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**On a new lung fluke found in Peru,
Paragonimus peruvianus sp. n.
(Trematoda: Troglotrematidae)**

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Introduction

Since indigenous cases of human paragonimiasis were reported by Barton (1910), Arce (1915) and Corvetto (1921 a, b) in Peru, this country has been known to be infested with the disease, which was suspected to have been introduced by Japanese or Chinese immigrants. In recent years the disease has begun to attract medical attention, and Miranda *et al.* (1967) found *Paragonimus* eggs unlike those of *P. westermani* (Kerbert, 1878) in the sputum of patients. But, the causative agent of the disease was entirely unknown before 1967, when Ibáñez and Miranda found adult lung flukes for the first time in Peru. They obtained 19 worms from a cat in La Asunción, an endemic area situated close to San Juan, Cajamarca Province, and they thought that the worms concerned were probably different from either *P. westermani* or other known species of the genus. Recently, a part of the same materials as well as newly obtained specimens were sent to the senior author (Miyazaki) for taxonomical studies.

On the other hand, the metacercariae of *Paragonimus* sp. were found for the first time in Peru in a crab, *Pseudothelphusa chilensis*, and three of them were sent to Japan. Furthermore, formalin-preserved sputum of a Peruvian patient containing a lot of *Paragonimus* eggs was made available for investigation. In the present paper the authors describe the Peruvian lung fluke as a new species, emphasizing the medical importance of this parasite.

Materials and Methods

The adult worms were collected from two cats captured in the above-mentioned La Asunción and then in El Guayo, Cajamarca, where human paragonimiasis is also occurring. The worms were flattened in formol-acetic, and six of the first lot and two of the second lot were made available for the present description. Except three specimens of the first lot, which were mounted in Peru, the remainder five worms were stained in Japan with hematoxylin and mounted in balsam. In some specimens the cuticle and the vitelline gland covering the

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ovary and testes were removed in order to demonstrate their branching clearly. Pieces of the cuticle removed were used for photographing cuticular spines. Fertilized eggs were obtained from the terminal part of the uterus before staining. The metacercariae of *Paragonimus* sp. were found in five of 40 crabs examined, which were collected in El Guayo area where the second cat was proved to be infected with adult *Paragonimus*. Three excysted metacercariae fixed in formol-acetic under slight cover-glass pressure were stained in Japan with carmine and mounted in balsam. *Paragonimus* eggs in the formalin-fixed sputum of the patient residing in San Juan were carefully compared with uterine eggs of the adult flukes.

Description of *Paragonimus peruvianus* sp. n.

Holotype (Figs. 1 and 9) spindle-shaped, 13.2 mm long by 6.5 mm wide. Whole body covered with singly spaced cuticular spines, some of them splitting longitudinally into two or three (Figs. 3 and 4). Oral sucker subterminal, 0.92 by 0.68 mm, followed by a small pharynx and a short esophagus. Two intestines run posteriorly to the end of body, winding slowly. Ventral sucker 0.94 by 0.90 mm,

situated slightly anterior to the center of the body. Ovary moderately branched and located on the right side of the body, measuring 1.73 by 1.19 mm in outline. Uterus coiled on the left side of the body, containing numerous eggs. Vitelline glands widely distributed on both sides of the body. Testes much larger than the ovary, measuring 4.93 by 1.45 mm in outline on the left and 3.38 by 1.96 mm on the right. They branched moderately, some lobes showing antlerlike branching. Genital pore opens immediately behind the ventral sucker. Excretory bladder extends to the bifurcation of intestines.

Four paratypes (Figs. 2 and 10-12; Table 1), fully mature specimens, are entirely allied to the holotype in morphology, except that the oral sucker is slightly larger than the ventral one in all paratypes, the ovary is situated on the left side in one specimen (No. 4) and that one testis (No. 2) is almost the same size as the ovary.

Eggs (Figs. 5 and 6) yellowish in colour and oval in shape; 75 to 86 μ long by 44 to 53 μ wide, averaging 79 by 48 μ when free from pressure. Eggshell thin (about 1.5 μ) and uniform in thickness, but shows irregularly undulating contour. When the egg is strongly pressed under a cover-glass, the feature of shell is more clearly demonstrated, as shown in Fig. 6.

Table 1 Measurements of four paratypes* (in mm)

No.	Body	Oral sucker		Ventral sucker		Testis		
		Width	Length	Width	Length	Left	Right	
1.	12.2×5.8	1.07	0.87	0.94	0.95	1.56×1.16	2.55×1.29	3.40×1.50
2.	13.3×7.6	0.97	0.77	0.78	0.75	1.90×1.75	2.07×1.48	3.03×1.96
3.	12.9×6.5	0.99	0.75	0.83	0.81	1.60×1.39	3.25×1.62	3.26×2.04
4.	11.6×6.3	1.19	0.90	0.82	0.85	1.48×1.41	3.32×1.41	2.14×1.82

* Stained and mounted specimens

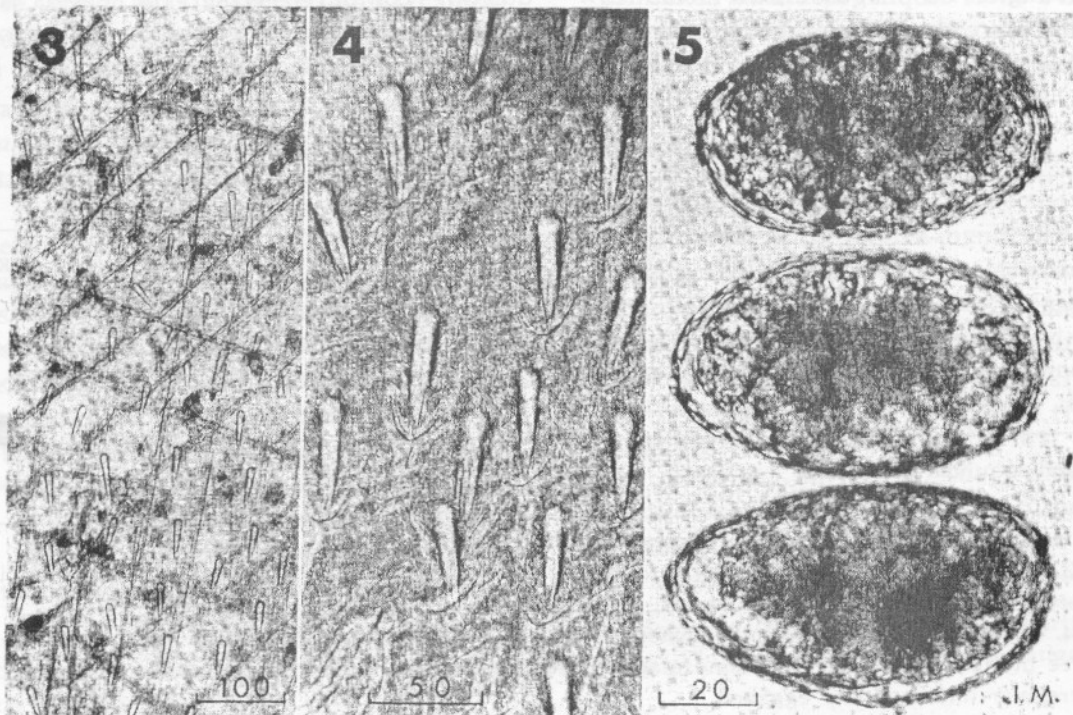
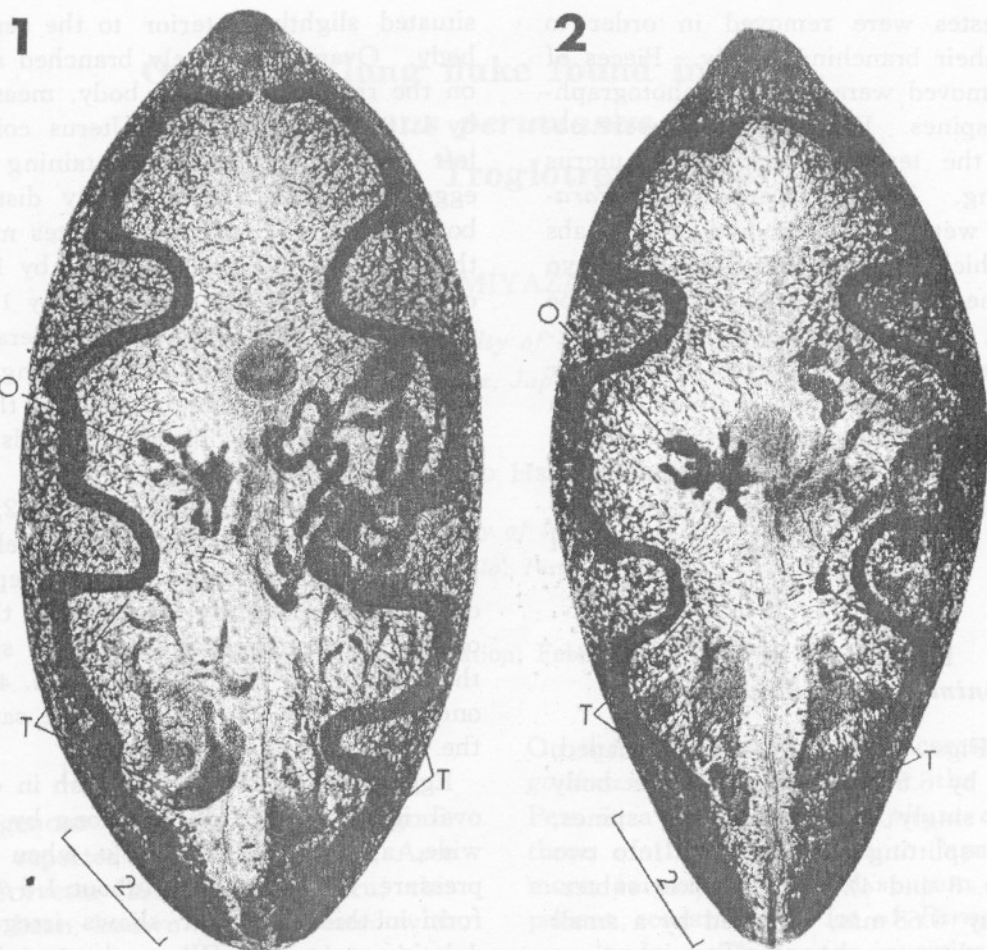
Explanation of Figures

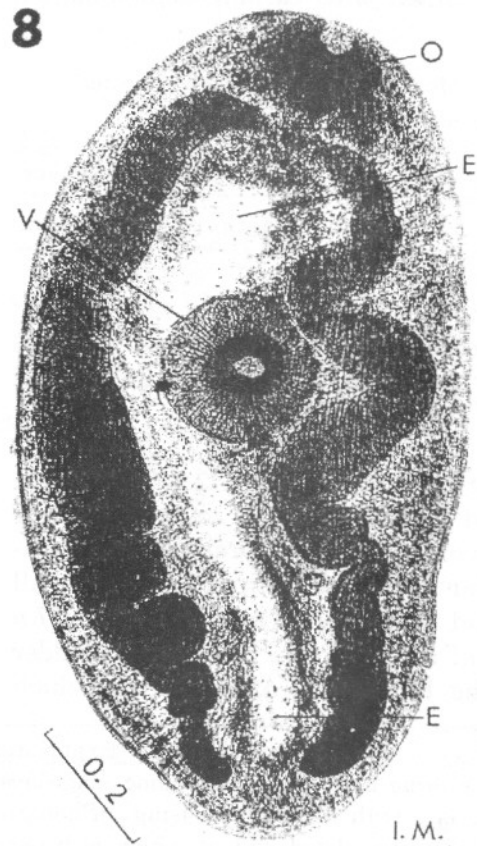
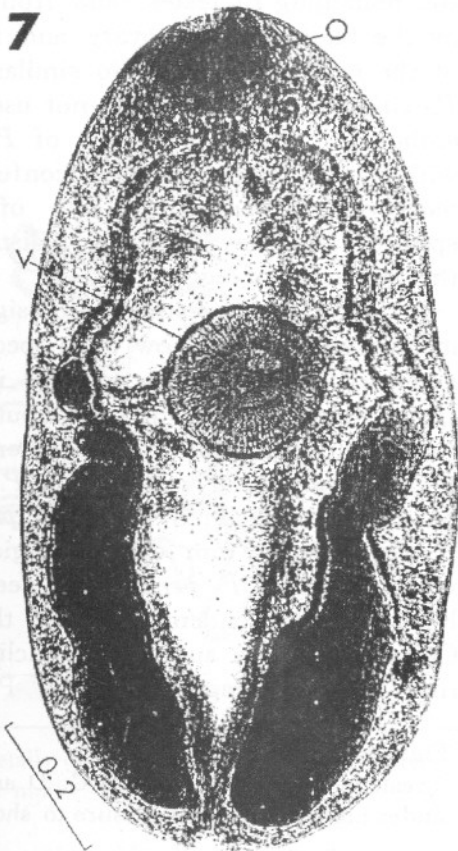
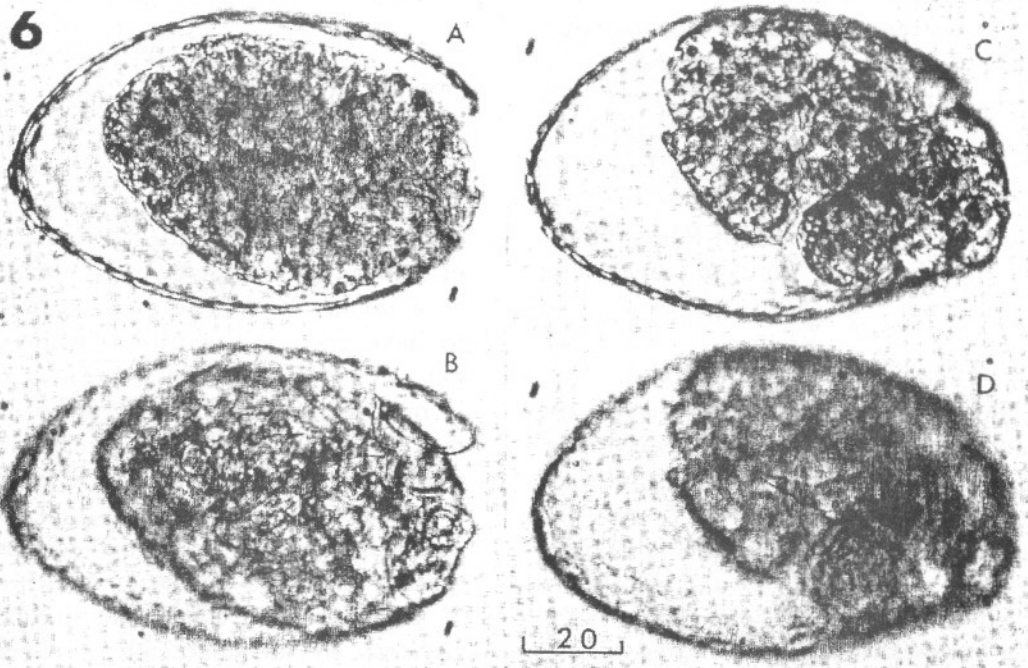
Figs. 1 and 2. Ventral view of adult *P. peruvianus* sp. n.; stained and mounted specimens. (Scales in mm)

1. Holotype 2. Paratype no. 1 (O: ovary, T: testis)

Figs. 3 and 4. Cuticular spines on ventro-posterior part of an adult body. (Scales in micron)

Fig. 5. Three uterine eggs under the same magnification. (Scale in micron) Operculum on the right side. Note irregular undulation of eggshell.





It is likely that the surface of eggshell is provided with a lot of dents of various size. This surface view becomes more conspicuous, when the egg dries up under a cover-glass.

Host: *Felis catus* Linnaeus.

Location: Lungs.

Locality: La Asunción, Cajamarca Province, Perú.

Type specimens: Department of Parasitology, Faculty of Medicine, Kyushu University, Fukuoka, Japan.

Description of Metacercaria

From epidemiological point of view, the metacercaria found in El Guayo seems to belong to *P. peruvianus* sp. n. Living metacercaria is oval in shape and enveloped with one cyst. Since the cyst wall is thin and fragile, the larva excysts very easily. Pinkish granules are recognized in the parenchyma of the larval body. Measurements of three excysted larvae, which were stained with carmine and mounted

run to the posterior end of body, winding slowly.

Discussion

In the Western Hemisphere, five species of *Paragonimus* have so far been recorded in literature; i.e. *P. rudis* (Diesing, 1850), *P. westermani*, *P. kellicotti* Ward, 1908, *P. caliensis* Little, 1968 and *P. mexicanus* Miyazaki et Ishii, 1968. However, *P. rudis* is regarded as a *nomen nudum* and *P. westermani* seems to have been misidentified by previous investigators. Of three valid species, *P. mexicanus* is most closely allied to *P. peruvianus*, but the ovary is more delicately branched in the former, while the testes are more delicate in the latter. Furthermore, the feature of eggshell, shown in Figs. 5 and 6, is a good criterion for separating the two species. On the other hand, *P. peruvianus* is easily distinguished from *P. kellicotti* by the character of uterine eggs and the branching of testes, and from *P. caliensis* by the feature of the ovary and testes. Eggs of the new species are so similar to those of *P. caliensis* that they are not used for differentiation. Some specimens of *P. peruvianus* with large testes may be confused with *P. macrorchis* Chen, 1962, one of the Asian species, but they are clearly distinguished by the character of eggs.

It is very interesting and significant for medical science to know what species of *Paragonimus* causes human disease in Peru. Investigating the eggs in the sputum of a Peruvian patient, the authors considered that these eggs were absolutely not those of *P. westermani*, but they belonged to either *P. peruvianus* or *P. caliensis*. From epidemiological point of view, however, *P. peruvianus* seems to infect humans in the endemic area of the disease in Cajamarca. The authors are inclined to think that human paragonimiasis in Peru was not

Table 2 Measurements of three excysted metacercariae* (in micron)

No.	Body	Oral sucker		Ventral sucker	
		Width	Length	Width	Length
1.	1,156×595	154	110	220	211
2.	1,224×655	150	114	224	220
3.	1,105×680	145	114	255	207

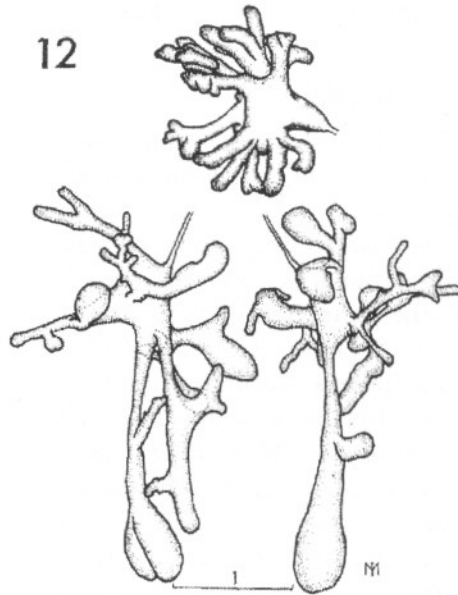
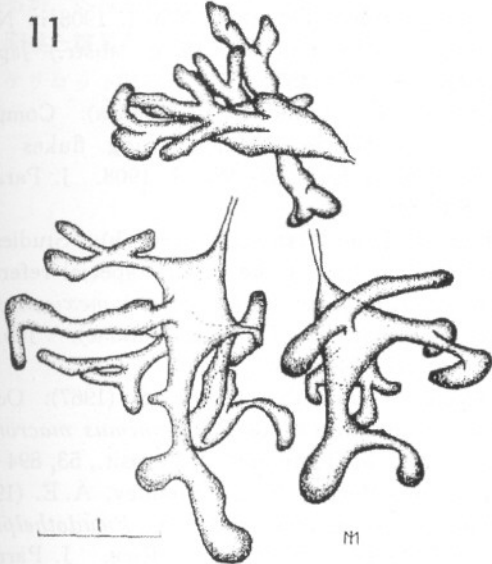
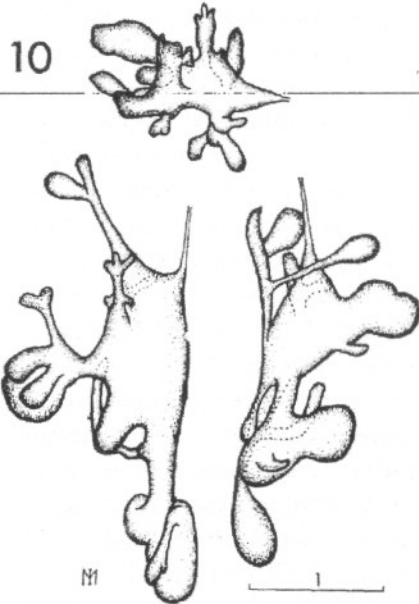
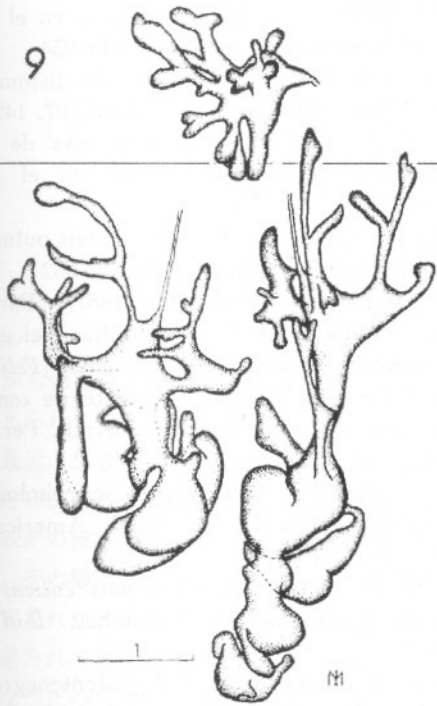
* Stained and mounted specimens

in balsam, are shown in Table 2. The larvae (Figs. 7 and 8) are densely covered all over with single pointed spines. Oral sucker is evidently smaller than the ventral sucker in all specimens and armed with a small stylet, 17 μ long, in one of three larvae. Excretory bladder extends to the bifurcation of intestines, which

Explanation of Figures

Fig. 6. Two uterine eggs under the same magnification. (Scale in micron) A, B and C, D are respectively the same egg with different focusing. Photographed under high cover-glass pressure to show the feature of eggshell, operculated end of which is broken.

Figs. 7 and 8. Ventral view of excysted metacercariae which belong probably to *P. peruvianus* sp. n.; stained and mounted specimens. (Scales in mm. E: excretory bladder, O: oral sucker, V: ventral sucker)



Figs. 9-12. Details of an ovary (upper) and two testes (lower) in adult *P. peruvianus* sp. n.; ventral view. (Scales in mm)

9. Holotype

10. Paratype no. 1

11. Paratype no. 2

12. Paratype no. 3

introduced by immigrants from the Orient, but it has been caused by the autochthonous lung fluke from old times.

Concerning *Paragonimus metacercaria*, only two species were reported in the Western Hemisphere; i.e. *P. kellicotti* and *P. caliensis*. In addition, that of an unknown species was reported from Costa Rican fresh-water crabs by Sogandares and Smalley (1965, 1967). The larva found for the first time in Peru is most probably that of *P. peruvianus*, although it was not proved by experiment. The Peruvian larva is similar to that of *P. caliensis* in morphology, which is also enveloped with a single cyst, but the former is larger in the size of body and two suckers, and its stylet seems shorter than the latter. As compared with *P. kellicotti*, the present larva is apparently larger and is enveloped with a single cyst, instead of with two cysts in *P. kellicotti* as shown by Miyazaki (1964). The Costa Rican metacercaria, which was described very briefly, seems to have a larger ventral sucker than the present one. Anyway, the body of the Peruvian larva is the largest that the senior author has ever studied.

Summary

Paragonimus peruvianus sp. n. was described from two cats captured in La Asunción and El Guayo, Cajamarca, Peru. The new species is allied to *P. mexicanus* Miyazaki et Ishii, 1968 in morphology, but they are separated by the branching of the ovary and testes as well as by the character of eggs. It is most likely that human paragonimiasis occurring in Cajamarca area is caused by the new species. The metacercaria belonging probably to *P. peruvianus* was found in a fresh-water crab, *Pseudothelphusa chilensis* collected in El Guayo, which is not infrequently eaten uncooked by inhabitants in that area. Ultimately, *P. peruvianus* seems to be very important in the medical field.

Acknowledgement

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ペルーで発見された *Paragonimus peruvianus* sp. n.
(ペルーハイキュウチュウ, 新称) について (特別掲載)

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ペルーにヒトの肺吸虫症があることは、すでに今世紀初頭から知られており、それは、東洋からの移民によると考えられていた。病原虫については全く不明であつたが、最近、患者の発生が注目されるようになった結果、やつと1967年になつて、Ibanez and Miranda が Cajamarca の流行地でえたネコから、はじめて成虫をみつけた。その標本とともに、患者のタンと、流行地のカニからえられたメタセルカリアが、同定のために宮崎のもとに送られてきた。精査の結果、新種であることが明らかになつたので、上記の学名と和名をつけて、記載した。

アメリカ大陸での独立種は現在のところ、北米のケリコット肺吸虫、中米のメキシコ肺吸虫、および南米(コロンビア)の *P. caliensis* (カリ肺吸虫, 新称) の3種であるが、ペルー種はメキシコ肺吸虫に最も近い。しかし、卵巣と精巣の分枝や卵殻の特長で区別できる。また、ケリコット肺吸虫とは、精巣の分枝や卵が明らかに

ちがう。最も近くに分布するカリ肺吸虫とは、卵巣と精巣に著明な差があるが、卵は非常によく似ている。ペルー人のタンにみられた卵は、この両種のものに一致するが、患者と同地区のネコからペルー肺吸虫がえられたのであるから、患者のも同じ種類とみてよいであろう。一方、流行地の住民に生食されるカニからえられたメタセルカリアも、まだ実験的証明はないが、おそらくペルー肺吸虫であろう。従来、アメリカ大陸で報告された幼虫は、ケリコットとカリ肺吸虫だけであつて、ペルーのはどちらにも一致しない。また、コスタリカのカニからえられた幼虫(未同定)とも異なるようである。とにかく、新しく現われたペルー肺吸虫は、医学上も注目すべきものになりそうである。そして、同地の肺吸虫症は、以前から、固有の種類によるものであつて、東洋から移入されたとは考えにくい。