

be plasmocytes or mature lymphocytes.

Thus, the marked immunodepressive effect of a murine leukemia virus such as FDV may be related directly to morphologic alterations in the spleen, a tissue in which more than 95 percent of the antibody-forming cells appear (in normal mice) after a single immunization with sheep erythrocytes (9). Whereas noninfected mice immunized with RBC have a rapid development of PFC, as well as a marked increase in germinal centers and characteristic morphologic changes, mice infected with FDV do not have a similar cellular response. However, even infected mice produced some antibody—generally less than 5 to 10 percent of the PFC observed in normal controls. Electron-microscopic examination of sections of spleens from these animals revealed mainly undifferentiated large cells, most with virus particles. There was no evidence that similar virus particles were present in cells which, according to morphologic characteristics, could be engaged in antibody synthesis. Studies on the ultrastructure of single cells in the center of hemolytic plaques, obtained by plating dispersed spleen-cell suspensions from normal and FDV-infected mice immunized with sheep erythrocytes, should reveal whether or not virus particles can be detected in demonstrable antibody-producing cells.

Our observations and previous studies on the kinetics of antibody formation in animals infected with tumorigenic viruses suggest that the immunologic defect caused by such a virus could be in the stem cell stage. Other studies of transfer of spleen cells from virus-infected mice into immunologically incompetent recipients have indicated a marked deficiency in the number of "antigen-sensitive target cells" (presumably stem cells) found in large numbers in spleens of normal, noninfected donor mice (7). Thus, the leukemia virus may compete with antigen for specific stem cells. This does not seem to be merely an antigenic competition because there is no evidence that virus infection, either with or without immunization with red cells, results in stimulation of cells that appear to be morphologically similar to antibody-forming cells. Apparently, infection with the leukemia virus that we used results in a marked decrease in appearance of such cells.

Histologic examination indicates that the marked hyperplasia of spleen cells,

with appearance of typical tumor cells, does not occur until 1 week or more after infection with FDV (2). However, electron-microscopic examinations indicated that most lymphocytes found in the red and white pulp of mice infected 1 week previously with virus and then immunized with sheep erythrocytes appear to be undifferentiated large nucleated cells without the morphologic characteristics of antibody-forming cells. Whether similar morphologic changes may be correlated with immunodepressive effects of leukemogenic viruses other than FDV is unknown.

If a virus infection alters the ability of lymphoid cells to respond to antigens during the stage prior to clinical symptoms of leukemia, there might be, for such a tumor virus, a selective advantage in which the host animal might not respond immunologically to the viral agent or to any other new antigen that may be associated with the developing neoplasia. Viral tumorigenesis results in appearance of new antigens (11). If such is the case with a leukemia virus such as FDV, a concomitant, generalized suppression of immune responsiveness may aid survival of new tumor cells in the host.

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## Infrared Receptors in the Facial Pits of the Australian Python *Morelia spilotes*

**Abstract.** *There is a series of pits in the scales of the rostrum and posterior portion of the lower lips in some pythons and boas. In the Australian python Morelia spilotes, these pits are innervated by the maxillary and mandibular branches of the trigeminal nerve. Structural and neurophysiological evidence indicate that in the pits there are receptors that function as detectors of radiant heat flux.*

In pythons and boas, the rostral scales, anterior upper labial scales, and posterior lower labial scales often have depressed centers which, if sufficiently deep, may be referred to as pits (Fig. 1). These pits vary in number and depth in different species and are even absent from some species. Noble and Schmidt (1) have compared the pits of pythons and boas in structure and function to the facial pits of pit vipers (Crotalidae). The histological structure of the crotalid pits has been examined with light microscopy (2) and with electron microscopy (3). Bullock and Diecke (4) reported on the function of the crotalid facial pit as an infrared receptor. Not much information is available about the rostral and labial pits of pythons.

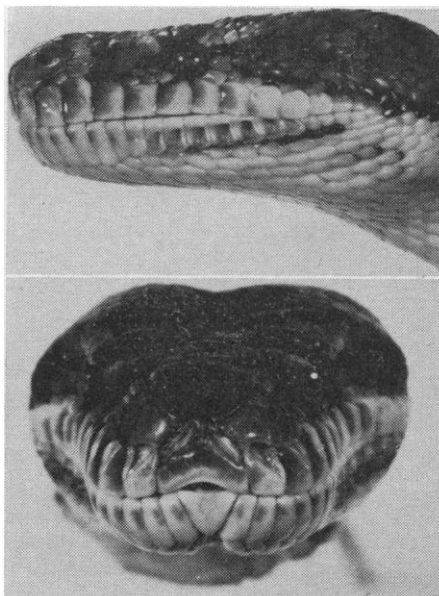


Fig. 1. Facial pits on the lower lip (upper) and rostrum (lower) in the Australian carpet snake *Morelia spilotes*. Pits on the rostrum have high posterior margins which cause them to be directed forward; those on the lower lips are directed laterally and only slightly forward.

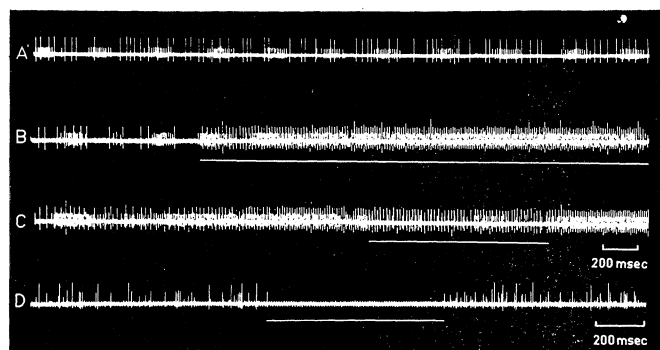
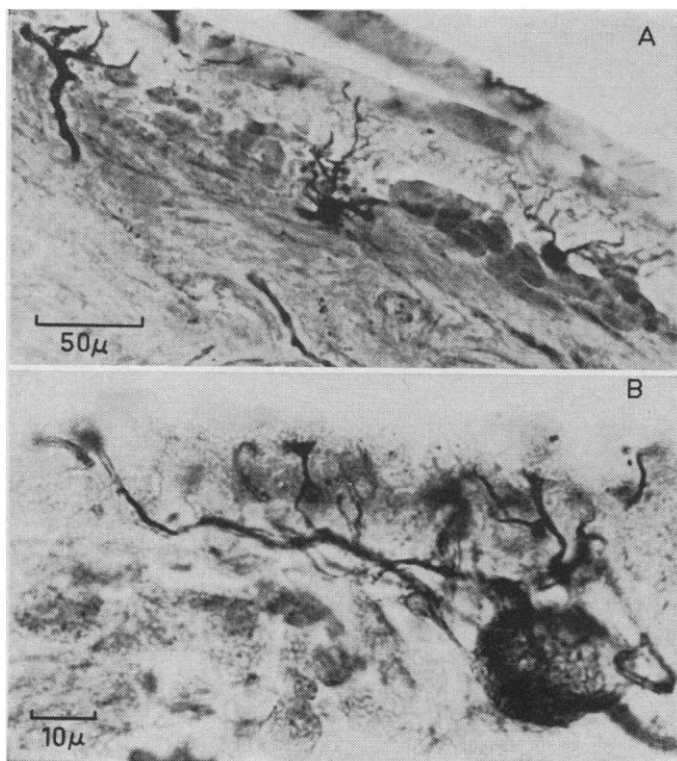


Fig. 2 (left). Nerve endings in a facial pit of *Morelia spilotes*. The outside of the pit is toward the top. (A) Slight separation of the outer layer is a sectioning artifact; (B) filaments that arise from the globose swelling of the axon terminate in conical expansions directed outward. Fig. 3 (above). Recordings of nervous discharges from branches of the trigeminal nerve innervating the pits of *Morelia spilotes*. (A) Resting discharge with one unit firing randomly and another in bursts; (B) increase in frequency when radiation is directed into pits (white bar under electrical record indicates duration of stimulus); (C) receptor discharge significantly reduced when water is interposed (white bar) between source of radiation and receptor; (D) cold object placed directly in front of pit (white bar) inhibits background discharge. (A) and (B) Recorded from mandibular branch (lower pits); (C) and (D) recorded from maxillary branch (upper pits).

Ros (5) described the occurrence and position of the pits in several species of pythons and showed that, in one species (*Python sebae*), they are used to detect warm objects in the environment. Noble and Schmidt extended these behavioral experiments to other species; after demonstrating that the covering of the pits in blindfolded animals impaired their ability to strike at warm objects, they concluded that the pits were warm receptors. We now present neurophysiological evidence that confirms these general conclusions and further suggests that these pits, like those in crocodiles, function as detectors of change in radiant heat flux.

The rostral and upper labial pits are innervated by the maxillary branch of the trigeminal nerve, and the lower labial pits by the mandibular branch [lower maxillary branch (1)]. Noble and Schmidt described the nerve endings in the pits as knoblike enlargements. However, at least in the Australian python *Morelia spilotes*, these knoblike enlargements are not endings but are subterminal swellings of the axon approximately 20  $\mu$ m in diameter; from these swellings, further filaments extend into the outermost regions of the skin (Fig. 2A). The most distal portions of these finer filaments then expand again into conical enlargements (Fig. 2B) which, if examined under suitable lighting conditions, appear to break up

into branches of very fine, short filaments that lie in the  $\alpha$ -layer of the skin (6).

There is some variety in the shape of both the axonic expansions and the neurofilaments. In some cases, there is little expansion, and the entire terminus then appears more palmate (see, for example, the axon on the far left of Fig. 2A). However, none of these types of endings, either palmate or with an axonic expansion, are found outside of the pits where finer, less elaborate nerve terminations occur. It does not appear that any one pit or group of pits is more heavily innervated than another, although we have not made actual counts of the numbers of nerve endings (7).

We recorded nerve impulses from both the maxillary and mandibular branches of the trigeminal nerve in the carpet snake *Morelia spilotes* (Pythonidae). The snakes were initially anesthetized intraperitoneally with nembutal, and subsequent doses were administered by cannulation of the jugular vein. The dosage varied from 5 to 7.5 mg per hour for a snake weighing 800 g. The animals were artificially ventilated with a Palmer small-mammal pump operating at 8 cycle/min with a stroke volume of 25  $\text{cm}^3$ . The temperature of the animals was not monitored but was presumably the same as, or close to, the ambient temperature of 22°C. The trig-

eminal nerve was exposed deep to the adductor mandibularis muscle, and the mandibular and maxillary branches of the nerve were cut as far centrally as possible. The fibrous sheath was then removed from these branches, and their central end was split into fine filaments on a glass plate. The nerve filaments were moistened with physiological saline (8) and then covered with a pool of mineral oil. Action potentials were recorded from these filaments with fine platinum electrodes and displayed on a Tektronix 502 oscilloscope.

A large number of the units have a resting background discharge and may either fire in short bursts or discharge at random (Fig. 3A). As an object warmer than the environment is brought near the pits, the frequency is markedly increased. A distinct response may be evoked if a hand is brought within 50 cm of the snake's head, so long as an unobstructed line exists between the hand and the central region of a pit or series of pits. However, we used more intense radiation from a focused light operated by a 2-volt battery.

Radiation directed into the pits results in an immediate increase in frequency which is sustained (Fig. 3B) as long as the intensity of radiation remains below a certain, as yet undetermined, level. Sufficiently large amounts of radiation result in complete blockage of the detectors. When the stimulus is

stopped, there is no prolonged after-discharge. Reflecting the radiant beam off a front-surfaced mirror and then into the pits does not reduce its effectiveness. On the other hand, if the radiation is filtered through water, the frequency of discharge is decreased (Fig. 3C), an indication that the infrared absorbed by the water is an important component in the action spectrum.

If the balance of radiation is outgoing, the effect is reversed, and the frequency is reduced. This may be demonstrated by placing a relatively cold object some distance in front of the pits. For this purpose, we used a Frigistor thermoelectric cooling element with a surface area of 5.8 cm<sup>2</sup> which was well below 0°C (probably nearer -30°C). At a distance of 5 cm from the pits, this heat sink was very effective in completely inhibiting the background discharge (Fig. 3D).

These data suggest that the pits are radiant energy detectors, although the limits of the stimulus parameters have not yet been measured; we must establish the threshold to a stimulus, spectral sensitivity of the receptors, and the angle of reception of a single pit. Also, the transducing mechanism is not known, and because the morphology of the nerve endings in the pits of pythons contrasts sharply with those in the crotalid pit membrane, the mechanism may differ in the two groups.

Because the pits in pythons have a wider distribution on the face and subtend a greater angle, these snakes may detect radiation sources from a larger arc of the environment than crotalid snakes do. To what degree the snakes use such information in avoiding predation or in capturing prey will only be discovered by controlled behavioral experiments.

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9. Supported by the National Health and Medical Research Council of Australia.

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#### Premature Citations and Zoological Nomenclature

It is frequently necessary to refer to data that are in the process of being published elsewhere or in reports that may never be published. This practice is potentially confusing when the subject deals with zoological names. Premature publication of zoological names adds to the confusion and difficulty of the bookkeeping imposed by the International Code of Zoological Nomenclature. The object of the Code is to promote stability in the scientific names of animals by means of a set of rules and recommendations. However, there is no mechanism to enforce adherence to the Code among zoologists.

To be accepted by the community of zoologists, the scientific name of an organism has to be published, as defined in the Code (Articles 8 and 9) and also it must satisfy Articles 12, 16, or 13 (I). Published names which fail to meet these conditions are *nomina nuda* and have no standing in nomenclature. Names prematurely cited in papers that happen to be published before the primary paper may meet the conditions of publication. This publication is then the official establishment of the scientific name.

The date that appears on a report may not necessarily be the correct date for purposes of nomenclature, and Article 21 provides guidelines for the determination of publication dates. For purposes of priority a new name takes the year, month, and day on which the report became available to the public, and the date on which the publication is mailed is considered to be the official date of publication. For example, one of my papers is dated 1960, but was released on 24 February 1961, and a second paper dated 1961 was released on 22 March 1962 (2). The new names in those publications date from 1961 and 1962, respectively. Swain described, illustrated, and discussed eight species, one genus, and one family which he credited to Kraft, 1962, citing in the synonymies Kraft's

page and figure numbers for each taxon. Swain's paper (3), dated July 1962, was mailed on 16 July 1962, while Kraft's paper (4) was first mailed in September 1962. All these names take their date of publication as 16 July 1962 and should be credited to Swain.

Dadlez and Kopik (5) cited and illustrated a Triassic species *Notocythere media excelsa* Will, 1953. The synonymy cited page and figure references in Will, 1953, which is an unpublished dissertation on Keuper ostracodes from northwest Germany in the University of Tübingen, whereas Dadlez and Kopik illustrated a Rhaetian specimen from a well in western Poland. The above taxon was illustrated for the first time but not described by Dadlez and Kopik. The genus, species, and subspecies are *nomina nuda* because their publication does not meet the requirements of Article 13 of the Code, and the genus does not enter into homonymy with *Notocythere* Hart and Hart, 1967 (Article 54) (6). Furthermore, Dadlez and Kopik also created the *nomen nudum* of the nonexistent nominate subspecies *media media* (Article 47, 61a).

The present ease of duplication and distribution of unpublished typescripts has increased similar cases. One of my papers that was submitted for publication in 1965 and is still in press was cited in a publication in 1966 (7).

The use of "in litt." to identify the authors of taxa in unpublished reports and in reports "in press" is a common practice that causes nomenclatural snarls. Egorov (8) described the new genus *Mossolovella* and designated *M. incognita* (Glebovskaja and Zaspelova in litt.) as the type species, for which he published a description and illustration for the first time. The parentheses around the authors' names indicate that *incognita* was transferred from a different genus (Article 51d). Because "in litt." indicates that *incognita* was a manuscript name, the taxon should be cited as *M. incognita* Egorov, 1953.

Polenova (9) had access to Egorov's report prior to its publication as well as to the unpublished report by Glebovskaja and Zaspelova. She described the Late Devonian genus *Ellesmerina* which she credited to "Glebovskaja et Zaspelova, in litt." and cited without description or illustration *Ellesmerina incognita* Gleb. et Zasp. in litt. as the type species. In the generic discussion