CATEDRA DE PARASITOLOGIA Y PATOLOGIA INFECCIOSA
Catedrático: Prof. Dr. M. CORDERO DEL CAMPILLO

# SOME FACTS CONCERNING THE EPIZOOTIOLOGY OF TRICHINELLOSIS IN SPAIN*

*By M. Cordero del Campillo*
*A. Martínez Fernández*
*B. Aller Gancedo*

Trichinellosis is a zoonosis which is of considerable importance in Spain, both from a sanitary point of view and by way of its economic repercussions. This is due to its existence in hosts of the domestic and sylvatic fauna, together with other special circumstances such as certain national gastronomic habits (the consumption of uncooked pork, ham, «chorizo» sausages, etc.), the structure of the active population (a great proportion of whom are employed in Agriculture), and the relatively low standard of living amongst country people, in whose diet pork is one of the main sources of animal proteins. These circunstances have necessitated the setting up of organizations for the microscopic examination of meat, the cost of which amounts to a considerable sum.

However, it is true that in recent years most of these concepts have been gradually changing. The consumption of cooked pork, whether it be as York ham or sausage, is becoming more common. The introduction of factory farming for pigs whose growth is quicker, and the acceptance in the market of pigs of lower weights (baconer and pork types) have been accompanied by the establishment of numerous industrial slaughterhouses with extensive refrigeration facilities, deep-freeze tunnels and other hygienic guarantees which, although not intended as anti-*Trichinella spi-*

* Paper presented to II International Trichinellosis Conference in Wroclaw, Poland. June 26 to 28, 1969.

*ralis*, in their effects are complimentary to the microscopic inspection of meat. The breeding of roaming pigs (the so-called «montanera» system) is evidently in decline. this having been accelerated by the appearance of African swine fever; they are being replaced by installations providing permanent housing, which bring greater hygienic guarantees. Finally, the importance of pork as the basic meat food in a countryman's diet has been reduced by the availability of alternatives, such as chicken etc.

However, the risk remains, and the protection given to wild species during recent times by way of legal measures and a more efficient service of keepers has given rise to an increase in the number of possible *Trichinella spiralis* hosts.

Thus, it may be interesting, in order to evaluate the future of this zoonosis in Spain, to have a knowledge of the present position, whilst also looking at facets of the disease in the past.

We will consider the following aspects:

1. Trichinellosis and the microscopic inspection of meat.
2. Human infection.
3. Swine trichinellosis and sylvatic fauna.

## MATERIALS & METHODS

By examining the most significant literature, it has been possible to gather together the most interesting facts about some of the epidemics of trichinellosis which have had the greatest influence on the establishment of a service of microscopic meat inspection, which continues to be carried out in this country under the control of veterinarians. The relevant figures as regards the number of pigs killed, both on the farm and at industrial establishments, have been taken from the Annual Statistics published by the Ministry of Agriculture. The information concerning emoluments paid to veterinarians in connection with sanitary inspection has been supplied by appropiate authorities of the province of León, or by the Dirección General de Sanidad-Inspección General de Sanidad Veterinaria, Madrid (Central Office of Public Health). This has enabled us to calculate the sum paid out to cover veterinary fees for pig inspection.

The information concerning human cases of trichinellosis comes from the publication of the Direccion General de Sanidad (up to 1953), or from the Provincial Health Service for León (thereafter).



The figures relating to the incidence of trichinellosis in pigs have been published elsewhere. and are complemented by personal observations during recent years on 170.000 pig carcases in a meat factory in León.

Lastly. the information about trichinellosis in wild animals and rats is a summary of figures taken from various sources, together with those which we ourselves have obtained, and those provided by veterinarians in practice in the mountainous León-Asturias region; there are mostly unpublished. Microscopic diagnoses of compressed muscular preparations of fresh meat were undertaken.

## RESULTS & DISCUSSION

At the end of the 19th century, several dramatic outbreaks of human infection by *T. spiralis* occurred in various parts of Spain due to the consumption of pork; several deaths were recorded. The first of notoriety took place in Villar del Arzobispo (Valencia) in 1876. the pig having been killed for home consumption. It probably constitutes the first Spanish record of this disease, reported by Rodríguez Cepeda (1877). Shortly afterwards (1878). an infection produced three deaths (Sanz Egaña. 1941). A new focus appeared in Málaga, in 1883, many people being affected and several deaths being caused: the outbreak was studied by Marcos Pérez (*cit.* López-Neyra, 1947). Other cases were recorded in La Mamola (Granada), Cortijada de Ortega (Málaga) and Aldea de Posadillas (Córdoba) with several deaths. Lastly, another epidemic took place in 1887 in the neighbourhood of Cartagena (Murcia), the resultant 25 deaths provoking a strong reaction in Spanish public opinion.

Faced with this situation, the public authorities reacted by enacting the Royal Decree of 16th July 1879, which made provision for the microscopic examination of meat, one of the first legal measures of its kind in the world. Various Town Councils acquired microscopes in order to carry out trichinella examination effectively, and wide publicity was given to the danger of consumption of meat that had not been inspected. In order to avoid errors of diagnosis, slaughter-houses that had samples of trichinellosis meat made them available to the veterinarians entrusted with inspection. Pigs containing parasites were soon discovered, generally from the outer urban belt, where they fed on garbage (Tuñon de Lara, 1879).

A little later, following the serious outbreak in Málaga, the Royal Decree of 9th October 1883 forbade the killing of pigs in all slaughter-houses lacking «the instruments that science deemed necessary». Once again, the Royal Decree of 4th January 1887 reiterated identical principles, and after the Cartagena epidemic. the acquisition of microscopes which enabled 100 × magnification were insisted on, this, also being extended to cover sausage factories. The Circular of 28th ovembre 1900 drew attention to preciding regulations. Besides. a commission was set up to study the cases that occurred in Murcia. García e Izcara (veterinarian) and Mendoza (physician) taking part.

Later, legal regulations have gradually perfected the service which is carried out by veterinarians in all Spanish slaughter-houses: they also visit homes at a pre-arranged time during the pig-killing season, normally in autumn or winter, to inspect the animals that are going to be slaughtered for home consumption.

Veterinary fees are fixed annually by public health authorities, taking into account inspection itself and any transport expenses, which have to be paid by the owner of the animals. In order to try to standardize the rate, many provincial authorities have fixed an amout per slaughtered pig, which, on average, works out at about 50 Pts. (0.71 U. S. $).

According to the latest Livestock Statistical Yearbook published by the Ministry of Agriculture, 700,496 pigs were slaughtered for home consumption in 1965; the resultant veterinary inspection costs amounted to 35,024,800 Pts. (500,353 U. S. $).

On the other hand, the situation in industry is different. The average fees received for microscopic examination amount to 5.00 pts. per pig. The above-mentioned Yearbook states that 2,256,733 pigs were slaughtered for industrial use. the cost of microscopic examination being 11,283,665 pesetas. (161,195 U. S. $). Altogether, veterinary inspection of the 2.957,229 pigs slaughtered for meat during 1965 cost 46,308,465 Pts. (661,548 U. S. $). Of course, the cost of sanitary inspection does not exclusively correspond to trichinellois inspection, in view of the fact that one is acting, in general, against all zooanthroponosis, but there is no doubt that, were it not for fear of trichinella infection, a great number of slaughtered pigs would escape veterinary inspection.

The effectiveness of the service has been considerable, as is proved by the fact that a clinically appreciable human infection due to the consumption of inspected meat has never been reported. The known cases



have been incurred by the consumption of meat slaughtered clandestinely for home use, and. as will be seen from Table I, it is a decreasing tendency. In general, this relates to the slaughter of only one or two animals, which have been reared for the special purpose of eating in the home. In the country, the pig-killing season is one for family celebration, and many friends sit down together to a meal. On the other hand. the Spanish taste for lightly cooked meat gives use to massive infection. with violent symptoms amongst the affected, which can lead to death if not promptly counteracted.

However, meat products originating from industrial slaughter-houses, when they contain a mixture of meat from various animals (sausages, for example) are normally harmless even though a mild parasitic infection is not noticed, owing to the fact that the proportion of infected meat is less overall. The first-named author remembers the case of a parasitically infected pig, in which only one positive sample was found with a single trichinella larva among 125 compressed preparations. The mixture of this meat with that of the other nine uninfected pigs that made up the batch would probably not have given rise to human trichinellosis with clinical evidence. Another factor favouring the gradual decline in human trichinellosis has been the purchase, in order to regulate the market, by Food and Transport Supply Commission (Comisaría de Abastecimientos y Transportes) of pork carcases which are kept frozen for several months.

Cases of human trichinellosis produced by consumption of wild boar and other animals shot by hunters are not infrequent (S. De Buen and Casas, 1933). Infection in this species is found in 1.4 % of animals, according to information supplied by the official veterinarian of Alía (Cáceres). on a basis of 500 observations.

As regard the frequency of pig infection, figures very greatly according to the region from which they proceed. In Table II a cross-section will be found, originating from different individuals and regions of Spain. Those referring to the province of León relate to personal observations, augmented by information supplied by Dr. M. Alvarez González. The pigs came from the province of León itself, but there are also many figures from the bordening areas of Extremadura and Andalusia, so that great significance can be given to these records. The average figures for the whole of Spain has been calculated taking into account a known number of animals used for turning into meat products, and the number of cases

officially reported to the General Inspection of Veterinary Health in Madrid. This figure is almost certainly not exact, owing to the fact that official reports are not always made.

Which is the main animal host of *T. spiralis*, what difference do the different methods of pig husbandry have, as well as other ecological considerations?

The high incidence of rat infection is well known. García e Izcara (1927) found it to be 7 % in those caught in various parts of Madrid. Herrero Martín and Martín Calama (1961) found 0.8 % infected in Cáceres. In limited foci in the province of Ciudad-Real, Sainz Moreno (1957) has given 42.2 %, a very high percentage. In Spain, as in other countries, this animal, without doubt, plays some role in continuing pig infection, especially if the so-called urban trichinella cycle is mantained, by means of garbage feeding. In several enzootic foci in the province of León (in Lorenzana, a village a few km from the capital) we have been able to verify infection of the pigs during several consecutive years; this did not cease until the rats had been got rid off. Dogs have also been found infected in Spain (Pozo Lora, 1963).

The eating of rats by pigs bears a certain relation, in most cases, to quantitative and qualitative deficiencies in their diet, especially insufficient proteins. Romagosa Vila (1955) quotes a veterinarian from Extremadura, who said of roaming pigs («montanera»-pigs): «the few acorns, the more trichinella, and *vice versa*». That is to say, when the animals are well fed, they return to their sties replete, without feelings of hunger, and leave untouched any rat carcases they may find. On the other hand, in years of poor agricultural yield, the amount of acorns and pasture is insufficient to satisfy their needs, even quantitative, and so they search for the remains of any matter, the carcases of rats and other wild animals of the rural cycle which might be contaminated with *T. spiralis*. Cironeanu (1964) has made similar observations in Rumania.

The domestic cycle of trichinellosis is perfectly understable. The rural cycle has also been verified in Spain, principally in the Cantabrian mountain range, whose climatic condicions favour forestal development and abundant fauna reproduction, together with other ecological factors which have an influence on the rural communities, and their methods of pig farming. In Table III, details are given of trichinellosis incidence in various wild species caught in the León-Asturias mountains, in accor-



dance with observations made by Rodríguez García (1964a and 1964b; personal information). Suárez Lobo (personal information) and ourselves.

From these one can deduce that badgers, genets, foxes, wild cats, ferrets and wolves, in this order, are very frequently found with *T. spiralis* infection. As a result of this, in Asturias trichinellosis is commonly found in pigs originating from areas bordering the province of León, from the boundary with Lugo as far as the European Peaks. The existing relationship between wild life foci and pig infection is evident, although the exact mechanism has not been determined. Rodríguez García suggestion (personal information) is worth taking into account: he attributed the infection of some pigs bred in an inn to the fact that they fed on garbage that was thrown away nearby, this being also a feeding place for foxes and similar wild species. It is possible in this case that foxes and other wild animals may have passed larvae in their excreta, this leading to the pig's infection, as Zimmermann *et. al.* demostrated (1959); or perhaps the link between the domestic and wild fauna was a rat. Anyway, the part played by wild fauna in the area is undeniable. Rodríguez García (1946 b) states that when hunters were instructed no to leave dead animals in the open country without having first them checked for *T. spiralis*, which could then be counteracted, there was a resultant decrease in trichinellosis infection. In the rural district of Pola de Lena (Asturias) there was a percentage drop in the number of infected pigs from 0.43 % in 1959-61 to 0.12 % in 1966-68. The large number of birds of prey could also contribute to the dissemination of contaminated remains, and even the elimination of larvae in intestinal transit, as has been shown by Trommer among others (1965).

However, there is another factor which is worth looking at. On the southern side of the Cantabrian Mountains, where slopes are less steep as they descend to the highlands of the Meseta, the same results are not obtained. Only two pigs, which came from a different regions, have been found with trichinellosis in Maraña at the foot of the mountain slope, in León. We consider the causes to be of two types. On the one hand there are fewer wild animals: on the other, climatic and agrarian conditions have caused the villages to be considerably different to those of rural Asturias. On the northern slopes, scattered farmsteads are the most common, whilst the Atlantic climate also gives rise to more freedom for pigs, which are frequently allowed to roam through the fields rooting up matter that may be parasitically infected. Wild creatures can also, for their part, more easily approach the isolated buildings, which are often located in very

rustic surroundings. On the other hand. on the León side of the range. the villages are compact nuclei of small perimeter, with little scattering of population. This means that, owing to the continental climate and the very compactness of human dwellings, any contact between pigs and wild fauna, both direct and indirect, is very difficult.

In conclusion, there are two types of connections between pigs and wild animals in Spain. In Southern Spain, where roaming pigs are common. swine become in mediate or inmediate contact with the reservoirs of the wild fauna. In Northern Spain is the very wild fauna which comes in contact with the domestic pigs.

## SUMMARY

Trichinellosis continues to be of great sanitary and economic importance in Spain, one of the reasons being the gastronomic habits of Spanish people (consumption of raw pork).

A survey of the history of trichinellosis in Spain shows the important role of human epidemics in the establishement of compulsory microscopic investigation of pork products, method which continues being the official test. Total cost of veterinary inspection amounts to 661,548 $ a year. The efficiency is considered to be very satisfactory. No case have been reported from inspected pork.

Statistics of human clinical cases show a decreasing tendency in the last twenty years. Veterinary inspection and a national network of packing plants with deep-freeze facilities, intended to keep pig carcases for months, in an attempt to regulate prices in the market, are considered to be responsible.

Official figures show a rate of infection of 0,0007 % in swine. However, authors experiences and data from other sources show average infections ranging from 0.002 up to 0.43 % in some places.

Rats are considered the main reservoir of *T. spiralis* in some urban and rural areas, rates of infection being 0.8-7.0 % although as high a percentage as 42 % has been reported. The significance of food defficencies in the diet of swine are discussed, as far as ingestion of carcases of rats and other residues of animal origin is concerned.

Dogs have also been found infected.

A survey on the incidence of trichinellosis in wild animals from the



Cantabrian Mountains, showed the following rates of infection: badgers 40.0 %; genets, 38.8 %; foxes, 31.6 %; wildcats, 31.5 %; ferrets 25.0 %; wolves 20.0 %; and baum marten 5.5 %.

A discussion on the differences between pig infection in Northern and Southern Spain is undertaken. Two types of connections are admited. In Southern Spain, where roaming pigs («montanera-system») are common, swine become in mediate or inmediate contact with reservoirs of wild fauna. In Northern Spain is the very wild fauna which comes in contact with the domestic pig.

A selected list of references is included.

## RESUMEN

La triquinelosis sigue teniendo gran interés en España, a pesar de los progresos de la producción e industrialización del cerdo, pues persiste el hábito del consumo de productos cárnicos porcinos crudos y, en el medio rural, el cerdo sigue siendo la principal fuente de proteínas de origen animal para el campesino.

La revisión histórica demuestra el decisivo papel que tuvieron las epidemias de finales del siglo XIX en España, para el establecimiento de la inspección microscópica de carnes de cerdo con carácter obligatorio, vigente en la actualidad. El importe de la inspección veterinaria de cerdos asciende a 46.308.465 pesetas por año (661.548 $ USA), estimándose que en las zonas rurales el temor a la triquinelosis es el principal estímulo para someter los cerdos a la inspección veterinaria. La eficacia del servicio ha sido óptima, pues no se conoce ningún caso de infestación clínica humana por consumir carnes debidamente inspeccionadas. La estadística de las infestaciones humanas, desde 1948 a 1968, demuestra una tendencia decreciente.

La parasitosis porcina media oscila entre el 0,0007 y el 0,002 % estimando con amplitud la procedencia de los cerdos. No obstante, en algunas provincias y en zonas circunscritas se han hallado porcentajes hasta del 0,43 %.

Los reservorios de la infestación en las zonas urbanas y en los núcleos de población rural son ratas. infestadas en proporciones que van del 0.8 al 7 %, con tasas hasta del 42,2 %. La rata se estima que es responsable de la triquinelosis, especialmente cuando la alimentación del cerdo

es deficiente cuantitativa y cualitativamente. Además, se considera que es el enlace entre la fauna silvática y el cerdo, en las zonas rurales.

La incidencia de *Trichinella spiralis* en la fauna silvestre de la Cordillera Cantábrica. entre las provincias de Oviedo y León, indica que las especies más importantes son: tejón (40,0 % parasitados), gineta (38,8 %), zorra (31,6 %), gato montés (31,5 %), hurón (25,0 %), lobo (20,0 %) y marta 5,5 %). La diseminación de la población en la vertiente asturiana de la cordillera, junto con el clima atlántico y la libertad de merodeo de los cerdos, así como la diseminación de la población, que facilita el acercamiento de las alimañas a los alojamientos porcinos, se estima que explican satisfactoriamente la mayor incidencia de la triquinelosis en Asturias, en relación con la Montaña de León.

## RESUME

La Trichinose a toujours un grand intérêt en Espagne, malgré les progrès de la production et de l'industralisation du porc, car l'habitude de la consommation de produits crus provenant de la viande de porc persiste encore et, à la campagne, le porc est toujours la principale source de protéines d'origine animale pour les paysans.

La révision historique démontre le rôle décisif des épidémies de la fin du XIXème siècle en Espagne, pour l'établissement obligatoire de l'inspection microscopique de la viande de porc, loi encore en vigueur actuellement. Le montant de l'inspection vétérinaire des porcs atteint le chiffre de 46.308.465 pesetas par an (661.548 $ U. S. A.) et l'on sait que dans les zones rurales la crainte à la Trichinose est le principe stimulant pour les paysans pour soumettre leurs porcs à une inspection vétérinaire. L'efficacité de ce service a été excellente, car on ne connaît aucun cas d'infestation clinique humaine pour avoir mangé de la viande dûment inspectionnée. La statistique des infestations humaines de 1948 à 1968 montre une tendance décroissante.

La parasitose porcine moyenne oscille entre un 0,0007 % et un 0,002 %, en calculant amplement la provenance ou origine des porcs. Cependant, dans quelques provinces et dans des zones circonscrites, on a trouvé des pourcentages voire même 0,43 %.

Les foyers de l'infestation dans les zones urbaines et dans les centres de population rurale sont des rates infestées dans des proportions du 0,8 au 7 %, avec des limites jusqu'â un 42,2 %. On croit que la rate est responsable de la Trichinose spécialment quand l'alimentation du porc est insuffisante quantitativement et qualitativement. En outre, on la considère comme une liaison entre la faune sauvage et le porc dans les zones rurales.

L'incidence de *Trichinella spiralis* dans la faune sauvage de la Cordillère Cantabrique entre les provinces d'Oviedo et de León indique que les espèces les plus importantes sont: le blaireau, 40 % parasités; la genette, 38 % parasités; la renarde, 31,6 %; la chatte sauvage, 31 % parasités; le furet, 25 %; le loup, 20,0 % parasités; et la martre, 5,5 % parasités.

La dissémination de la population dans le versant du côté des Asturies de la susdite Cordillère, ainsi que le climat atlantique et la liberté de maraudage des porcs, et aussi la dissémination de la population, ce qui facilite l'approche animaux nuisibles aux étables à cochons, expliquent satisfactoirement la plus grande incidence de la Trichinose dans les Asturies en rapport avec cette maladie dans La Montaña de León.

## BIBLIOGRAPHY

1. Anuario Estadistico de la Producciòn Ganadera (1965).—Ministerio de Agricultura, Madrid.

2. Buen, S. de, and Casas, V. (1933).—Nota sobre unos casos de triquina debidos a la ingestión de carne de jabalí. *Rev. San. Hig. Públ.*. **3**: 4.

3. Croneanu, I. (1964).—L'epizootiologie de la trichinellose du porc et des autres animaux domestiques et sauvages en Roumanie. *I. Cong. Int. Parasitol*, Roma, Sept. (Proc. pp. 21-26).

4. Garcia e Izcara. D. (1927).—Estudios sobre la triquina. *Rev. Hig. San. Pec.*. **17**: 940-941.

5. Herrero Martín, F. and Martín Calama, A. (1961).—El problema de la triquinosis en la provincia de Cáceres. *Rev. San. Hig. Púb.* **35**: 1-23.

6. La Agricultura Española en 1967.—Ministerio de Agricultura. Secretaría General Técnica. Madrid.

7. López-Neyra, C. R. (1947).—*Helmintos de los vertebrados ibéricos*. II, p. 489. Imprenta Urania, Granada.

8. Pozo Lora, R. (1963).—Primeros resultados españoles de la investigación de triquinelosis en los perros. *Cons. Gen. Col. Vet. España* (Sup. Cient.) **9**: 131-135.

9. Rodrìguez de Cepeda, A. (1878).—La triquinosis en Villar del Arzobispo. *Actas Soc. Español. Hist. Nat.* (Valencia). **6**: 32-33.

10. Rodrìguez Garcìa, M. (1964a).—La fauna salvaje. reservorio de la triquinelosis en Asturias. *Caza y Pesca, 225* : 169-172.

11. _____. (1964b).—Aportación a la lucha contra la triquinelosis en Asturias. *III Sem. Nac. Vet.*, Córdoba (España), *2* : 8.

12. Romagosa Vila, J. A. (1955).—Sugerencias sobre la lucha contra la triquinosis. *Ciencia Vet., 16*: 210-220.

13. Saiz Moreno, L. (1957).—*Aspectos económicos y sanitarios de algunas helmintiasis relacionadas con las industrias cárnicas y la infestación humana.* Imprenta Provincial. Ciudad Real.

14. Sanz Egaña, C. (1941).—*Historia de la veterinaria española.* Espasa-Calpe, Madrid. pp. 393.

15. Trommer. G. (1965).—Welche Rolle spielen Aas und Fleisch fressenden Wildvögel in der Epidemiologie der *Trichinella spiralis.* Inaug. Diss., Giessen.

16. Tuñon de Lara. R. (1879).—Experiencias con el *Trichinus spiralis. Gac. Agríc. Min. Fom.*, **9**: 641-655.

17. Zimmermann. W. J.. Hubbard. E. D. and Mathews. J. (1959). Studies on the fecal transmission of *Trichinella spiralis. J. Parasit.* **45**: 441-445.



TABLE I

CASES OF HUMAN TRICHINELLOSIS REPORTED TO THE HEALTH SERVICES

| Year | Number of Human Cases |
|---|---|
| 1948 | 96 |
| 1949 | 77 |
| 1950 | 170 |
| 1951 | 205 |
| 1952 | 121 |
| 1953 | 411 |
| 1954 | ? (without records) |
| 1955 | 63 |
| 1956 | 355 |
| 1957 | 106 |
| 1958 | 130 |
| 1959 | 113 |
| 1960 | 312 |
| 1961 | 40 |
| 1962 | 50 |
| 1963 | 46 |
| 1964 | 95 |
| 1965 | 34 |
| 1966 | 28 |
| 1967 | 37 |
| 1968 | 10* |

* Up to Nov. 23th. 1968.

TABLE II

SWINE TRICHINELLOSIS IN SPAIN

| Years | Place of origin | Number of pigs slaughtered | Infected % | Reported by |
|---|---|---|---|---|
| 1928-35 | Madrid | 459.577 | 0.05 | Saiz Moreno (1957) |
| Several | Zaragoza | Not stated | 0.10 | *Ibid.* |
| Several | 20 slaughter-houses | 300,000 | 0.02 | Najera cit. Saiz |
| 1952-56 | Ciudad Real | 244,185 | 0.02 | Saiz Moreno, *ibid.* |
| 1953-59 | Cáceres | 500,000 | 0.21 | Herrero y Martìn (1961) |
| 1959-60 | Cáceres | 89,490 | 0.31 | *Ibid.* |
| 1959-61 | Pola de Lena (Ast.) | 5,950 | 0.43 | Rodrìguez Garcìa (1961a) |
| 1966-68 | Pola de Lena (Ast.) | Not stated | 0.12 | *Ibid.* |
| 1948-68 | León | 170.000 | 0.02 | Pers. observation |
| 1965 | Whole Spain | 2.957.229 | 0.0007 | Pers. calculation* |

* Numbers of slaughtered pigs obtained from the Statistical Yearbook of the Ministry of Agriculture, and those of infected pigs from the Central Office of Public Health (Inspección General de Sanidad Veterinaria. Madrid).

TABLE III

TRICHINELLOSIS IN SYLVATIC ANIMALS FROM THE CANTABRIAN MOUNTAINS

(Between the provinces of León and Oviedo)
(1960 - 1969)

| Species | Number of specimen | Positive to *T. spiralis* | Percentage |
|---|---|---|---|
| Badger *(Meles meles)* | 5 | 2 | 40.0 % |
| Genet *(Genetta genetta)* | 18 | 7 | 38.8 % |
| Fox *(Vulpes vulpes)* | 60 | 19 | 31.6 % |
| Wildcat *(Felis sylvestris)* | 19 | 6 | 31.5 % |
| Ferret *(Putorius furo)* | 8 | 2 | 25.0 % |
| Wolf *(Canis lupus)* | 5 | 1 | 20.0 % |
| Baum marten *(Martes martes)* | 18 | 1 | 5.5 % |
| Squirrel *(Sciurus vulgaris)* | 4 | 0 | — % |
| Otter *(Lutra lutra)* | 2 | 0 | — % |
| Weasel *(Mustela nivalis)* | 1 | 0 | — % |
| Wildboar *(Sus scrofa fera)* | 1 | 0 | — % |
| Mole *(Talpa europaea)* | 6 | 0 | — % |