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SCANNING ELECTRON MICROSCOPIC STUDY OF THE VULVA OF SOME TRICHURIDS (NEMATODA)

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Abstract. The structure of vulva of four *Trichocephalus* species has been studied using scanning electron microscopy (SEM). The shape of vulva and cuticular elements on vulval appendages is described and documented. The cuticular structures on the vulva have a characteristic shape specific for each species. It is supposed that SEM can be successfully employed in a detailed study of vulval structure, which is an important taxonomic character for the differentiation of females of *Trichocephalus* species.

The structure of vulva of nematode females of the genus *Trichocephalus* has been little considered in comprehensive systematical works and monographs (Skryabin et al. 1957, Sarwar 1959). However, some authors (e.g., Kreis 1935, Burdelev 1951, Wolfgang 1951) used this character for better diagnosis and differentiation of species of this genus. Other morphological characters are not very characteristic and the structure of vulva may therefore be applied in the solution of some taxonomical problems.

The present SEM study of the vulva of four *Trichocephalus* species was therefore designed to complement the knowledge of the structure of this organ and apply it as a taxonomic character of these nematodes. This is the first SEM study of the vulva of nematodes belonging to this genus.

MATERIAL AND METHODS

Four nematode species of the genus *Trichocephalus* Schrank, 1788 were chosen from our collection for the SEM study. One of them, *T. skrjabini* from *Ovis aries* L., originated from Afghanistan, the other three, *T. lani**) from *Capreolus capreolus* L., *T. globulosus* from *Ovis musimon* Pall. and *T. ovis* from *Ovis aries* L., originated from Czechoslovakia. Two females of *T. lani* and seven specimens of each of other species were used. The material was first studied, measured and determined by means of an optical microscope. The postesophageal (vulval) part of body measuring 3—4 mm was then separated and placed on separate stubs containing glue on a drop of water. The samples were then quenched in liquid nitrogen and freeze-dried. The preparations were examined with ASID-1 scanning device used with the JEM 100B electron microscope operating at an accelerating voltage of 40 kV.

RESULTS

1. Trichocephalus skrjabini (Baskakov, 1924)

The vulva is situated on the ventral side of body, at the distance of 0.11—0.18 mm from posterior end of esophagus. The conspicuous vulval appendage is cylindrical, bell-

*) There were only females available in our material and therefore the determination as *T. lani* is only tentative.

shaped or tubular (mostly longer than wide) and measures 0.037—0.130 mm in length and 0.033—0.044 mm in maximum width. The transitional part of body adjacent to the vulval appendage is covered with flat, scale-like structures (Plate I, Fig. 1). The whole surface of the vulval appendage is densely covered with cuticular processes ("sines"). On the tubular part of vulval appendage they are distinctly finger-shaped (longer than wide) and their tips are rounded (Plate I, Fig. 2; Plate II, Fig. 1). On the margin of opening of the vulval appendage these processes have a wider base and are of more or less triangular shape with rounded tip (Plate I, Figs. 3, 4). The spines on the vulval process are not very sclerotized. Their length is 0.0052—0.0084 mm and width 0.001—0.003 mm at base.

2. Trichocephalus lani Artyukh, 1948

The vulva is postesophageal, 0.096—0.115 mm from posterior end of esophagus. The vulval appendage is tubular and measures 0.047—0.051 mm in length and 0.029—0.037 mm in maximum width. It is only sporadically covered with spines (Plate II, Figs. 2, 3, 4) of finger-like or triangular shape. The length of spines is 0.0035—0.011 mm. Their tips are always round. The opening of the vulval appendage is round, circular and without spines.

3. Trichocephalus globulosus Linstow, 1901

The vulva is postesophageal, 0.093—0.17 mm from posterior end of esophagus. Its margin is round and circular (Plate II, Fig. 5). The cuticle around the vulva is smooth or with only fine transverse striations. The external vulval opening measures 0.042 to 0.048 mm in diameter. From the vulval opening a hemispherical internal vulva appendage protrudes with a circular internal vulval opening at the tip. This opening measures 0.015—0.017 mm in diameter. The wall surface of the internal vulval appendage seems to be smooth or covered with only small cuticular bosses. The distal part of the vagina is 0.038—0.050 mm long and covered inside with spines measuring 0.008 mm in length and 0.003 mm in width.

4. Trichocephalus ovis Abildgaard, 1795

The vulva is situated 0.14—0.19 mm from posterior end of esophagus. The vulval appendage is spherical, egg-shaped or tubular and measures 0.022—0.061 mm in length and 0.081—0.096 mm in width (mostly wider than long). The transitional part of body cuticle and vulval appendage forms round, flat processes (Plate III, Figs. 1, 2, 3). The surface of vulval appendage is densely covered with scale-shaped to finger-shaped processes arranged in irregular longitudinal rows and measuring 0.0048—0.0051 mm in length and 0.0042—0.0050 mm in width (Plate IV, Figs. 1, 5). These flat cuticular structures are present also on the margin and internal funnel-shaped opening of the vulval appendage (Plate IV, Figs. 2, 3, 4). The cuticular elements around the vulval opening are of more or less triangular shape. Their tips are always round.

DISCUSSION

Three of the four species examined possess a characteristic vulval appendages armed with cuticular processes (spines or leaf-like elements). In *T. skrjabini*, the spines are very densely distributed on the whole vulval appendage. Although their presence and distribution is visible already in the optical microscope (Magomedbekov 1953 in Skryabin

et al. 1957), only SEM method revealed that they are finger-shaped to triangular and their tip is always round. It is also of interest that the cuticular elements begin to form already on the proper body of female (Plate I, Fig. 1) where they are more or less leaf-shaped to triangular.

The species which was tentatively determined as *T. lani* has a distinctly different topography of spines on the vulval appendage. The spines are very scarce and irregularly arranged. In the original description by Artyukh (1948) it was mentioned that the spines are present on the vulval appendage of *T. lani* but no details were given. As it follows from the literature, the males of *T. lani* very closely resemble those of *T. skrjabini*. The data on the detailed structure of female vulva may serve for the differentiation of these two species.

Also in *T. ovis* the vulval appendage is covered with cuticular structures, but these are more flat and leaf-shaped. Their presence has already been observed by Magodbekov (1953 in Skryabin et al. 1957) and other authors using optical microscope. Their detailed shape, however, is now first described on the basis of the SEM studies. The cuticular structures begin to form already on the proper body of female near the vulva. They have the shape of round, irregularly distributed processes.

In agreement with other authors we have found that the vulva of *T. globulosus* is never salient. We have observed a small, internal hemispherical vulval appendage (probably the distal part of vagina — see Baylis 1932). In all females examined the internal vulval opening on the tip of this appendage was circular. We consider this character a suitable criterion for the differentiation of *T. globulosus* from the related species *T. capreoli* Artyukh, 1948. The external vulval opening of the latter species (not documented in the present paper) is oval and measures 0.085—0.088 × 0.049 to 0.052 mm. In our specimens of *T. capreoli*, the internal opening of the vulva had always the shape of a longitudinal, narrow slit about 0.044 mm long.

Further SEM studies of the structure of vulva might yield another detailed knowledge of *Trichocephalus* species applicable for the differentiation of related taxons.

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ЭЛЕКТРОННОМИКРОСКОПИЧЕСКОЕ ИЗУЧЕНИЕ ВУЛЬВЫ НЕКОТОРЫХ ТРИХУРИД (NEMATODA)

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Резюме. Методом сканирующей электронной микроскопии (СЭМ) изучали структуру вульвы четырех видов рода *Trichocephalus*. Описана и документирована форма вульвы и кутикулярных элементов на придатках вульвы. Структура кутикулы вульвы всех четырех изучаемых видов имеет характеристическую, специфическую для каждого вида форму. Предполагается, что СЭМ может быть успешно использована для подробного изучения структуры вульвы, которая является важным таксономическим признаком для дифференцировки самок видов рода *Trichocephalus*.

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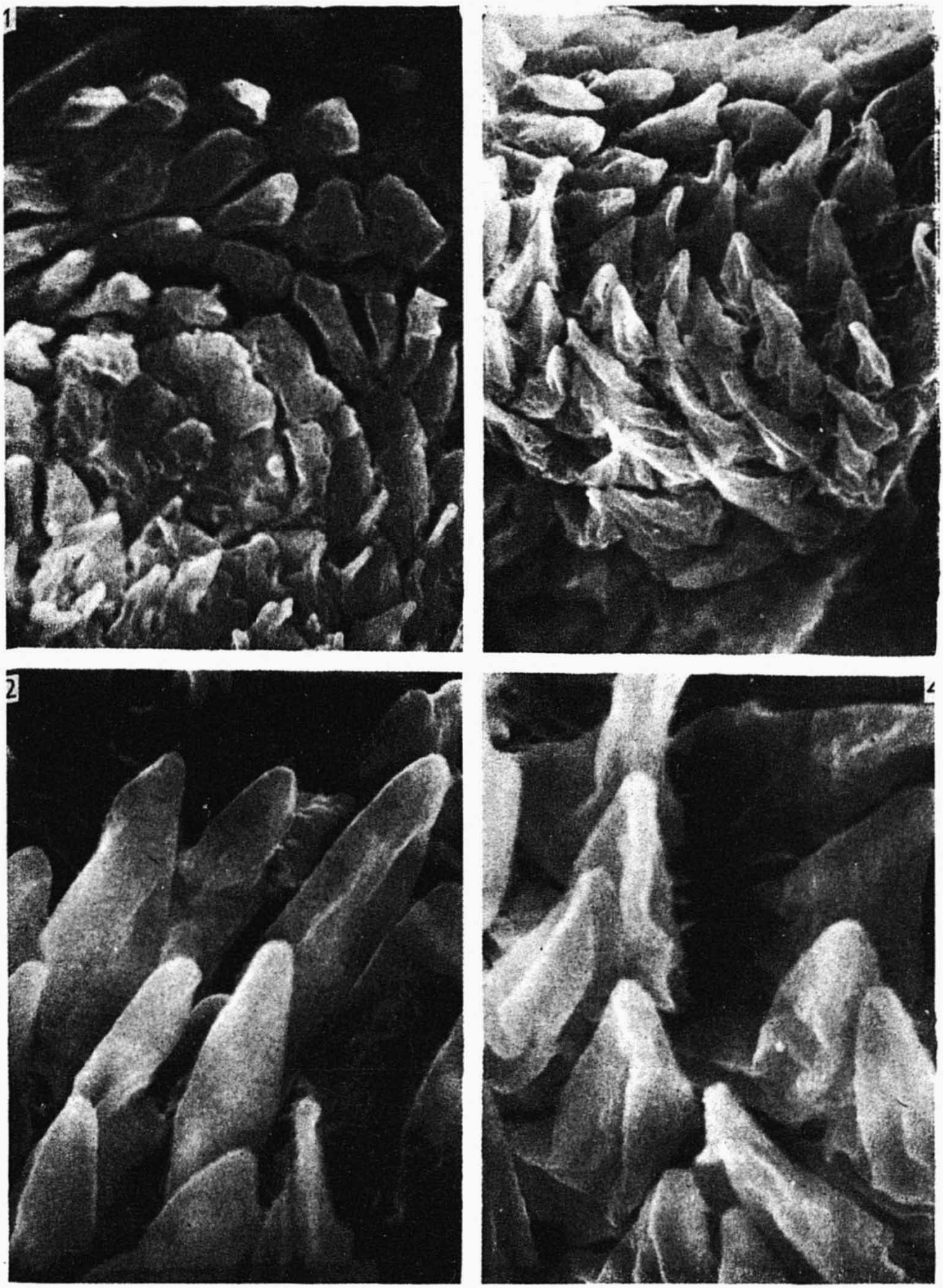


Fig. 1—4. Scanning electron micrographs of vulva region of *Trichocephalus skrjabini* (Baskakov, 1924). **Fig. 1.** Transitional part of body and attached parts of vulva (detail) — (×3,000). **Fig. 2.** Group of finger-shaped processes on middle part of vulva (detail) — (× 10,000). **Fig. 3.** Margin of vulval opening — (× 3,000). **Fig. 4.** Group of finger-shaped to leaf-shaped processes on the margin of vulval opening (detail) — (× 10,000).

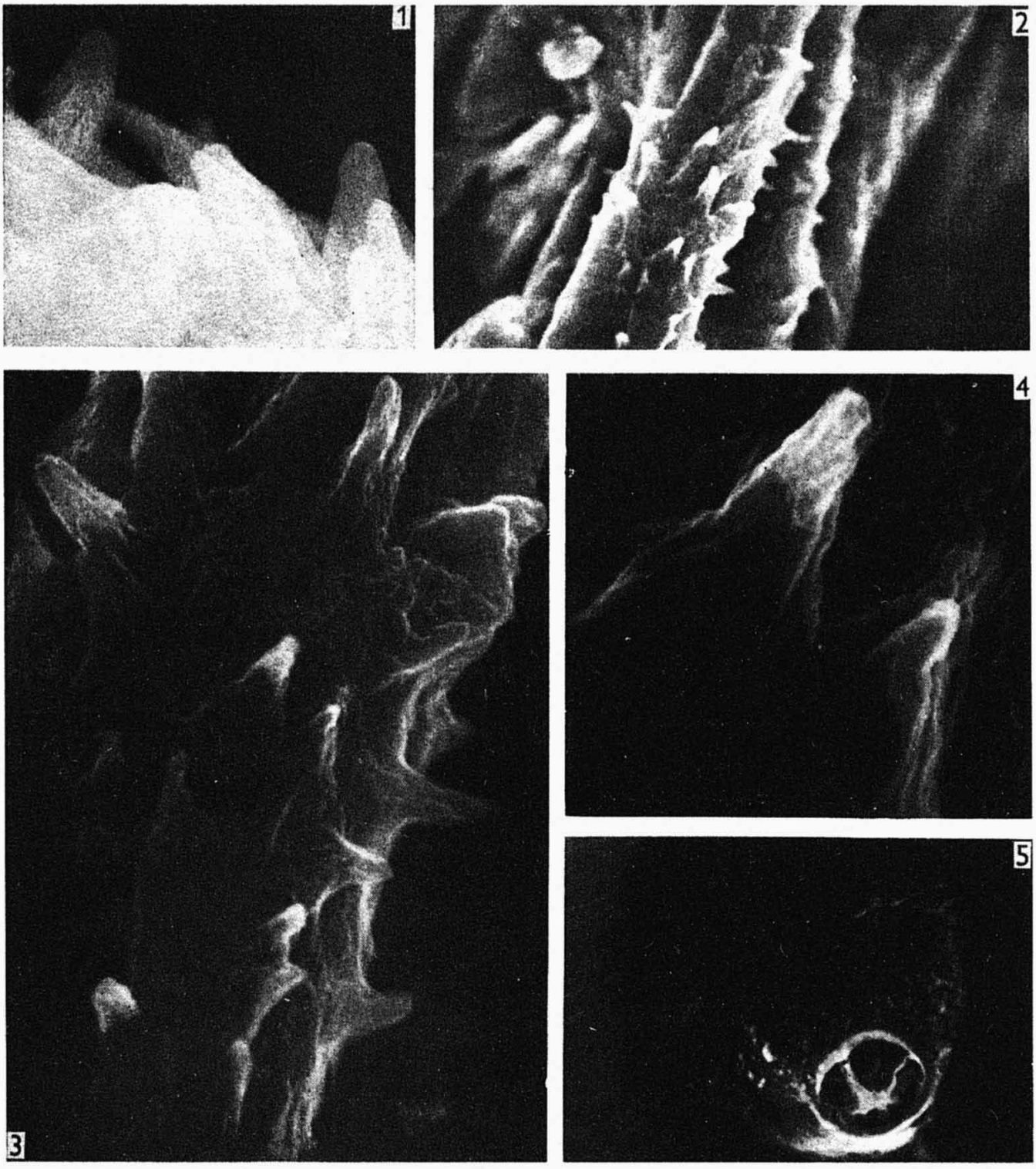
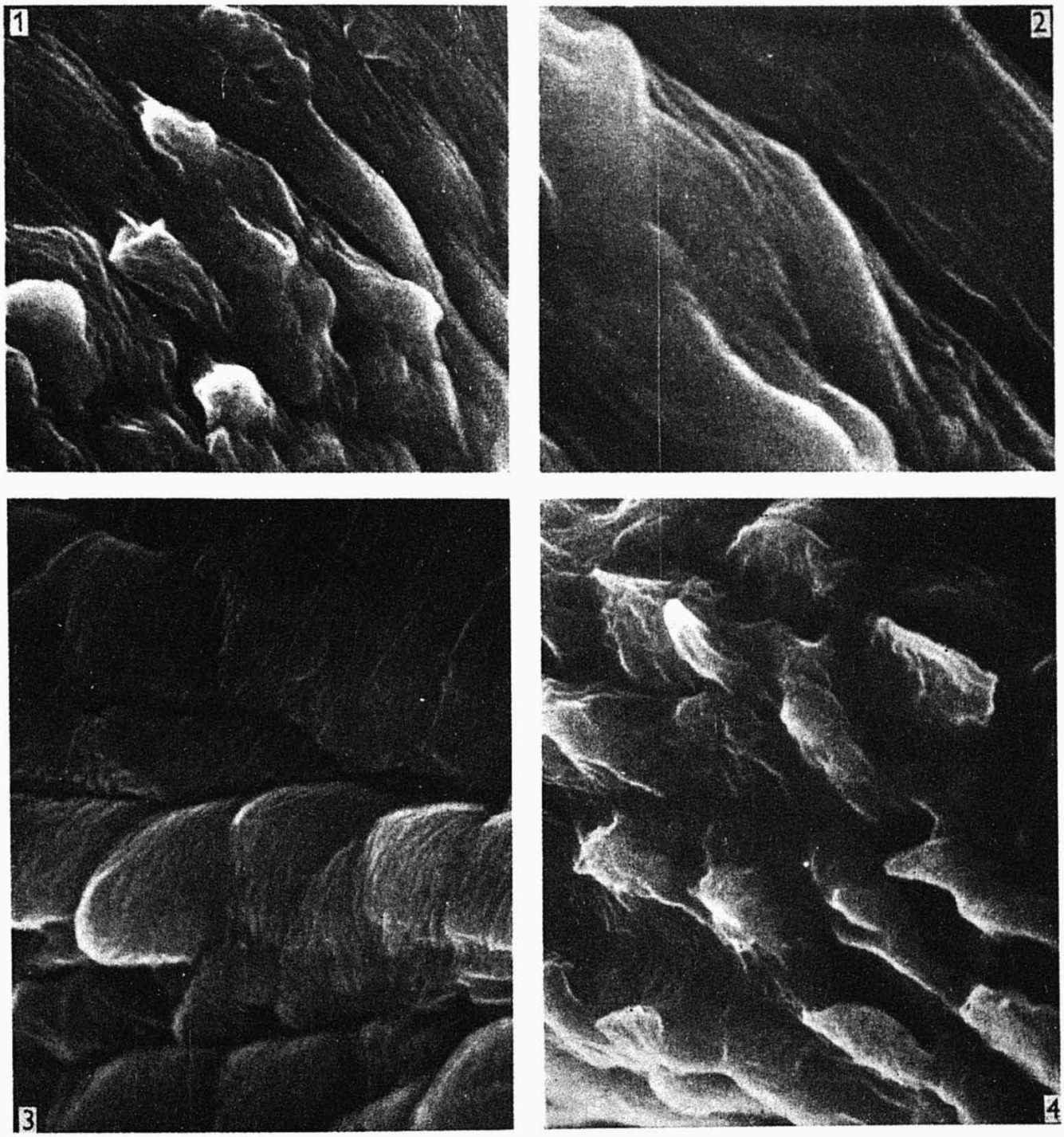
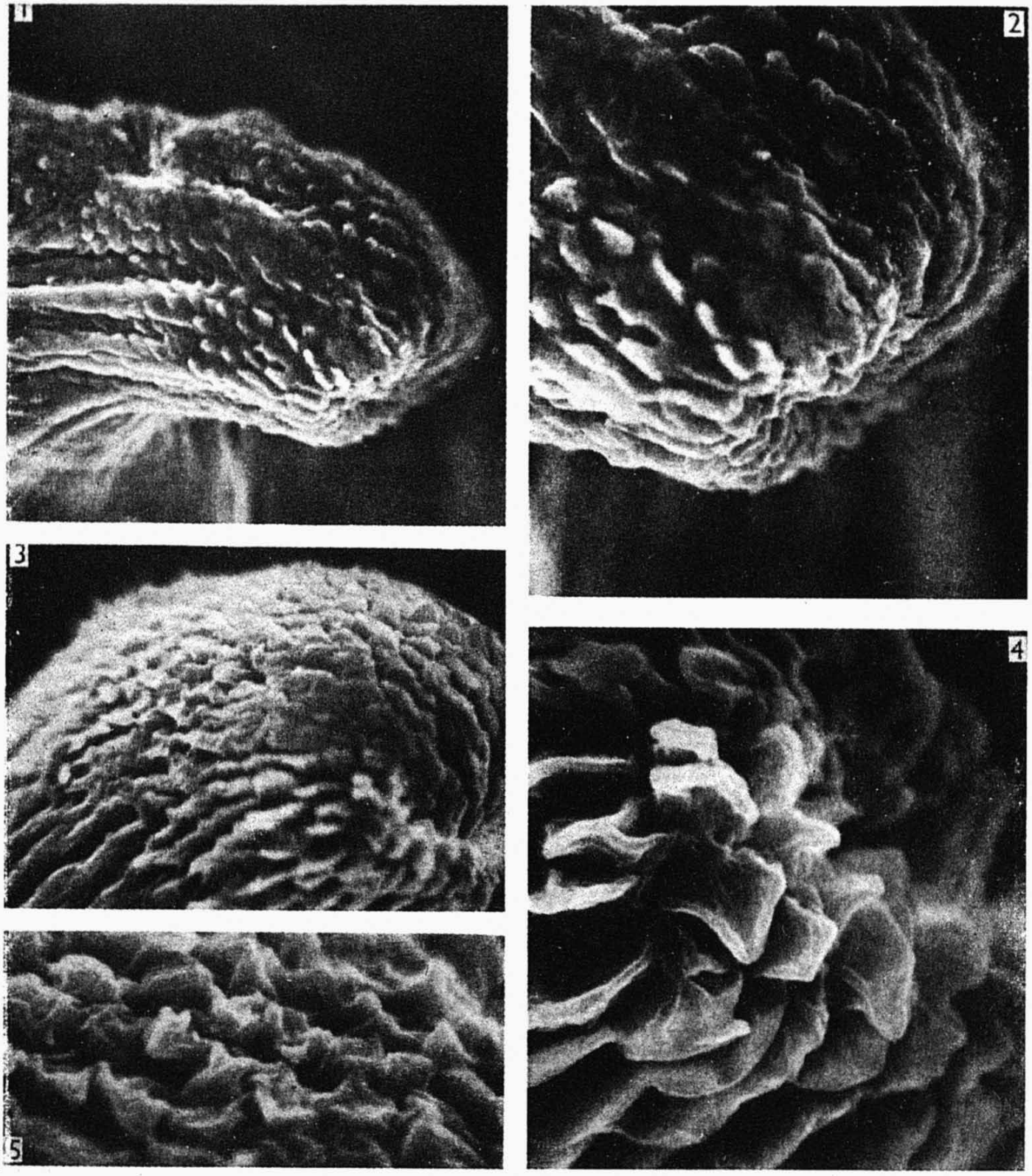


Fig. 1. Scanning electron micrograph of finger-shaped processes on lateral margin of vulva of *Trichocephalus skrjabini* (Baskakov, 1924) — (× 10,000). **Fig. 2.** Distribution of finger-shaped processes in middle part of vulva of *Trichocephalus lani* Artyukh, 1948 — (× 1,000). **Fig. 3.** Variability of finger-shaped processes on middle part of vulva of *T. lani* (detail) — (× 3,000). **Fig. 4.** Two finger-shaped processes on the vulva of *T. lani* (detail) — (× 10,000). **Fig. 5.** Vulva of *T. globulosus* (Linstow, 1901) slightly salient and without finger-shaped processes (general view) — (× 2,000).



Figs. 1—4. Scanning electron micrographs of vulva region of *Trichocephalus ovis* (Abildgaard, 1795). **Fig. 1.** Transitional part of body and vulva; beginning of formation of leaf-shaped processes — (×3,000). **Fig. 2.** Transitional zone (detail) — (× 10,000). **Fig. 3.** Transitional zone on lateral part of body, formation of leaf-shaped processes — (×3,000). **Fig. 4.** Surface of vulva in middle part with leaf-shaped to finger-shaped processes (detail) — (×3,000).



Figs. 1—5. Scanning electron micrographs of vulva of *Trichocephalus ovis* (Abildgaard, 1795). **Fig. 1.** Vulva (general lateral view) — (× 500). **Fig. 2.** Vulval opening (detail, lateral view) — (× 1,000). **Fig. 3.** Vulval opening (detail, ventro-lateral view) — (× 1,000). **Fig. 4.** Margin of vulval opening with densely distributed leaf-shaped processes (detail) — (× 3,000). **Fig. 5.** Leaf-shaped processes on lateral side of vulva — (× 2,000).

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Second seminar on the automatic data acquisition in ecology

During 25 and 26 April 1977 the second state-wide seminar entitled "Automatic data acquisition in ecology" was held at Liblice near Mělník, organized by the Institute of Parasitology of the Czechoslovak Academy of Sciences and the Works Branch of the Czech Scientific and Technical Society attached to the Institute of the Theory of Information and Automation of the Czechoslovak Academy of Sciences. It was attended by 65 specialists from 12 institutes of the Czechoslovak and Slovak Academies of Sciences and 12 universities and institutions. A total of 23 papers were read and discussed by the participants.

Lectures of the seminar were divided into 4 parts according to the theme. The first part included methodical and organizational approaches to performation of biological field experiments, the second part concerned the questions of mathematical and statistical elaboration and evaluation of the data acquired and some program systems of computational technique. The third part dealt with the characteristics and qualities of different types of measuring apparatuses and their parts suitable for continual measurement. Concrete results were presented in the fourth part. Questions of parasitology and medical zoology were represented in papers dealing with the experience of the long-term field experiment evaluation of the life cycle of *Ixodes ricinus*, with mathematical and statistical characteristics of parasite-host relation of *Hypoderma bovis* in different parts of its distribution, with the automatic observation of body temperature in hedgehog during hibernation, and with telemetric methods for studies of spacial activity in vertebrates. Also projection of films from the International Film Parade Ecofilm on the environment was of striking acceptance.

The seminar pursued with great success the similar one held for the first time in 1975. Once again research workers from various biological, technical and mathematical disciplines assembled in a joint meeting to discuss possible solution of problems in question. The problems of ecology proved to find their way even more from basic research sphere into practice in the connection with solution of problems of nourishment of population, its healthful development and protection of the environment. Automatic data acquisition is becoming an integral part of some research tasks of groups of problems mentioned above. Automation gives precision to data, saving of labour and increases the quality and quantity of views from which biological objects may be examined. Permanent attention to the development of its methodic point and acquaintance with results reached should be given in various institutes. As a result of positive estimation of the seminar by its participants it was recommended to continue in this tradition and to organize a similar meeting within 2 or 3 years.

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