ON THE PRODUCTION OF GASTRIC TUMORS, BORDERING ON MALIGNANCY, IN JAVANESE MONKEYS THROUGH THE AGENCY OF NOCHTIA NOCHTI, A PARASITIC NEMATODE

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The discovery by Fibiger (1913) that development of a carcinoma in the forestomach of the rat could be initiated by the presence of a parasitic nematode, Gongylonema neoplasticzim, was the first demonstration of the possibility of producing an autochtho nous malignant tumor in a laboratory animal. This demonstration evoked considerable interest among cancer workers for, at least in part, it appeared to substantiate some of the old and largely discounted theories of the parasitic etiology of certain types of cancer. Subsequently the attention of many students of the problem has been directed to the carcinogenic potentialities of other parasitic worms. As a result, in the past quarter of a century numerous species of helminths, belonging to such diverse groups as the Trematoda, Cestoda and Nematoda, parasitic upon various organs and tissues of different animals, including man, have been found capable of playing a more or less direct rôle in inducing the formation of neoplasms, some of malignant character.

The literature on parasites and tumor growth has been recently reviewed in a comprehensive manner by Hoeppli (1) who, in discussing the mechanism that may underlie the development of tumors of helminth origin, points out that there is not only a host and tissue specificity for the parasite, but that marked differences exist also in the disposition of various strains—and even individuals—of a species of host to react to the parasite’s presence by the production of malignant neoplasms.

It is the purpose of this paper to report upon an epithelial tumor arising in the stomach of the common Javanese monkey, Macacus mordax, Thomas and Wroughton, 1909 (synonym pro parte M. cynomolgus). In our experience this tumor is constantly and, as we attempt to show in the following pages, causally associated with a small nematode, whose morphology and life-cycle are here described.

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Material

For some years the occasional occurrence of a conspicuous tumor in the stomach of monkeys maintained for experimental purposes in the pathological institute in Batavia has been observed. Sections of the tumor had revealed the presence of a nematode parasite, but no further work was done on the subject pending the identification of the worm. This identification was established shortly after the arrival as guest investigator in the institute of one of the authors (J. H. S.), who, in the course of miscellaneous helminthological studies, again encountered the tumor and succeeded in securing examples of the living worm.

In order to study the biology of the parasite and to investigate its relation to the stomach lesions, a survey of the incidence of the condition was undertaken. In the course of this investigation a series of 68 monkeys of various ages and from various sources was examined. A careful exploration of the stomach was made, usually within five minutes of the death of the animal. Six out of the 68 monkeys were found to present the gastric tumor, and in each case from eleven to twenty-three worms were found in the hypertrophied tissue mass. Despite all efforts, no parasites were ever found either in the gastric contents or in the wall of the stomach in animals showing no papillomatous lesions. Furthermore, the worms were never encountered elsewhere in the alimentary tract.

The Parasite and Its Developmental Stages

(Plate I)

The relatively small nematodes are never seen superficially, but they may be stimulated to emerge from the depths of the cauliflower-like mass in which they live by immersing the empty stomach in a bath of physiological saline solution maintained at a temperature of 35°–39° C. Within less than half an hour all the worms present in the tumor will be found either free in the solution or moving with a lively, undulating motion on the surface of the mucosa.

The family Trichostrongylidae, of which this parasite is a typical representative, is a very large group whose members are found in the alimentary tract of amphibia, reptiles, birds, and mammals. More than one hundred genera have been created to accommodate the multiplicity of described species in an orderly taxonomic system. Several systems of classification of the family (or suborder, as some authors prefer to regard the assemblage) are still in process of construction and trial, so that at the present time it is inadvisable to speculate on the natural phyletic affinities of many of the genera.

A careful study of the anatomy of the parasite under present consideration has shown that it coincides in all significant features with Nochtia nochti described in 1929 by Travassos and Vogelsang (2) from the stomach of Macacus rhesus.

Since the original description of this parasite is in Portuguese and is published in a Brazilian journal accessible only in a few of the larger library centers, it may be a service to English readers to provide a new description
of the worm before giving an account of its hitherto unknown larval stages.3

Suborder Strongyloidea (Weinland, 1858)
Family: Trichostrongylidae Leiper, 1912
Subfamily: Trichostrongylinae Leiper, 1908
Genus: Nochtia Travassos and Vogelsang, 1929
*Nochtia nochti* Travassos and Vogelsang, 1929

**Description:** In life the worms are suffused with a bright red color, which changes to a dirty gray after preservation. The body is filiform, sharply attenuated anteriorly in both sexes and posteriorly, also, in the female. The cuticle is delicately striated transversely, the striae being less than 1 μ apart; in addition the cuticle bears slightly elevated ridges, 4 or possibly 5 in each quadrant, extending longitudinally along the body. Behind the mouth the cuticle is inflated for a distance of about 35 μ in males and 45 μ in females, the inflation being about 35 μ wide and showing 5 or 6 faint annulations (Fig. 1).

The excretory pore is inconspicuous, about 0.36 mm. from the anterior extremity. The cervical papillae, so minute as to be difficult to detect, are symmetrically situated about 0.1 mm. behind the excretory pore.

The oral aperture is naked, surrounded by four diminutive cephalic papillae in the submedian lines. The oral vestibule is unarmed by teeth, taking the form of a shallow funnel that gives entrance to the esophagus.

The esophagus is rather less than one-tenth the length of the body: 0.52–0.56 mm. in the male and 0.65–0.71 mm. in the female. It increases very gradually in width to terminate in a slight bulbous swelling. The nerve ring encircles the esophagus near the level of its anterior third.

**Female** (Fig. 2): Length from 7.6 to 9.9 mm.; maximum width at middle of body, 0.15 to 0.17 mm. Didelphous. The vulva, marked by very slightly salient lips, is situated in the posterior fourth of the body 1.4 to 2.2 mm. from the extreme tip. The short muscular vagina opens into a well developed ovejector whose divergent horns, each about 0.14 mm. long, give entrance to the uteri by way of globular sphincters. Each uterus has an estimated capacity of 60 to 70 eggs. The anterior ovary reaches forward to within a short distance of the esophagus, where it bends back and becomes coiled on itself; the posterior ovarian tube extends to within 0.2 mm. from the anus and is then reflected forward, with little coiling, to terminate anterior to the level of the vulva. The tail (Fig. 4) is 0.16–0.18 mm. in length, digitiform, with bluntly rounded extremity. The eggs, with a very thin, transparent shell, are ellipsoidal, 60–80 μ by 35–42 μ in dimensions.

**Male** (Fig. 3): From 5.7 to 6.5 mm. in length and 0.10 to 0.14 mm. in maximum width. The bursa (Fig. 5) is relatively large, consisting of a well separated dorsal lobe and symmetrical lateral lobes, the margins of which are delicately decorated with striated markings, while the internal surface carries numerous irregularly distributed verrucae, each tipped with a filamentous (?) tactile) hair. Prebursal papillae are present; also telamon. The ventro-ventral and latero-ventral rays are of about equal size, bent slightly forward to reach the edge of the bursa. The antero-lateral runs parallel with the ventro-lateral but is distinctly shorter than the other lateral rays. The externo-dorsal is slender, arising from near the base of the dorsal ray; it arches over into the lateral lobe of the bursa but stops short of the margin of the latter. The dorsal ray is stout, about 75 μ long; three pairs of lateral twigs of successively smaller size are given off in its distal portion. The spicules are slender acicular structures, from 0.36 to 0.41 mm. in length, including the swollen head to which the retractor muscles are attached. The shaft of the spicules is marked with striae and the inner margin carries a membranous ala. Spicules terminate in simple points which appear to be united.

Except for a slightly greater amplitude in the range of measurements,

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3 We desire to acknowledge our indebtedness to Dr. Emmet W. Price of the Zoological Division, Bureau of Animal Industry, Washington, D. C., for the pains he took to secure for us a transcript of the original article.
due probably to the larger number of worms at our disposal, the above description coincides in all major particulars with that given by Travassos and Vogelsang for *Nochtia nocti*, and we have no hesitation in identifying our material with that species. No mention is made by Travassos and Vogelsang of any pathological lesions in the stomach of the *rhesus* monkey from which their worms were derived. This may be due to lack of observation; on the other hand, it is possible that different strains of *Nochtia nocti* having different pathogenic potentialities exist, or that the difference in the host species may be critically involved.

**Development of Eggs and Larvae of Nochtia nocti:** The fact that a large proportion of our monkeys carry spontaneous infections with such intestinal nematodes as *Strongyloides fuelleborni* and *Oesophagostomum apiostomum*, whose eggs are very similar in shape and size to those of *Nochtia nocti*, makes it a matter of great practical difficulty to determine in life (by fecal examination) whether any individual monkey is, or is not, infested also by the latter species. Without a knowledge of the morphological peculiarities of the larvae of *Nochtia nocti* it is also impossible to make the differential diagnosis by "culturing" the animal's feces and then examining the larvae isolated by means of the so-called Baermann apparatus. Consequently we have adopted the device of following the development of eggs obtained directly from the adult female worm. Even when we had become familiar with the distinctive morphology of the larval stages of *N. nocti*, we continued to examine by preliminary gastrostomy the monkeys to be used for experimental purposes. This we consider a safer procedure than relying upon the examination of larvae from fecal cultures, since the absence of larvae from a culture may be due simply to unfavorable conditions for larval development.

To obtain the eggs of *Nochtia*, the living worms, which have been stimulated to emerge from the depths of the tumor, are transferred to a small Petri dish containing Locke's solution. At room temperature (27–31°C in Batavia) the worms usually live for about twenty-four hours, and during this period each female may yield from 20 to 30 viable eggs.\(^4\)

The eggs, when freshly oviposited, are often in the unicellular condition, but cleavage takes place rapidly, so that within ten minutes the four-cell stage is attained. The gastrula stage (Fig. 6) can be found within a couple of hours and a motile embryo occupies the egg before twelve hours have elapsed. Hatching occurs soon after with the escape of the first-stage, so-called "rhabditiform," larva (Fig. 7), which is about 200 μ in length and 15 μ in diameter at the widest point of its body. The most distinctive feature of the early rhabditiform larva of *Nochtia nocti*, differentiating it from the rhabditiform larva of most other species of parasitic nematodes, is its relatively long cylindrical buccal cavity, which, according to age, ranges from 13 to 17 μ in length by about 2 μ in width. The tail of this larva, as contrasted with the corresponding stages in the development of *Strongyloides* and *Oesophagostomum*, is relatively short, being about 50 μ in length. The cuticle is transversely striated, but so fine are the markings that they are

\(^4\) After oviposition has ceased the adult worms may be re-introduced into the stomach of a monkey to set up a new infection, as happened in the experiments described on p. 182.
NOCTIA NOCHTI

All drawings, with the exception of Fig. 5, which is a composite diagram from several specimens, were made with camera lucida by Sandground.

FIG. 1. ANTERIOR EXTREMITY OF ADULT FEMALE SHOWING CEPHALIC INFLATION
FIG. 2. FEMALE WORM: GENERAL ANATOMY
FIG. 3. MALE WORM: GENERAL ANATOMY
FIG. 4. TAIL OF FEMALE, FROM SIDE
FIG. 5. BURSA OF MALE
The accompanying scale is a fairly close approximation for size.
FIG. 6. EGG IN GASTULA STAGE OF DEVELOPMENT
FIG. 7. FIRST-STAGE OR Rhabditiform Larva
FIG. 8. SECOND-STAGE OR FILARIFORM LARVA
visible only with the highest magnification. The esophagus, including its valved, pyriform bulb, measures 90 μ in length. The spindle-shaped genital primordium is only 4 μ long.

The rhabditiform stage larva will not continue to grow and develop unless it feeds. Acceptable food may be provided by adding a small quantity of a suspension of Bacilli coli to the Locke's solution. The mortality of larvae is high, however, and the best growth has been obtained by transferring the young larvae with bacteria to an open dish containing filter paper kept constantly in a very moist condition. Thus provided with nourishment, a fair proportion of young rhabditiform larvae will increase in size until they have attained a length of about 0.5 mm. and a breadth of 20 μ. About the end of the third day the larva ceases to feed. A period of lethargy now sets in. During this period the buccal cylinder disappears and there is a reorganization of the differentiated parts of the esophagus, which gradually assumes a more cylindrical shape. About this time a new cuticle is formed and when this is finally shed the larva enters into its second, or so-called "filariform," stage. It is the filariform larva in all members of the Strongyloidea that is infective, capable of penetrating the skin of the host, as in the case of the hookworms, or gaining entrance to the body only through the mouth, with food, etc., as in the case of the majority of trichostrongyles.

The filariform stage of Nochtia nochtii (Fig. 8) is reached in "culture" by the fifth or sixth day. It measures from 515 to 580 μ in length and from 20 to 24 μ in greatest width. The esophagus averages 160 μ in length by 12 μ in width, and the musculature of its wall is so transparent that the terminal bulb is sometimes difficult to observe. The tail is relatively short (about 60 μ) and comes to a rather abrupt, pointed end. In general appearance the filariform larva of Nochtia somewhat resembles the infective larva of hookworms, but it is much more sluggish in its movements. Its activity is not markedly increased by the application of slight heat and furthermore it is capable, especially in the sheathed condition before ecdysis, of withstanding desiccation as evidenced by revival after evaporation of visible moisture in a watch glass for five hours at room temperature. It is because of these biological characters of the filariform larva that the assumption is made that Nochtia nochtii, like all its known fellow members of the Trichostrongylinae, gains entrance to its host through the contamination of food and water rather than by way of the skin.

THE TUMOR

(Plates II–IV)

The tumor protrudes as a hyperemic, cauliflower-like mass from the wall of the stomach (Fig. 9) usually at the border of the prepyloric and the fundal areas. Microscopically the tumor is surrounded by healthy looking mucosa containing fundal glands in most cases. Sometimes pyloric glands in normal mucosa are present in the immediate neighborhood.

At first sight the tumor seems to be a benign papillomatous growth. Closer study, however, reveals a more complicated condition. Histological study has been possible in eight cases, including two that were observed
FIG. 9. *Nocitia Tumor in Stomach of Javanese Monkey after Fixation in Formalin: Diameter 3 cm.*

FIG. 10. **Two Nocitia Tumors in Stomach of Javanese Monkey in Fresh Condition:** Diameter of Largest Tumor 1.5 cm.

A Nocitia is seen emerging from this tumor, appearing black on account of its reddish color.

FIG. 11. *Nocitia Tumor, Showing Papillomatous Structure*

The black spots in the debris of the clefts of the tumor are Nocitia eggs.

FIG. 12. *Nocitia Eggs in the Débris of the Tumor Clefts Further Enlarged*
several years ago. Serial sections are available from six tumors. In all of these there is a conspicuous, more or less sharply localized, papillomatous thickening of the mucosa (Figs. 9 and 10). The finger-shaped protrusions of the papilloma are still covered with a single layer of undifferentiated epithelial cells and separated by deep clefts almost reaching the muscularis mucosae. In the depth of the clefts some débris has collected and in this débris scattered worm eggs are visible (Fig. 11). The eggs are thin-shelled and colorless; in the sections the shells are shrunken; they contain a rounded cell mass (Fig. 12) but apparently no completely developed larvae. The eggs can also be observed pressed against or attached to the layer of epithelial cells, usually singly (Fig. 13). At these spots the epithelial cells do not take the stain well, indicating that some destructive action on the mucosal tissue has taken place. It is possible that eggs are sometimes situated in healthy connective tissue beneath the epithelium of the mucosa, but this has not been observed with certainty. Eggs can often be seen, however, surrounded by semi-necrotic tissue, staining more or less homogeneously with eosin and losing all differentiation (Fig. 14). The general contour of a finger-shaped projection remains vaguely discernible for some time, but as necrosis progresses this tissue falls to pieces and, together with the eggs it contained, is added to the débris in the depths of the papillomatous clefts. Cross-sections of the worms themselves can sometimes be observed (Fig. 15).

In the 6 cases studied in serial sections the epithelial hyperplasia is not entirely restricted to the mucosa; it penetrates into the muscularis mucosae and very often invades the submucosa. This penetration of the muscularis mucosae may occur at several spots in the same tumor. It sometimes takes the form of a number of thin tubules breaking through the muscle (Fig. 16) and in other cases a solitary wide epithelial sac makes its way alongside a blood-vessel through the muscularis mucosae towards the submucosa (Fig. 18). Once the submucosa is reached, there is a tendency to the development of epithelial cysts. From the walls of these cysts papillomatous growth occurs into the cyst lumen, producing structures that resemble cystadenoma papilliferum (Fig. 17), which may completely occupy all the space between the muscularis mucosa and the muscular wall of the stomach. No invasion of the muscular wall has been observed thus far. Neither worms nor eggs have been found in these submucosal cystopapillomatous developments.

This invasion of the submucosa by the mucosal epithelial hyperplasia is not simply an accidental heterotopia. It represents very active growth. Fig. 18 shows the penetration of the muscularis mucosae by an epithelial protrusion which at first sight seems innocent enough. If, however, we follow this epithelial downgrowth in serial sections, it is seen to approach a neighboring vein, which probably under its influence becomes considerably dilated, until it is much wider than any other submucosal blood-vessel visible in the series. Eventually the tumor reaches the wall of the vessel and invades it. The vessel reacts with abundant endothelial proliferation and formation at this particular spot of a thrombus, attached to its wall (Fig. 19). The tumor then starts to invade the vessel wall but apparently this process is still at a very early stage. In Fig. 20 the elastica of the vessel, although not clearly visible on account of its thinness, can be followed all around the tumor.
**Fig. 13.** Single Egg (Black) Firmly Attached to the Tumor Epithelium
The surrounding epithelial cells show signs of damage.

**Fig. 14.** Four Nochtia Eggs (Black) in Necrotic Finger-shaped Protrusion Still Adhering with Its Base to the Living Part of the Tumor

**Fig. 15.** Tumor Tissue with Cross-section of a Nochtia Worm in the Center

**Fig. 16.** Penetration of the Muscularis Mucosae by a Number of Thin Tubules
The invasion of the submucosa, the thrombosis resulting from the contact of tumor and vessel wall, and a possible incipient invasion of vessel wall and thrombus by the tumor indicate very aggressive potentialities. Although it may not entirely prove the malignant character of this tumor process, it is certainly sufficient reason to disallow considering the tumor as a simple benign papilloma.

**EXPERIMENTAL PRODUCTION OF PAPILLOMAS**

The fact that 6 out of the 68 monkeys killed have had gastric papillomas from which in each instance *Nochtia nochti* has been recovered, taken in combination with the further fact that in no case have these worms been found in the absence of a tumor, constitutes an extremely strong statistical correlation pointing to a causal relationship between parasite and tumor. For the further confirmation of this relationship and in order to investigate the mechanism whereby tumor growth is incited, a number of experiments were carried out.

Two different procedures were followed:
1. Infestation by direct transfer of fully mature adult worms.
2. Infestation with filariform larvae of *Nochtia*.

The natural occurrence of the *Nochtia* infestation among the Batavian monkeys makes it essential to exclude preexisting infestation and tumor formation. As mentioned earlier in this paper, for the critical diagnosis of *Nochtia* infestation we have felt it unsafe to rely upon the detection of larvae in "cultures" made from the stools, and in those animals which we proposed to infest experimentally, we have always resorted to a preliminary gastrotomy followed by a thorough exploration of the mucosa of the stomach.5

Following preliminary gastrotomy under general anesthesia on two monkeys in which no sign of gastric papilloma or worm infection had been detected, living adult *Nochtia nochti* removed from papillomas of other monkeys, after being kept for about twenty-four hours at room temperature in Ringer-Locke solution, were introduced into the stomach. The stomach was then sewed up and the monkey was put in a separate cage, isolated from other animals in the colony. Our observations on these monkeys are now recorded:

**MONKEY No. 3:**
*Dec. 7, 1938:* Twenty-two adult *Nochtia nochti* (11 male and 11 female) introduced into the stomach.
*Jan. 9, 1939:* At gastrotomy, a lesion was seen in the prepyloric region which was thought to be an incipient papilloma. Tumor left in situ, stomach sewed up, and animal restored to cage.
*March 9, 1939:* On inspection of stomach at operation a papilloma measuring about 1.5 × 1 cm. was found 2 cm. from the pyloric sphincter. After the animal was killed and the stomach immersed in Ringer-Locke solution, 13 *Nochtia nochti* worms emerged from the lesion. On histologic examination the tumor appeared to be a papilloma of the type described above, with beginning invasion of the muscularis mucosae.

**MONKEY No. 3B:**
*March 10, 1939:* Sixteen *Nochtia nochti* adults (11 female and 5 male) introduced into the stomach.

5 For performing gastrotomy operations on our monkeys, we wish here to record our indebtedness to the assistants of the Department of Surgery of the School of Medicine, Batavia.
PLATE IV
(Figs. 17–20)

Fig. 17. Replacement of the loose fibrous tissue of the submucosa by papilliferous cystadenomatous epithelial tumor tissue
The muscularis mucosae runs from left to right, separating the upper papillomatous from the lower invasive part.

Fig. 18. Penetration of the muscularis mucosae and invasion of the submucosa by a solitary epithelial sac

Fig. 19. Endothelial proliferation and thrombosis in a dilated vein of the submucosa with incipient invasion of the vessel wall by the epithelial sac of Fig. 18

Fig. 20. Same vessel with elastin stain
The thin layer of elastin can be followed around vein and tumor.
May 10, 1939: On inspection of the stomach at operation a papilloma with a diameter of about 1 cm. was found in the prepyloric region. Animal killed. Half the tumor was immediately fixed for histologic examination. Only eggs were detected in this part, which proved to be the overhanging portion of a typical papilloma without the stalk. From the other half 3 female worms emerged in Ringer-Locke solution.

Further experiments along these same lines, as well as experiments with filariform larvae, have been performed, but sufficient time has not yet elapsed to allow for the development of tumors. The investigation is being continued and a further report on the subject will be presented later.

Discussion

There seems to be little room for doubt as to the causative rôle played by Nochtia nochti in the formation of these gastric tumors. In the studies here reported we have never found the worms in the absence of tumors and we have not found the tumors unaccompanied by worms. The introduction of adult Nochtia worms into the stomachs of two monkeys, which appeared healthy at gastrotomy, was promptly followed by formation of distinct tumors within two and three months. There are indications that in one monkey tumor formation had started one month after the infestation had been established. Additional infestation experiments have been carried out with male and female Nochtiae in combination as well as separately and also with infective Nochtia larvae; these experiments will be continued as material becomes available and the results will be described in another paper.

The sharply localized character of the Nochtia tumor is striking. Microscopically the gastric mucosa at some distance from the tumor appears perfectly normal. We find no evidence of any factor of a general nature such as a general inflammatory condition or a general metaplasia acting in a preparatory way on the gastric epithelium. Everything seems to point towards a primary local action of the worms. The more or less constant location of the tumor a few centimeters from the pylorus remains to be explained; at present we offer no opinion as to the cause of this localization.

Although some of the Nochtia tumors border on malignancy, especially the one whose aggressive characters are illustrated by Figs. 18–20, we have no proof that they will eventually develop into definite carcinoma.

As many Java monkeys of the species involved (usually called Macacus cynomolgus in medical literature) find their way to zoological gardens all over the world, there are possibilities that further stages of this Nochtia tumor may be discovered at autopsies of old Java monkeys elsewhere. Thus far we have had no opportunity of examining old monkeys.

There is a certain similarity between these Nochtia tumors of monkeys and a tumor of the forestomach of the rat presumably caused by the nematode Capillaria (= Hepaticola) gastrica and described by one of us (3). Although a different epithelium is involved, the tumor has the same sharply localized character. It also shows affinities for the blood-vessels and it could be definitely diagnosed as a carcinoma by its invasion of an artery. There was no general thickening of the gastric epithelium, which was such a prominent phenomenon in Fibiger's classical Gongylonema experiments. Certain doubts
have recently been expressed whether in Fibiger's experiments the worms were the only determining factors in the causation of the epithelial changes produced in his rats (Cramer, 4). In the Nochtia tumors there is no indication of any provocative factor other than the local action of the worms; this was also true for the Capillaria tumor referred to above.

Whether this action is exerted by the worm itself or by its eggs, is difficult to decide. We observed processes of necrobiosis at spots where there were eggs but no worms. However, a female worm must have been present at these spots for oviposition and may have excreted deleterious substances at the time. This point needs further investigation. In practically all our experiments we allowed the worms to emerge from the tumors, because we needed them for helminthological study or for infestation experiments. We are consequently not yet fully familiar with the position that the worms may take up in the tumor.

**SUMMARY**

*Nochtia nochti*, Travassos and Vogelsang 1929, a trichostrongylid nematode parasite, causes tumor formation in the stomach of *Macacus mordax*, Thomas and Wroughton 1909 (syn. *Macacus cynomolgus pro parte*). The worms live in the depth of the tumor and have never been found free on the surface of the gastric mucosa.

There is a constant association of tumor and worm.

The tumors are sharply localized adenopapillomatous growths, invading the submucosa. In one case evidence of very aggressive potentialities was obtained, the tumor producing endothelial proliferation and thrombosis of a submucosal vein with incipient epithelial invasion of the vessel wall.

In two monkeys found at preliminary examination to be free of both tumor and worms, a tumor developed two and three months respectively after worms had been introduced into the stomach.

A description is given of *Nochtia nochti* and its larval development.

**REFERENCES**