

PART II.

A SURVEY OF THE INCIDENCE OF CYSTICER-
COSIS IN SWINE AND BOVINES.

In providing a survey of this nature, it must be explained that figures representative of the incidence of infection as observed at abattoirs in many countries, must be regarded as not necessarily indicative of the actual extent of infestation in such particular countries, since, in many cases infected stock slaughtered may have been imported from elsewhere, and the survey would then, rather, tend to show the surmised incidence of infection in the export country. In some countries, also reliable statistics have not been compiled, and, therefore, data given must frequently be judged more as speculative than actual. In some other countries statistics of infection were available many years ago, but more recently, owing to a decreased incidence of infection, the relatively few cases have not been recorded.

The statistics supplied in the following pages have been obtained from (a) old, recent and contemporary literature; (b) as the result of personal enquiry from the respective authorities and from the obliging replies sent by those colleagues; (c) from "speculative" sources reflecting the incidence of infection found among exported stock slaughtered and found infected in foreign countries. It might be explained that questionnaires were forwarded to no less than fifty countries, and replies were obtained from the vast majority of them. It is regretted that no statistics are available for a few important territories.

A.

The Incidence of Cysticercosis in Swine and Bovines in Europe.Great Britain.

Through the kind favour of Col. T. Dunlop Young of London, enquiries were made from the abattoir reports from most of the important centres, but not a single instance of measles was reported for the year 1935.

Robertson (1920) accidentally infected some of his patients at Leith (whom he had placed on a raw beef diet for tuberculosis) with Taenia saginata. It can, therefore, be presumed that C. bovis must have occurred at that time among Scottish slaughter cattle.

Stockman (1909) stated that although no statistics on the frequency of measles were available in Britain, there was little doubt that it existed in British swine at that time. "In the past few years the author has met with several cases, and others have been reported by practitioners." (Stockman, 1909). Cameron (1933) suggests that both species are sometimes met with in the British Isles.

Germany.

According to von Ostertag (1934), the incidence of C. bovis in oxen varied between 0.321% in 1904 and 0.27% in 1928. In Berlin the percentage of animals infected fell from 0.84 in 1913 to 0.33 in 1922, and rose to 0.617 in 1928.. In Breslau, Mahlendorff (1930) recorded the incidence of infection at that abattoir during 1929-30 to be over 1%. The highest percentage (1.54) was during the month of November 1929. (i.e. during the period under report.)

According to Leeb and Berngrüber (1932), during 1931, 1.906% of slaughtered bovines were found to be measly in Würzburg, and there was evidence that infection was increasing throughout the State of Bavaria. According to

Krueger (1934), 2% of all cattle slaughtered in Kottbus were infected with C.bovis.

Junack (1926) draws attention to the fact that for Prussia for the years 1922 and 1923, 18 and 11 bovines, respectively, were shown as measly, whereas the thousands of cattle which were passed after treatment (cooling for 21 days), were not mentioned. Thus the last named numbered 403 and 398 for Berlin alone. Junack mentions that, by not including all these lightly infested bovines in the count, a false impression is given. Thus, on the one hand hygienists, and on the other hand butchers get the wrong impression that C.bovis (inermis) is not of much moment any longer from a point of view of Public Health and Food Economy.

In Germany the incidence of C.cellulosae has diminished to almost nil in German reared pigs. Most of the cases found during the past few years at German abattoirs have been in imported slaughter pigs. Thus Berdel (1930) records that at Frankfurt a.M. abattoir, between 10.9.29 and 19.11.29, out of 1415 pigs imported from Lithuania, 100 were found to be measly (i.e. 47 heavily infested and 53 lightly infested.) The same author quotes Meyer, who stated the year before that 19.47% of slaughtered Russian pigs were found to be measly at Barnaul. In the Saxon foreign-import meat inspection halls 39 out of 13,472 half-pigs were found measly during 1925-26. (Berdel).

Von Ostertag (1913) showed the gradual diminution in the number of measly hogs in Germany thus:-

(a) <u>Kingdom of Prussia.</u>	(b) <u>Kingdom of Saxony.</u>	(c) <u>Berlin.</u>
1876-1882 ... 0.324%	1894 0 .151%	1883-1890...0.577%
1886-1889 ... 0.181%	1896..... 0.017%	1892-1893...0.319%
1890-1892 ... 0.122%	1899... . 0.010%	1895-1896...0.099%
1899 ... 0.09%		1899....0.043%

Ministerialdiregent Professor Dr. Müssemeier of Berlin kindly supplied the following official table showing the incidence of cysticercosis (measles) in Germany for the 10 years, 1925-1934.

YEAR.	HEAVILY INFESTED.				LIGHTLY INFESTED.			
	Cattle		Pigs		Cattle		Pigs.	
	No.	Per/1000	No.	Per/1000	No.	Per/1000	No.	Per/1000.
1925	112	0.03	193	0.02	6174	1.91	336	0.03
1926	102	0.03	178	0.01	6801	2.09	256	0.02
1927	103	0.034	92	0.01	7110	2.23	186	0.01
1928	166	0.05	98	0.01	9555	2.69	222	0.01
1929	167	0.04	567	0.03	11257	2.82	646	0.04
1930	194	0.05	753	0.04	11501	3.24	975	0.05
1931	278	0.06	219	0.01	11950	3.53	283	0.01
1932	247	0.06	60	0.00	135368	3.83	133	0.01
1933	224	0.06	49	0.00	141188	4.08	131	0.01
1934	350	-	46	-	16697	-	108	-

Note the steady increase in numbers and per thousand in cases of C. bovis in Germany.

Switzerland.

The statistics given for Switzerland were kindly obtained by Dr. W. Frei, of the Veterinary Pathological Institute of the University of Zürich, from the abattoirs at Basel, Zürich and Berne. The statistics cover periods ranging from 15 years to 25 years, and may be taken as fairly representative for Switzerland. The statistics are those for pigs and adult bovines only. The incidence of C. bovis in calves is very low.

At the Abattoir at Berne. Statistics kindly supplied by the Director.

<u>Year</u>	<u>Bovines Slaughtered.</u>	<u>Measly</u>	<u>Percentage.</u>	"	<u>Year</u>	<u>Bovines Slaughtered</u>	<u>Measly</u>	<u>%</u>
1921	4175	16	0.38	"	1930	5487	18	0.30
1923	5116	16	0.31	"	1931	4788	20	0.42
1924	6205	18	0.29	"	1932	4745	34	0.72
1925	5098	7	0.14	"	1933	5650	21	0.37
1926	4615	8	0.17	"	1934	7202	17	0.23 65
1927	4799	18	0.38	"	1935	8518	15	0.18
1928	5012	9	0.18	"	1936	5486	10	0.18
1929	4974	13	0.26	"				

Very nearly half the cattle killed at Berne were imported.

Note During the above period only one measly pig was slaughtered, (during 1926, out of over 20,000). This pig was imported from Italy.

At the Abattoir at Zürich. Statistics kindly supplied by the Director.

<u>Year</u>	<u>Bovines Killed</u>	<u>Measly</u>	<u>Percentage</u>	"	<u>Year</u>	<u>Bovines Killed</u>	<u>Measly</u>	<u>Percentage</u>
1910	11838	20	0.17	"	1923	12929	14	0.11
1911	11181	24	0.21	"	1924	17629	6	0.034
1912	10918	20	0.18	"	1925	14902	17	0.12
1913	11150	15	0.13	"	1926	12660	21	0.17
1914	11835	26	0.22	"	1927	20442	14	0.069
1915	5177	8	0.15	"	1928	12011	13	0.11
1916	13369	24	0.18	"	1929	19740	21	0.106
1917	13558	32	0.24	"	1930	13477	9	0.067
1918	20015	44	0.22	"	1931	7920	3	0.038
1919	18062	27	0.15	"	1932	9854	4	0.041
1920	10994	13	0.12	"	1933	17036	15	0.088
1921	3946	6	0.15	"	1934	175 69	9	0.051
1922	11531	19	0.16	"	1935	11340	10	0.088
				"	1936	15575	16	0.13

During the period 1910-36, over half-a-million pigs were slaughtered, of which number only 52 were measly.

At the Abattoir at Basel. Statistics obtained from annual reports for the years 1915 till 1935. Reports kindly supplied by Dr. J. Unger, Director of Abattoirs.

Year	Bovines	Measly	%age.	Year	Bovines	Measly	%age.	Year	Bovines	Measly	%age
1913	18285	15	0.082	1921	9807	27	0.28	1929	14732	39	0.27
1914	16639	15	0.09	1922	11858	39	0.33	1930	12720	39	0.31
1915	14546	24	0.17	1923	14224	52	0.37	1931	13388	49	0.37
1916	12621	17	0.14	1924	18167	100	0.55	1932	13975	40	0.29
1917	13402	12	0.09	1925	13663	72	0.52	1933	15425	13	0.29
1918	17455	45	0.26	1926	13770	22	0.16	1934	16485	38	0.23
1919	14211	61	0.43	1927	13045	40	0.31	1935	16533	24	0.15
1920	10221	61	0.61	1928	13618	32	0.23				

During the period quoted above more than one million pigs were killed at Basel, and of that number only eleven were found measly, the last (one pig) being in 1931, and previous to that, one pig in 1924.

Special Notes relative to the Reports for the Abattoir for Basel:

1920: Of 61 measly cattle, 11 were imported, viz. from Denmark 6 out of 1165; from Canada 2 out of 615; from Italy 2 out of 222; from Lichtenstein 1 out of 52.

1921: Of 27 measly cattle, 16 were imported, viz. from Denmark 7 out of 2427; from Czechoslovakia 5 out of 1228; from Canada 4 out of 1145.

1922: Of 39 measly cattle, 13 were imported, viz. from Denmark 1 out of 439; from Germany 1 out of 93; from Canada 1 out of 152; from France 3 out of 42; from Czechoslovakia 5 out of 728; from Argentine 2 out of 770.

1923: Of 52 measly cattle, 28 were imported, viz. from Holland 1 out of 191; from South-West Africa 1 out of 204; from Argentine 8 out of 908; from Denmark 18 out of 5024.

1924: Of 100 measly cattle, 87 were imported, viz. from Canada 1 out of 392; from South-West Africa 2 out of 117; from Czechoslovakia 17 out of 235; from Germany 8 out of 1340; from Argentine 11 out of 3742; from Denmark 58 out of 8833.

1925: Of 72 measly cattle, 56 were imported, viz. from Austria 19 out of 1502; from Italy 14 out of 1394; from Canada 8 out of 2321; from Czechoslovakia 7 out of 624; from Germany 5 out of 539; from Hungary 3 out of 1821.

1926: Report does not give separate origin of measly stock.

1927: Of 40 measly cattle, 19 were imported, viz. 14 out of 411 from Czechoslovakia; 2 out of 2713 from Hungary; 3 out of 991 from France.

1928: Of 32 measly cattle, 4 were imported, namely from France 2 out of 1910; from Hungary 2 out of 480.

1929: No stock imported.

1930: Of 39 measly cattle, 16 were imported, all from Hungary, i.e. 16 out of 2889.

1931: Of 49 measly cattle, 23 were imported, viz. from Germany 1 out of 233; from Hungary 22 out of 3814.

1932: Of 40 measly cattle, 3 were imported, viz. 1 out of 376 from Hungary; 2 out of 56 from Czechoslovakia.

1933-1935: No records of imported cattle.

In older Swiss literature, Buri (1915) mentioned that in Eastern and North-Eastern Switzerland the incidence of C.bovis was higher than in Western Switzerland. Thus, for Eastern Switzerland he gave an incidence of 1.5 to 2.3%, and for Western Switzerland 0.3 to 0.4%.

Krupski (1917) found at Liestal a percentage of 5.9. This high percentage Krupski attributed to more thorough inspection of predilection sites.

Holland.

Le Coultre (1928) obtained the following data from Professor van Oijen:-

At Rotterdam from 1918 to 1923, only cases with living Cysticerci bovis were noted. The percentage infection varied between 0.001 and 0.03. From 1924 to 1927 cases with degenerated measles were also noted, and the percentage was then between 0.1 and 0.2.

At Haarlem, in 10 years up to 1927, the incidence varied between 0.33% and 0.6%.

At Alkmaar the incidence varied between 0.1% and 0.5%.

At Leiden, in adult bovines, between 1918 and 1922 the incidence of infection varied between 0.1% and 0.66%; in 1923 it was 0.04%; and between 1924 and 1927 it varied between 0.2% and 0.4%.

At Groningen, in 10 years the incidence varied between 1.03% and 1.5%.

At Arnhem, the figures were - 1918, 1.51%; 1919, 2.45%; 1920, 2.94%;

(Arnhem, continued).

1921, 3%; 1922, nearly 4% (238 cases out of 5927 bovines slaughtered); from 1923 to 1927 the percentage varied between 2 and 2.75.

At Nijmegen, the percentage varied from 1918 to 1922, between 0.22 and 0.4. From 1923 to 1927 a sudden tremendous increase in the percentages occurred, thus for the five years 1923-1927, inclusive, the figures were 3%; 3.7%; 4.7%; 4.4% and 3.2%, respectively.

(LeCoultré ascribes this increase in the incidence, as observed at Arnhem and Nijmegen to more thorough inspection technique. Schoon (1933) expressed a similar opinion.)

At Utrecht the percentages varied from 1918 to 1927 between 0.23 and 0.61.

Professor C.F. van Oijen of Utrecht kindly supplied me with the following statistics for the years 1933 and 1934:-

Cysticercus bovis was found in 1933 in 4515 adult bovines, and in 1934 in 4572 adult bovines. According to Prof. van Oijen, the number of cases of cysticercosis, so far as this concerns the whole country, has again risen, namely from 0.83% to 0.92%.

At Leeuwaarden an increase in the number of cases of cysticercosis in bovines has been noted, which is reflected in the following statistics:

	Dead specimens <u>%age cases.</u>	Living specimens <u>%age cases.</u>
1930	0.69	0.016
1931	1.07	0.059
1932	1.74	0.06
1933	1.6	0.06
1934	1.64	0.1

At Rheeden, 9.2% of the total slaughtered bovines were found measly - 105 cases. "The percentage is still steadily increasing". (Prof. v. Oijen).

At Arnhem, Cysticercus bovis was found in 257 adult bovines (4.45%)

"The percentage is still increasing" (Prof. v. Oijen).

At Utrecht, 128 adult bovines were found measly. The percentage this figure represents was not given.

At Apeldoorn, 64 adult bovines were found measly (~~was~~ 2.1%)

At Zutphen, 138 adult bovines were found measly (4.24%)

At Doetinchem, in adult bovines 4.07 % were found measly. (The number of cases has increased.)

At Amersfoort, 17 cases were measly (Percentage not given).

At Amsterdam,

1st quarter,	9 cases living	or 0.08%	&	24 cases dead	measles,	0.32%
2nd "	, 7 "	" "	"	18 "	" "	, 0.13%
3rd "	, 8 "	" "	"	47 "	" "	, 0.52%
4th "	, 20 "	" "	"	93 "	" "	, 0.75%.

At Haarlem, where the percentage cysticercosis is considerably higher than at Amsterdam, the increase was not so obvious, as is shown in the subjoined table:

1st qtr.	10 cases living	measles - 0.45%	&	37 cases dead	measles - 1.7%
2nd "	7 "	" " - 0.3%	&	38 "	" " " - 1.6%
3rd "	8 "	" " - 0.33%	&	55 "	" " " - 2.3%
4th "	7 "	" " - 0.28%	&	62 "	" " " - 2.5%

Only three cases of C.cellulosae were found in pigs in Holland during the years 1933 and 1934. Kerstens (1931) showed that it was dangerous to presume that C.cellulosae was non-existent in Holland. He referred to a case he found in a pig which was slaughtered domestically by a farmer.

Belgium.

Professor V.Rubray, Rector of the École de Médecine Vétérinaire, Cureghem-lez-Bruxelles writes (5th March 1937):-

" 1. As regards infection in the pig, we find only one or two cases per year, out of about 150,000 subjects slaughtered at the abattoirs.

2. In cattle, during the war, 1 to 2% were found infected, but nowadays it is as rare as in the pig.

The result of this notable decrease in the incidence of cysticercosis we attribute to our hygienic measures and the fact that the ox ~~and the~~ ~~fact that the~~ ~~ox~~ and the pig are given no facility to become contaminated by human excrement."

France.

In spite of exhaustive enquiry into recent French literature, and personal communications to French authorities, the present author was unable to obtain any recent information as to the incidence of C. cellulosa and C. bovis in France at the present time.

Vosgien (1911) gave the percentages recorded at three centres.

C. cellulosa in pigs -

Paris: 1900, 0.03% ; 1901, 0.05%; 1904, 0.01%; 1906, 0.0175%, 1910, 0.034%.

Bordeaux: 1905, 0.05%; 1906, 0.063 %; 1909, 0.024%.

Limoges: 1890, 0.76%; 1895, 0.62%; 1900, 0.48%; 1905, 0.41%; 1910, 0.27%.

According to Ballou (1913) (leCoultré, 1928), the percentage infected bovines was as high as 17.42 (i.e. 23 cases out of 132 bovines) at Troyes-sur-Aube. Raymond (le Coultré, 1928) found the percentage to be 3.5 in bovines in Paris in 1908 and 1909.

If we were to consider the incidence of infection in French bovines exported to Switzerland as a criterion of the extent of infection in French domestic cattle, then the incidence of C. bovis in that country is very much lower at the present time. During the years 1922-32, 3,140 cattle from France were slaughtered at the abattoir at Basel, Switzerland, and of this number only 8 were infected- (0.25%). The maximum record of infection was shown in 1922, when 3 French cattle out of 43 were found measly at Basel.- (Approximately 7%).

Spain.

Owing to conditions at the present time, it is not possible to obtain statistics from this country. According to Vosgin (1910/11), 0.292% of pigs slaughtered in Madrid in 1910 were found to be measly. Out of 61,547 pigs slaughtered in that city during 1910, 180 had measles.

Portugal.

Dr. Fernando de Fontes Pererira de Mello kindly supplied the following statistics relevant to the incidence of cysticercosis in Portugal:-

1. Cysticercus cellulosae - (Portugal).

	<u>1933</u>	<u>1934</u>	<u>1935</u>
Number of cases	312	429	437
Percentages	0.184%	0.209%	0.213%

2. Cysticercus bovis - (Lisbon abattoir).

Number of cases	153
Percentages of slaughtered bovines	0.003%.

These cases came from:

Alentejo (Portugal)	1.
Ribatejo (Portugal)	1.
Angola (West Africa)	151.

Italy.

Cysticercus cellulosae was relatively common in Italy about the year 1870. Thus, Pellizari (Leuckart, 1886) estimated the number of measly pigs in Italy to be 1 per 3,000, but Permoncito (Leuckart) stated that in Turin 1 pig in every 250 was measly, and in Milan 1 in every 70.

In reply to a request for information on the present incidence of cysticercosis in Italy, the Union Minister Plenipotentiary at Rome very kindly submitted the following translated Note Verbale dated 17th March, 1937, from the Royal Italian Ministry of Foreign Affairs.

Note Verbale. (17/3/37)

"In Italy, due to the continuous and strict reinforcement of the Legislative Regulations dealing with sanitary supervision over meat, infection through Cysticercus Cellulosae has become rare, so much so that in many big abattoirs in the Kingdom, where the meat of thousands of pigs has been controlled for many years, there has not been found a single case.

The same thing can be said about Cysticercus bovis, which, for example, has for more than 10 years not been found in the Rome abattoir, notwithstanding the continuous and regular research as with Cysticercus cellulosae, in points where the infection is most likely to be found.

It should also be considered that in Italy butchering for private use is, by regulation, under veterinary control, and it is to be borne in mind that this too, has advantageously contributed to reaching the favourable situation indicated above!

From 1920 to 1932, 16 export Italian bovines out of 1837 were found measly at the abattoir at Basel. (Switzerland)

Austria.

Vosgien (1910/11) gives the following statistics for C. cellulosae found at the Vienna abattoirs:-

In 1902,	4109	cases of measles	out of	594739	pigs slaughtered	-	0.671%
" 1903,	3425	" " "	" "	564813	" "	-	0.606%
" 1904,	3213	" " "	" "	579317	" "	-	0.555%
" 1905,	4243	" " "	" "	575340	" "	-	0.737%
" 1906,	3421	" " "	" "	600244	" "	-	0.569%

In Wiener-Neustadt, Schmidt (von Ostertag, 1913) found between the years 1901 and 1910 that 1.8% of pigs were measly.

According to Schmid (1930), 89 pigs out of 54,461 slaughtered at Wiener-Neustadt (i.e. 0.17%) were found measly in 1929. Of this number 57 came from Yugoslavia; 16 from Hungary; 11 from Poland.

According to the same author, 17 bovines out of 5439 were measly at Wiener-Neustadt during 1929.

The Chef der Veterinärverwaltung des Oesterreichischen Bundesministerium für Land-u. Forstwirtschaft writes (letter dated 8/1/37):-

"In the years 1930 to 1935 were found in the abattoir of the Capital City of Vienna:-

1930 -	<u>Cysticercus</u>	<u>cellulosae</u>	in	2983	pigs	out	of	696233	slaughtered-	0.43%
1931-	"	"	"	2441	"	"	"	860707	"	-0.28%
1932-	"	"	"	2702	"	"	"	711932	"	-0.38%
1933 -	"	"	"	2153	"	"	"	687660	"	-0.31%
1934 -	"	"	"	967	"	"	"	735244	"	-0.13%
1935 -	"	"	"	793	"	"	"	647678	"	-0.12%
1930-	<u>Cysticercus</u>	<u>inermis</u>	(bovis)	in	73	cattle	out	of	129050	" - 0.057%
1931-	"	"	"	"	120	"	"	"	128463	" - 0.094%
1932	"	"	"	"	155	"	"	"	130449	" - 0.12%
1933	"	"	"	"	114	"	"	"	108895	" - 0.104%
1934	"	"	"	"	156	"	"	"	105852	" - 0.14%
1935	"	"	"	"	217	"	"	"	113874	" - 0.19%

During the years 1901 to 1928, in Wiener-Neustadt, 8697 pigs out of 1,101,544 slaughtered, were found to be measly, i.e. 0.79%. Between the years 1926 and 1928, in Wiener-Neustadt, among slaughtered bovines 0.14% of the cattle from Lower Austria, 0.49% from the Burgenlands, 0.189% from Hungary and 0.49% from Roumania were found to be measly."

The Chef then stresses the point that one should observe that in Vienna a large number of the slaughtered pigs and cattle comes from the neighbouring states, Yugoslavia, Hungary, Roumania and also from Poland. This also applies to slaughter pigs in Wiener-Neustadt.

According to the various annual reports for the abattoir at Basel, Switzerland, Dr. Unger found, between 1920 and 1932, that 20 out of 1595 bovines imported from Austria (including Lichtenstein) were measly.

Hungary

According to Brener (Vosgien), the statistics of C. cellulosa at Budapest abattoir during the years 1902-1905 showed that 10,265 pigs out of 987,908 slaughtered, were measly, that is 1.03%.

These pigs were analysed as follows, as regards origin:

- 0.64% of Hungarian pigs were measly.
- 3.91% " Croatian pigs were measly.
- 2.26% " Serbian pigs were measly.

Judging from his observations at Wiener-Neustadt, Schmid (1930) estimated that between 1926 and 1928, 0.189% of Hungarian cattle were measly. This percentage represented the Hungarian export cattle which were found measly at Wiener-Neustadt.

During the years 1920-1932, 12,093 Hungarian cattle were slaughtered at Basel, Switzerland. Of this number 46 were found to be measly, approximately 0.38%. The highest number was 22 out of 3814 in 1931. (Jahresbericht des Schlachthofes von Basel-Stadt pro 1920 bis 1932.)

Czechoslovakia.

In 1896 Prettner found that 3.44% of pigs slaughtered at Prague were measly. In 1902 it was found that 1823 cases were measly out of 356,579 pigs slaughtered at Prague, that is 0.51%.

In 1909 in Dux, Liebscher found C. cellulosa in 2% of pigs, and in 1909 in 1% of pigs. In both years C. bovis was found in 0.6% of cattle by Liebscher.

For Karlsbad, Messner (1930) shows that the incidence of C. bovis during the twenty-five years, 1905-1929 had fallen from 2.6% and 3.0% in 1905 and 1906, respectively, to 0.44% in 1916. The following year it increased to 1.4%, but fell suddenly to 0.2% in 1918. Then,

between the years 1919 and 1922, the percentage oscillated round about 1.1. Between 1923 and 1927 the percentage varied from just below 0.5 to 0.8. In 1928 it rose to 1.44% and in 1929 it was 2.55% , the third highest record during the 25 years under report.

During the years 1920-1932, forty bovines from Czechoslovakia, out of 3961 slaughtered at Basel, Switzerland, were measly, that is over 1%. Of this number, 14 out of 411 were found to be measly in 1927. Dr. Unger, Director of the Basel Abattoir, made special mention of this record percentage (3.4) in consignments from a single country.

(Jahresbericht des Schlachthofes von Basel-Stadt pro 1927).

In a letter dated 3rd February, 1937, the Czechoslovak Republic Ministry of Agriculture supplies the following statistics in respect of the incidence of cysticercosis at their three principal abattoirs.

Abattoir	Year	Slaughtered		Cysticercosis found			
		Bovines	Swine	Bovines		Swine	
		Number	Number	No.	%age	No.	%age.
PRAGUE	1930	-	434,427	-	-	802	0.18
	1931	-	366,471	-	-	306	0.083
	1932	-	374,711	-	-	742	0.19
	1933	-	263,615	-	-	226	0.036
	1934	-	333,915	-	-	93	0.028
	1935	67,796	381,090	79	0.103	223	0.103
	1936	57,629	370,638	174	0.302	333	0.089
BRNO	1930	18,804	50,321	2	0.011	12	0.024
	1931	16,864	55,368	-	-	1	0.0018
	1932	18,471	51,706	1	0.0054	7	0.013
	1933	16,253	41,100	2	0.012	17	0.041
	1934	18,062	43,345	5	0.028	3	0.006
	1935	17,911	56,991	4	0.022	1	0.001
	1936	14,711	55,160	1	0.0067	8	0.014
Bratislava	1930	9,915	50,645	2	0.0201	1	0.002
	1931	9,999	57,430	1	0.01	4	0.007
	1932	10,727	55,924	3	0.027	3	0.0052
	1933	10,304	48,379	2	0.019	8	0.017
	1934	10,927	55,324	10	0.092	3	0.006
	1935	10,150	56,914	8	0.076	-	-
	1936	9,250	56,669	36	0.39	3	0.005

Yugoslavia.

It is not clear what the extent of infection with C. Cellulosae and C. bovis is at the present time in this multi-raced Kingdom.

Between the years 1902-1905, Brener found that 3.91% of the Croatian pigs and 2.26% of the Serbian pigs were found measly in the abattoir at Budapest (Hungary).

According to Vosgin, cysticercosis is quite rare in Croatia and Slavonia, but very common in Serbia. Martel, according to Vosgien, found in 1905 that from 8% to 12% of Serbian pigs were measly. In Bukowina and in Dalmatia, figures of 6% and 5%, respectively, are given.

Schmidt, according to von Ostertag, found 0.83% of Croatian pigs to be measly at Wiener-Neustadt, Austria, between 1901 and 1910.

According to Kukuljevic (1906) 0.5% of pigs in Serbia were found to be measly in tongue-inspections, without resorting to meat inspection. Kukuljevic attributed the high incidence of measles in pigs in Serbia to the unhygienic customs in that country, where pigs were allowed to wander about the streets and on open fields, and thus greater facility for infection existed than would have been the case had proper stying and husbandry been practised.

Rumania.

Schmid (1930) found that between 1926 and 1928 0.49% of Rumanian cattle slaughtered in Wiener-Neustadt, Austria, were measly.

The Director of the Directiunea Zootechnica si Sanitara Veterinaria kindly supplied the following official statistics showing the recent^{est} incidence of C. cellulosa and C. bovis as observed in Rumania:-

- Year 1933:- 5981 cases, i.e. 1.05% of the total pigs slaughtered at the abattoirs were measly.
110 cases, i.e. 0.014 % of the total bovines slaughtered at the abattoirs were measly.
- Year 1934:- 7984 cases, i.e. 1.25% of the total pigs slaughtered at the abattoirs were measly.
139 cases, i.e. 0.018% of the total bovines slaughtered at the abattoirs were measly.
- Year 1934:- 4604 cases, i.e. 0.77% of the total pigs slaughtered at the abattoirs were measly.
168 cases, i.e. 0.018% of the total bovines slaughtered at the abattoirs were measly.

Bulgaria.

Dikoff (1931) mentioned in his article that as regards eradication of taeniasis, Bulgaria had yet to commence, and a good deal had yet to be accomplished in meat inspection. According to Dikoff, the actual extent of human infection with Taenia solium and Taenia saginata is not known in that country, but C. cellulosa is encountered on an average in 0.39% to 2.45% in Bulgarian slaughter pigs. Since 1920 Dikoff has noticed no decrease in the incidence. Pig dealers know the disease, and frequently bring pigs to slaughter houses where no inspections exist, rather than risk condemnation at properly controlled abattoirs.

Cysticercus bovis, according to Dikoff, is very common. In Schumen the incidence of infection is 2.97% in adult bovines (buffaloes) and 5.8% in calves.

Russia.

According to von Ostertag, C. cellulosa is a common disease in Russian pigs. Thus, Menzel, according to von Ostertag, mentioned that during 1904 and 1907 1.68 to 3.21% of Russian pigs imported into Germany were found to be measly, notwithstanding the fact that in the live

inspection (tongue) of the export pigs 10% were withdrawn.

Hoffmeister (von Ostertag) mentioned that in 1918 in Berlin 5% of pigs imported from Russia and the Balkan States were measly.

Berdel (1930) quotes Meyer (1929), who found that 19.47% of all slaughtered Russian bacon pigs were measly at Barnaul.

Lithuania.

At Frankfurt a.M. Berdel (1930) found, in the short period between 10th September 1929 and 19th November 1929, that 100 out of 1415 imported Lithuanian pigs were measly (7%). On one day (28th October 1929) no less than 16 out of 81 were found to be measly, and on 1st October 1929 12 out of 65.

Poland.

For the official abattoirs in Poland for the year 1935, Trawinski (1937) gives the following statistics:-

<u>C. cellulosa</u>	-	12,765 cases out of 3,604,737 pigs slaughtered. (0.38%).
<u>C. bovis</u>	-	1,168 cases out of 1,148,483 bovines slaughtered. (0.1%).

Sweden.

Cysticercus cellulosa is said always to have been a very rare parasite in Sweden.

According to Vosgien (1910-11), the following percentages infections were observed at the abattoir at Malmö :- 1906:0.024%; 1907: 0.00034% (no 1 out of 28,616 pigs); 1908: 0.021%; 1909: 0.010%; 1910: 0.0068%.

Von Ostertag supplies the following statistics for Göttenburg:-
1908:0.004% ; 1909: 0.009%.

D^{en}mark.

Cysticercus cellulosa has only very sporadically been found in D^{en}mark. Thus Vosgien states that between 1888 and 1895 only one measly pig was found out of 1,344,296 pigs slaughtered.

According to Nielsen (1934), C. cellulosa last appeared in Denmark before 1929.

According to Elvinge (1929), the incidence of C. bovis is steadily increasing in Denmark. This was very noticeable at the abattoir at Odense, between 1st January 1927 and 1st October 1929. In the year 1927, out of 3433 slaughtered adult bovines, 2.07% had dead measles and 0.12% live measles. In 1928, out of 2145 adult bovines, Elvinge found 3.15% with degenerated measles and 0.26% with live measles. In the year 1929 (9 months only) in 6959 adult bovines, Elvinge found degenerated measles in 2.71% of carcasses and live measles in 0.39% of carcasses. The mean percentage for adult bovines was 2.90%. Elvinge then gives statistics for the year 1922, in which the percentage measles in adult bovines was 0.18. The cattle originated from the same areas.

Nielsen (1934) states that C. bovis is increasing in some localities. At Sonderborg the incidence is 1.21% of inspected carcasses.

1920-32

During the years 1920-32, out of 17,889 exported Danish bovines slaughtered at the abattoir at Basel, Switzerland, 90 were found measly. (0.50%).

B.

The incidence of Cysticercosis in Swine and Bovines in Asia.Syria.

It is not known to what extent cysticercosis occurs in Turkey proper, but it is surmised that the incidence of C. cellulosa must be negligible, on account of the predominant Mohammedan population. Definite statistics of the incidence of C. bovis are, however, available for certain Mandated States, which formerly formed part of Levantine and Asiatic Turkish Empire, e.g. Syria and Lebanon and also Palestine.

At Homs, Syria, Valade found 116 cases of cysticercosis in 615 bovine carcasses (i.e. 18.86%) in 1925-26.

Reference is made, in a subsequent Part of this work, to a survey made by Yenikomshian and Berberian (1934) of the incidence of T. saginata infection in various parts of Syria and Lebanon. Although these authors do not give any statistics of C. bovis infection in cattle, it is reasonable to presume that C. bovis is very frequent in Syria and in parts of Lebanon, where raw beef, as "Kibbi neyyi" is customarily eaten, and the incidence of T. saginata is up to 12% in certain parts. The authors stress the absence of T. solium infection, due to the fact that in many parts of the country Mohammedanism is the predominant Faith, thus implying that C. cellulosa must be correspondingly rare in pigs.

Reference is also made to the survey by Penfold, Penfold and Phillips (1936), who found that more than one-quarter of the Syrian-born inhabitants of the State of Victoria, Australia were T. saginata carriers. (See Part V.)

Palestine.

Mr. J. M. Smith, M.R.C.V.S., Chief Veterinary Officer to the Government of Palestine writes (15/1/37):-

- "1. The incidence of Cysticercus cellulosae is very low in Palestine, and very few swine are kept. For instance, during the last 10 years only 2112 pigs were slaughtered at the Municipal Abattoirs of Jerusalem, and of these four only were found to be affected with Cysticercus cellulosae.
2. With regard to Cysticercus bovis, this disease is endemic in this country. According to Jerusalem Abattoir figures, 10% to 22% of the cattle drawn from Hebron and Nazareth Sub-Districts were found to be affected with C. bovis. The percentage in respect of cattle drawn from other areas is lower.
3. The average annual percentage of C. bovis in the Jerusalem Slaughter-house varies from 6% to 8%."

Arabia, Iraq, Iran, Hedjaz and Oman.

No statistics are available for these Territories, but, speculatively, one may reasonably presume that on account of the predominantly Mohammedan populations, C. cellulosae must be very rare, whereas, like in Syria and Palestine, and on account of the proximity of these Territories to Syria and Palestine, C. bovis must be a very frequent parasite.

Persia and Afghanistan.

No statistics are available for Persia and the more primitive Afghanistan.

Siberia.

Hjortlund, according to von Ostertag, found that 12.5% of Siberian pig-fillets were measly, when imported into Copenhagen.

Kowalesky (according to Vosgien) found at the abattoir at Tachkend (Turkestan, Russian Siberia) the following percentages of pigs measly:- 1907: 0.641 ; 1908: 1.013; 1909: 0 ; 1910: 0.540.

India.

As regards the actual incidence of C.cellulosae in pigs in India, literature is extremely silent, and what little has appeared has frequently been somewhat contradictory. Thus, many British medical observers have stated that only the lowest caste Indians will touch or consume pork, and on that score they have presumed that the incidence of C.cellulosae-T.solium must be relatively low in India.

Rao (1935) mentioned the presence of C.cellulosae in the Madras Presidency and mentioned that he felt sure that the incidence was considerably higher than had been anticipated, so also was the incidence of T.solium. Then again, what is claimed to be the only recent authentic records concerning the prevalence of cysticercosis in swine and bovines, were published from Madras and Coimbatore where it was stated that 50% of swine were infected with C.cellulosae. (Indian Vet. Journ. Vol.3. p.52, 1926-27)

The same notes give the incidence of C.bovis in Madras and Coimbatore to be 1%. Gaiger, in his check list of parasites in the Punjab, mentions

the existence of bovine cysticercosis. Mr J.F.Shirlaw, M.R.C.V.S., of the Imperial Institute of Veterinary Research, Muktesar, mentions, however, in a letter dated 23rd March 1937, that his impression gauged on 10 years' service in the Punjab, is that the disease must be of

infrequent occurrence, since he found no measles in any bovines in routine post-mortem examinations.

It is astonishing that the recorded incidence of C. bovis should be so low in India at the present time, since during the latter part of the last century several English writers, and especially Fleming (Neumann, 1992) found in Punjab in 1869 that 5.55% of cattle slaughtered and inspected by him were heavily infected, and in 1868, 6.12%

Malaya.

At the abattoir at Singapore during 1935, Mr. J.T. Forbes, M.R.C.V.S., Municipal Veterinary Officer, found the following percentages of cysticercosis.

<u>Country of Origin.</u>	<u>Percentage in Beef.</u>	<u>Country of Origin.</u>	<u>%age in Pork.</u>
Bali	3.03	Bali	0.67
Siam	1.14	China	0.05
Saigon	0.85	Saigon	0.33
Malaya	1.17	Malaya	0.0004

Number of Animals Slaughtered in Singapore during 1935 and Origin.

<u>Origin.</u>	<u>Cattle</u>	<u>Pigs.</u>
Bali	6,387	75,187
Siam	5,656	2,486
Saigon	1,880	37,416
Malaya	837	126,180.

In a letter dated 19th November 1936, Mr. Forbes writes:-
 "Singapore depends largely on outside sources for its supply of slaughter animals. We have a very large Chinese population in Singapore, which accounts for the large number of pigs slaughtered. The Chinese usually roast their pork to a cinder and this may account for the rarity of Cysticercosis-Taeniasis in that group."

The analysis supplied by Mr. Forbes is interesting, since it

shows separately the respective percentages measly animals found for the various countries from which Singapore derives its meat supply.

As regards incidence of infection of stock of purely Malayan origin, it may be noted that Mr. Forbes records that 1.17% of bovines were infected and only 0.0004% of pigs.

French Indo-China. (Cochin China and Annam.)

In Part III of this work mention is made that Bergeon (1928) frequently found C. cellulosa among dogs (138 cases in 5 years) in Hanoi, Tonkin. Bergeon mentioned the frequency of Taenia solium among the Tonkinese. Although the actual incidence of infection in pigs is not given, it can reasonably be presumed that C. cellulosa does, with frequency, occur in pigs in that territory.

Bergeon also mentioned that T. saginata is also readily found in Tonkin, hence, speculatively, we may attribute this frequency to a fairly high incidence of C. bovis in that territory.

From a point of view of territorial incidence survey, we may here repeat that Mr. J.T. Forbes, in 1935 found that 0.85% of 1880 bovines and 0.33% of 37,416 pigs exported from Saigon, were found measly at Singapore abattoir.

Siam.

The present author was unable to obtain authentic data of infection from this country, but that C. bovis occurs relatively frequently in Siam, may be speculated from the report of Mr. J.T. Forbes for Singapore. In 1935, Siam exported 5656 cattle to Singapore, of which number 1.14% were infected with C. bovis.

Netherlands East Indies.

At the instigation of the Dutch Colonial Government, le Coultre (1928) made a detailed enquiry into the incidence of cysticercosis in bovines and pigs on the Island of Bali in 1927. Le Coultre also had comparative statistics for some of the other parts of the Netherlands East Indies. By careful inspection, le Coultre found that on Bali 2% to 3% of pigs were infected, and 20% to 30% of bovines were measly. At Boeleleng the percentage was as high as 32.23. (407 out of 1260). At Makassar in 1927, 1.29% of pigs were found measly, and at Soerabaia 0.6%. At Denpasar in 1927, 22% of bovines were found to be measly (178 out of 809). At Mataram (Lombok) in 1926, 5.6% of bovines were measly. At Batavia in 1925, 3.26% of oxen were measly.

According to The Tijdschrift voor Diergeneeskunde 60, Page 915, 1935, it would appear that there has been little or no decrease in the incidence of cysticercosis on Bali. The statistics given in that volume of the Tijdschrift are bovines 23.59% infected and pigs 2.98% infected.

Note that at Singapore in 1935 Mr. J. T. Forbes found that only 3.03% of Balinese bovines and 0.67% of pigs were measly.

China. (Including Hong Kong and Shanghai)

As in the case of India, and indeed, of the Orient generally, statistics regarding the incidence of cysticercosis in pigs and cattle in China are most vague, and it has been almost impossible to arrive at a true estimate of the prevalence of this condition in that country.

In Shanghai and Hong Kong meat inspection is carried out under the control of European veterinarians, and in both those cities it would appear that no cases of either parasite have been found for a number of years.

Chinese medical literature occasionally quotes sporadic occurrences of C. bovis and/or C. cellulosa, but as far as is known no article has yet been published, which portrays a true reflection of the incidence of cysticercosis.

Dr. H. Pedersen, Municipal Veterinary Officer, Shanghai, writes (12/1/37): "Uniform inspection in Shanghai over a period of many years has not revealed a case of either of these infections in hogs or bovines. It would appear thus that these parasites are non-existent in the areas from which we obtain our supplies. It is known, however, that C. cellulosa is prevalent in North China, but with the exception of Tsingtao, where it is stated that this infection is present amongst hogs to the extent of about $1\frac{1}{2}\%$, we have no statistics." Similar letters were received from Messrs. D. L. McWhirter, M.R.C.V.S., and H. C. Watson, M.R.C.V.S., both of whom have had vast experience in meat inspection in the French Concession at Shanghai and at Hong Kong, respectively.

Gear and Pedersen (1934) mention that in the Shanghai Municipal inspection no case of C. bovis was found, nor has it ever been reported from Hong Kong. Similarly, as regards C. cellulosa in pigs, meat inspection in Shanghai of over one million pigs did not reveal a single specimen of C. cellulosa; and in Hong Kong from 1910 to 1933, where an examination of over 200,000 pigs has been made annually, only two cases are reported, both in 1928.

Kuang Wu (1936) mentioned that Shu (1935) made a survey of Helminths in cattle in Soochow, but he did not find C. bovis. In Hong Kong Chen (1935) according to Wu, did not find C. cellulosa and C. bovis among the animals he studied; and in Canton, Chen (1936) reported the absence of C. cellulosa among the hogs he examined. Wu failed to find

C. cellulosa or C. bovis in the abattoirs at Hangchow.

Faust (1923), according to Mills (1923), wrote "Twenty-five years ago infestation with T. saginata was common in North China. The infection was brought down from beyond the Great Wall, by cattle which were slaughtered immediately and offered for sale on the markets. Today such infection occurs rarely in Peking and vicinity. The cattle come from the same locality and are presumably infected, but for economic reasons they are fattened for a period of from several months to a year in local yards and, when slaughtered, are relatively free from infection." Mills states that these remarks by Faust are somewhat misleading, and that Faust was mistaken. Mills secured various samples of beef from a butcher in Peking. One piece, weighing three pounds, contained four measles, and another weighing five pounds contained ten measles. By casual examination the butcher, a German, found five infected animals in less than 300 examined, or roughly 2%. Mills points out that all this meat was taken from the hind legs, therefore, according to the theory of commoner seats of infection, a far higher number would have been found if the predilection sites, (head, tongue, etc.) had been carefully examined.

Mills (1924) recorded two cases of C. cellulosa from pigs in Peking.

Japanese Empire.

According to Prof. S. Yoshida, C. cellulosa in pigs has never been found in Japan proper, and C. bovis very rarely in cattle.

Dr. S. Yokogawa of Formosa, however, suggests a relative prevalence of C. cellulosa in pigs in Manchukuo, in the fact that out of 18 cases of human cysticercosis reported from Japan proper, no less than 16 contracted the infection in Manchukuo.

According to Eguchi and Nishiyama (1930), it would appear that C. cellulosa is a rare parasite in pigs everywhere in Japan, except in the Prefecture Okinawa, where it is fairly prevalent. These authors supply an interesting table showing the incidence of C. cellulosa in this Prefecture, from their observations at abattoirs, and they found that in 1916 only 0.01% of pigs were infected. In 1920, infection was 0.91% and in 1923, 1.03%, which percentage remained more or less uniform until 1926, when there was a sudden rise to 2.71%, and thereafter a steady decrease illustrated thus:- 1927: 2.14%; 1928: 1.33%; 1929: 0.94%.

Prof. Yoshida supplies a recent translated article by Nakanishi, who found that in Korea 33% of adult cattle were measly. Nakanishi (1926) found that 37.5% of Korean calves were measly.

C.

The Incidence of Cysticercosis in Swine and Bovines in Oceania.Australia.

According to Drabble (1934), Cysticercus cellulosa has never been found in Australian pigs.

A mild outbreak of C. bovis was recorded from the State of Victoria a few years ago. This outbreak occurred as the result of the grazing of slaughter cattle on the Werribee Sewage Farm, and caused great consternation among the meat consuming public of Victoria.

According to personal advice from Mr. Drabble, a few (not more than half-a-dozen) sporadic cases of C. bovis have been found on meat inspection in abattoirs in New South Wales over a number of years.