTEOID FIBROMA					1		
LEIOMYOMA						1	
LIPOMA	1						
NEUROFIBROMA	5					1	
ASTROCYTOMA	1						
HEMANGIOMA	4					1	
LYMPHANGIOMA	3						
TERATOMA	1						
MIXED TUMOR	1					1	
TOTAL	447	28	6	14	51	83	7

Grand total 636

The five avian tumours of this classification were confined to kidney tissue only.

The feline lesion was found in one kidney.

CARCINOMA OF THE LIVER — HEPATO CELL

Three of the 4 bovine tumours had metastasized in the lung, secondary lesions were not found in the 4th specimen, other than wide dissemination throughout the liver. The sample of this tumour in the porcine subject had spread to the lung. No secondary growths were found in the chicken tumour.

CHOLANGIOCELL

These tumours arise from the epithelium of a bile duct. The cells in general are cuboidal or columnar in shape and attempt to form gland-like structures or passages resembling bile ducts. Anaplasia may be extreme and there is difficulty in distinguishing between cholangiocell carcinoma and metastatic lesion in the liver.

Seventeen of the 447 bovine tumours were classified cholangiocell carcinoma. Metastasis was reported in 10 instances with the peritoneum, lung, pleura and mediastinal lymph nodes involved, in frequency in the order given.

Three of the 6 ovine tumours were of this type of growth, 2 had metastasized in the lung and associated lymph nodes.

The three avian and 3 canine specimens involved the liver only.

CARCINOMA OF THE GUT

Only two specimens of this tumour reported here could be classified as carcinoma of the gut. One was from the bovine subject, and secondary lesions were not reported. The other was from a dog with a metastatic growths present in the liver, spleen, mesenteric lymph nodes and the lung.

CARCINOMA OF THE PANCREAS

One canine specimen was believed to have originated in the pancreas, secondary lesions were found in the spleen.

CARCINOMA OF THE SEBACEOUS GLANDS

Two specimens of this tumour occurred among the canine neoplasms; one involved the skin in the region of the elbow, the other the region of the sacroiliac joint.

SQUAMOUS CELL CARCINOMA

Of the 447 bovine tumours, 107 or approximately 24% belonged to this group. Ninety-six of the growths involved the orbit and of these, 22 had metastasized in the parotid gland, bronchial and mediastinal lymph nodes and occasionally in the lungs and pleura. Secondary growths were not reported in 74 cases. Seven lesions were found in the mediastinal, lungs or pleura without orbital involvement. One tumour came from the rumen, this had metastasized

on the pleura. Three were reported to have involved organs in the pelvic cavity, probably these arose from the bladder.

It is interesting to note that an unusually large number of the specimens affecting the orbital region were submitted from cattle slaughtered at Calgary, Alberta. Of the 96 tumours 80 were from Calgary. The total number of cattle slaughtered at that centre from January 1st, 1951 to September 30th, 1955, was 447,201, in other words .011% of the cattle slaughtered were affected with squamous cell carcinoma of the orbital region.

The tumour of this type found in swine involved an orbit with secondary growths in the parotid gland and lung. The two avian tumours involved the abdominal viscera. The probable site of origin was the anterior portion of the digestive tube. The four from dogs were confined to the skin and subcutis. They were located on the ear, lumbar region, the carpus and the gut.

BASAL CELL CARCINOMA

This was an extensive growth located in the submaxillary region of a dog and was believed to be of basal cell origin.

MELANOCARCINOMA

The two of bovine origin had metastasized — one in the lungs, bronchial lymph nodes and liver, the other in the parotid gland. In neither case was the primary lesion sent to the laboratory. The canine tumour was found in the skin over the thigh. The one from a cat was a recurred lesion over the ear. Twice previously similar growths had been removed from this area.

CARCINOMA OF UNDETERMINED ORIGIN

Eight carcinomata of undetermined origin were among the bovine tumours. In five instances affected lymph nodes only were submitted. Obviously these lesions were metastatic, in addition they were anaplastic to a degree where it was impossible to determine the site of origin with precision. In the remaining three instances, lesions were reported to have been present in the abdominal viscera and lung, the lung and uterus, the musculature of the leg. Again the specimen material submitted consisted of secondary lesions from which the origin of the tumour was not determined.

ADENOCARCINOMA

The bovine tumour classified as adenocarcinoma was a small growth on the eye. Apparently it had developed from the lacrimal or other glands of the lid. Two avian neoplasms found in the abdominal viscera were considered to have originated from the intestinal mucosa. One canine lesion involved the duodenum, the other had originated from the perianal gland and formed a large mass at the base of the tail.

The cat tumour was a large growth with metastasis in the abdominal viscera. The primary was considered to be in the mucosa of the duodenum.

ADENOCARCINOMA OF UNDETERMINED ORIGIN

Nine adenocarcinomata from the bovine subject were not classified as to site of origin. In seven instances specimens of affected lymph nodes only were submitted. These were metastatic lesions. While there was some evidence to suggest primary growths were in the intestinal mucosa, this could not be confirmed. In two cases, the tumours were reported to involve both abdominal and thoracic viscera as well as associated lymph nodes. Again the specimens forwarded were considered metastatic, and the origin not determined.

HYPERNEPHROMA

Nine of the bovine neoplasms belonged to this class. They involved the adrenal gland, and in some instances the kidney. One had metastasized in the liver. While the histological appearance was variable, a common denominator in all was areas where the cells resembled those of the adrenal cortex. The one from a pig occurred in the kidney tissue only.

EMBRYONAL NEPHROMA (WILMS' TUMOR)

That the neoplastic cells attempted to develop rudimentary tubules and/or glomeruli is a feature of this tumour. Four of the bovine neoplasms exhibited this formation. In three animals lesions were confined to kidney tissue. In one, secondary growths were present in the adrenal gland.

Embryonal nephroma is a common tumour of both swine and poultry. Six or approximately 21% of the 28 porcine lesions were of this type. All were confined to the kidneys. There were 15 or approximately 29% among the 51 avian tumours; all were from chickens less than 3 months of age.

GRANULOSA CELL TUMOR

Examples of this tumour were confined to the bovine subject. There were 11 specimens. Seven were reported to involve an ovary, 4 to be attached to the uterus. It is probable this was merely an adhesion of the diseased ovary to the wall of the uterus.

SEMINOMA

There were two seminomata among the dog neoplasms.

SERTOLI CELL TUMOR

One example of this lesion was of canine origin.

PHEOCHROMOCYTOMA

The two bovine examples were of limited size, approximately 8 cm.

THYMOMA

Two of the four bovine tumours placed in this category appeared to have originated from the epithelial element of the gland inasmuch as there were concentric arrangements of cells resembling rudimentary Hassall's corpuscles. The other two were from the lymphoid tissue.

ADENOMA

Those occurring in cattle were found in the liver, vagina and urinary bladder. The sheep specimen was a solitary circumscribed growth 10 cm. in diameter in the liver. The two avian specimens originated in accessory reproductive glands of male chicken.

Fourteen or approximately 17% of the canine tumours were adenomata. Eight involved the perianal gland, three from dermal glands located on the face, neck and fore legs. Three were from mammary glands.

NEVI

Included in the bovine tumours were two pigmented benign growths. One had occurred around the eyes, the other in the skin over the side of the neck.

VERRUCA

The bovine specimen was a typical verruca plantaris from the volar surface of the hind foot. The lesion from the pig was multiple and located in the skin over the lower jaw. That from the horse resembled the cow specimen and developed in the frog of a foot. Eight similar growths had been removed during a five year period. The two canine examples occurred in the gums and were multiple.

MESOTHELIOMA

Twenty-nine mesotheliomata were among the bovine tumours. This is approximately only 6% of the 447 specimens. Previous to the establishment of this project mesotheliomata were considered to be one of the most common neoplasms of cattle. Fourteen of the lesions occurred on the pleura with extension to the mediastinum, occasionally to the peritoneum. Nine involved the peritoneum only. The location of 6 was not reported. It is of interest to note that 10 of the specimens were submitted as tuberculosis. In the gross this tumour does resemble certain lesions of tuberculosis.

The one from a sheep occurred as a circumscribed mass on the parietal peritoneum.

FIBROSARCOMA

Seven of the 10 bovine tumours classified as fibrosarcoma involved the liver portal lymph node, spleen and lung. One occurred in the liver and adjacent segment of the gut, and one was reported to have affected the cervical and mediastinal lymph nodes only. The tenth case was reported as generalized with tumours present in all body lymph nodes: the kidney, pleura and pericardium. Only a small specimen from 1 lymph node was submitted for study.

Of the two porcine specimens, one was found in the lungs and bronchial lymph nodes, the other involved the liver and spleen.

The ovine specimens affected the mammae, the precrural, iliac and inguinal lymph nodes.

The one equine tumour of this class was a large growth 63 cm. in diameter. It involved the mesentery and serosa coat of portions of the small and large gut, secondary lesions occurred in the spleen.

There were 5 avian tumours of this class. Two were large masses of the abdominal cavity, 1 was in a wing, 1 on an eyelid and the other a diffuse lesion in the pectoral musculature.

The specimen from a cat involved the stomach and abdominal lymph nodes.

GIANT CELL SARCOMA

Two bovine specimens were classified in this indefinite group. One involved the rib, pleura, lung and bronchial lymph nodes. No information was received as to location of the other specimen.

The porcine specimen was reported as having a generalized distribution.

CHONDROSARCOMA

The three bovine examples of this type involved the sternum, with metastasis in the lung, pleura and pericardium. The presence of young bone in one specimen suggested it be classified as a chondro-osteogenic sarcoma but for simplification this is not done in this report.

The canine specimen involved the scapulo-humeral articulation.

OSTEOGENIC SARCOMA

The bovine specimen was a large tumour reported to have weighed 22 klg. Apparently it arose from the femur.

The dog specimen was located in a mammary gland with secondary lesions in adjacent lymph nodes.

HISTIOCYTIC SARCOMA

This bovine tumour developed in the subcutaneous tissue of the shoulder and it had infiltrated the musculature of the fore quarter.

MAST CELL SARCOMA

Four neoplasms from the skin of dogs presented a histological picture of this tumour. Mulligan (3) refers to it as mast-cell sarcoma.

NEUROFIBROSARCOMA

The canine example of this tumour was described as a massive lesion in the right thoracic musculature.

LYMPHOSARCOMA

One hundred and forty-two or approximately 32% of the 447 bovine tumours were classified "lymphosarcoma". This is the most frequently encountered neoplasm in the bovine subject. Of the 142 cases, lymph nodes only were involved in 37 instances, the distribution varied to include localized

groups to all visible body and visceral nodes. In such cases the condition probably should be regarded as an expression of lymphomatosis. However, the distinction was not made inasmuch as the microscopic picture present in the sections of affected lymph nodes varied in no way from that in specimens of frank tumours in parenchyma of organs or large masses in body cavities. Until more precise knowledge becomes available concerning tumours of the lymphoid series it would seem inadvisable to distinguish the condition on the premise of organ or tissue involvement only.

As in cattle, lymphosarcoma was the most common tumour in swine. Thirteen or just over 46% of the 28 tumours belonged to this group. In three instances lesions were confined to lymph nodes, in the other 10, lymph nodes were involved, but also tumours were disseminated in other organs, particularly the liver and kidney. Lesions occurred in the heart of one pig, in the mammary gland of another.

One equine tumour was a large growth 25 cm. in diameter located in the pelvic cavity and disseminated in the wall of the rectum and anus. The other specimen was more diffuse; there was a large growth in the kidney and all body lymph nodes were greatly enlarged and irregular in shape.

The three canine specimens were disseminated throughout the body lymph nodes with lesions in the abdominal organs, particularly in the liver.

One was found in a cat. It was disseminated throughout the abdominal organs, particularly the liver, kidney and spleen. A large mass surrounded the intestines.

RETICULUM CELL SARCOMA

Twelve bovine tumours belonging to the lymphoid group displayed a cellular morphology that differed from lymphosarcoma. The cells tended to be larger and the presence of cytoplasmic processes suggested they were of reticular origin. Reticulum was demonstrable in some cases. Nuclei of renal shape were usually seen.

One porcine tumour was an example of this group, all visible lymph nodes and abdominal viscera were involved.

The equine specimen was a large lobulated mass 23 cm. in the greatest dimension and was located in the mesentery of the duodenum.

The canine growth was small and in the spleen.

LEUCOSIS COMPLEX

This classification includes disease processes probably of different origin such as lymphoid and myeloid leucosis also those considered by some investigators not to be neoplastic such as the visceral and neural types of lymphomatosis. In other words the classification is one based on convenience. It was

used in this report owing to difficulty of distinguishing with accuracy the various conditions from examination of small bits of fixed tissue usually unaccompanied by descriptive history and always without knowledge of the blood picture.

Of the 53 avian specimens, 11 were placed in this category, 3 were from birds 1 year old, 1 from a 3 months old broiler and 1 from a 7 months old pullet. The age of 6 subjects is unknown. All lesions were reported to be found in the abdominal cavity.

EQUINE SARCOID Jackson (4)

This tumour of horses has a tendency to occur as multiple lesions in the skin. Growth may be rapid and there is a suggestion that transfer can occur by contact with an affected area by previously normal skin of another area. Microscopically the neoplasm consists of irregular arranged bundles of fibroblasts. Anaplasia is not marked and irregularity of nuclear shape, hyperchromatosis, and nuclear enlargement is not beyond that of non-neoplastic fibroblasts. Active participation of vascular endothelium may occur but usually not to the degree seen in granuloma. Infiltration of neutrophiles usually is limited to areas of ulceration, but lymphocytic and eosinophilic infiltration is more extensive. As a rule this tumour is not encapsulated, does not penetrate deeply nor does it infiltrate bones. In older lesions acanthotic epidermis with elongated rete pegs may be observed.

Three examples of this tumour were among the equine lesions.

HISTIOCYTOMA (CONTAGIOUS VENEREAL TUMOR)

In spite of this tumour being a common lesion in the skin of dogs, it has not been classified satisfactorily. Owing to the undifferentiated state of the cells, microscopic study usually does not reveal the true nature or the histogenesis of the growth. In 1949 Mulligan (3) stated "This neoplasm is composed of histiocytes in spite of claims to the contrary as exemplified by such names as "benign lymphosarcoma", "transmissible lymphosarcoma" and "extra venereal lymphosarcoma". Those interested in this tumour would do well to read Jackson's work (4).

Of the 83 canine tumours, 16 or approximately 19% belonged to this group. All lesions occurred in the skin.

FIBROMA

Five of the nine bovine fibromata occurred in the uterus, the trachea, the lumbar region of the spinal cord, the neck and the udder were the site of occurrence of the other 4 lesions.

The four avian lesions were small, two were found in the thoracic cavity, one in abdominal muscle and the fourth in abdominal viscera.

There were four fibromata among the dog tumours. One was in the mammary gland, one in the axilla and one the carpus. The location of the fourth was not mentioned.

CHONDROMA

The equine specimen was a large lobulated mass attached to the cartilage of the nose. It was reported to have measured 35 cm. in its greatest dimension.

OSTEOIDFIBROMA

The avian and only representative tumour in this group occurred in the thoracic cavity of a young broiler.

LEIOMYOMA

The example of this growth was found in the vagina of a cow.

LIPOMA

The solitary bovine growth was a large mass of fatty tissue in the pelvic cavity and attached to the rectum.

NEUROFIBROMA

There were five bovine neurofibromata. While microscopically there were variations in the structure, it was considered inadvisable to classify them into type for this report. The site or origin varied, and was in the skin surrounding the orbit, two were diffuse around brachial arteries and one was a circumscribed nodule on the intestine. The location of the other lesion was not determined.

The canine tumour was found on the medial aspect of a fore leg.

ASTROCYTOMA

The one representative growth of this type was found in an 18 months old heifer. It was located in the right hemisphere and involved the third ventricle. On section the lesion was markedly cystic.

HAEMANGIOMA

Two of the four cattle lesions involved the skin and were benign. The third specimen involved the internal iliac lymph node, the fourth the bronchial node with extension into the lung parenchyma. The latter two tumours exhibited microscopic characteristics that suggested malignancy and it would be preferable to classify these lesions as haemangio endotheliomata.

The canine example was cavernous in type and benign. It involved the skin over an area of the back.

LYMPHANGIOMATA

There were three lymphangiomata among the cattle neoplasms. One involved muscle tissue, between the hip and hock joints, the other two were found in the spleen and a lymph node. They were not described.

TERATOMA

One of the bovine growths was considered to be a teratoma. It was found in the abdominal cavity adherent to the diaphragm of a six months old female calf. The lesion was large, measuring 13 x 10 x 5 cm. A cavity of 100 mm. occupied the central area. Histologically the growth was composed of a multitude of irregular sized and shaped passages lined with a single layer of cuboidal cells. The lumina were patent except a few contained a sprinkling of erythrocytes and leukocytes. A dense collagenous tissue formed the stroma. Scattered through this, lightly encapsulated nodes of lymphoid tissue devoid of apparent germinal centres, were present.

MIXED TUMOURS

There was one bovine example of this growth. It was found in a salivary gland. Histologically the epithelial element was composed of glandular formations. Myoepithelial cell participation was extensive.

A canine tumour considered to belong to this group was discovered in a 10 year old female. The lesion submitted was reported to have recurred following surgical interference. The growth was characterized by neoplasia of ductal epithelium and the presence of myoepithelial elements. There was an abundance of connective tissue stroma with suggestive evidence of malignancy.

SUMMARY

In this paper 636 tumours have been classified. Four hundred and forty-seven were from cattle, 28 swine, 6 sheep, 14 horses, 51 fowl, 83 dogs and 7 from cats.

Among the bovine specimens were 96 squamous cell carcinomata that involved the orbital area. Eighty of these growths came from cattle slaughtered at Calgary, Alberta.

This apparent localized occurrence of squamous cell carcinoma of the face seems worthy of further investigation.

RÉSUMÉ

Des 636 néoplasmes étudiés et classifiés par l'auteur, 447 avaient été prélevés chez des bovins, 28 chez des porcs, 6 chez des ovins, 14 chez des équins, 51 chez des oiseaux, 83 chez des canins et 7 chez des félins.

Dans les spécimens provenant de bovins, 96 néoplasmes de la région de l'orbite furent diagnostiqués comme étant des épithéliomas spino-cellulaires. Quatre-vingt de ces néoplasmes provenaient de bêtes tuées à Calgary, Alberta. Cette localisation géographique de l'épithélioma spino-cellulaire de la face est un fait très intéressant et qui mérite d'être étudié plus à fond.

ACKNOWLEDGEMENTS

Thanks are extended to Dr. Chas. A. Mitchell, Chief, Animal Pathology

Division, for constant encouragement in the conduction of this work and to Mr. A. Beauvais for excellent technical assistance

REFERENCES

1. PLUMMER, P. J. G. A survey of twenty-four tumours collected from animals slaughtered for food. *Can. J. Comp. Med. and Vet. Sci.*, 12: 180-186, 1948.
2. PLUMMER, P. J. G. Survey of sixty tumours from domesticated animals. *Can. J. Comp. Med. and Vet. Sci.*, 15: 231-252, 1951.
3. MULLIGAN, R. M. Neoplasms of the dog. Williams & Wilkins Company, 1949. Baltimore Md., U. S. A.
4. JACKSON, C. The incident and pathology of tumours of domesticated animals in South Africa. *Onderstepoort J. Vet. Sci. and Animal Industry*, 6: 1-460, 1936.

THE FOLLOWING ABSTRACT APPEARED IN TROPICAL DISEASES BULLETIN VOL. 52. 1955

ALICE, F. J. Cultura do virus da raiva bovina em embriao de galinha. [Chick Embryo Culture of the Bovine Rabies Virus] *Bol. Fundação Gonçalo Moniz. Bahia*. 1954, May, No. 1, 1-21, 2 figs. [15 refs.] English summary.

A strain of rabies virus was isolated in mice from the brains of cattle infected by vampire bats in the province of Bahia, Brazil, and was adapted to chick embryos by inoculation into the yolk sac of eggs at the 7th day of incubation. The virus was carried through 40 passages in eggs by inoculating a suspension of infected embryos by the yolk sac route, and attained a maximum titre of 10^6 when titrated intracerebrally in mice. After 23 passages the virus had lost its pathogenicity for dogs and rabbits by intramuscular injection. Material from the 27th egg passage produced rabies in 2 calves, but was not pathogenic for dogs, goats, sheep or cattle inoculated in groups ranging from 10 to 17 animals of each kind, and virus from the 30th and 32nd passages was used for vaccinating 99 cattle on estates subject to outbreaks of rabies. Rabbits, guineapigs, dogs, goats, sheep and calves (77 animals in all) inoculated with egg-passage virus were resistant to intramuscular challenge with street virus, and protection against 5,490 LD₅₀ was obtained in a Habel test.

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