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LEPTOSPIRAL ANTIBODIES IN DOMESTIC ANIMALS IN TYROL

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Dedicated to Professor V. V. Kucheruk on the occasion of his 60th birthday

Abstract. Results are presented of a serological examination of 1,547 domestic animals (cattle, pig, sheep, horse, goat, dog, cat) from 9 Tyrolian districts (Austria), performed in order to disclose the incidence of leptospirosis. Completely significant titres were demonstrated by means of the MAL test in the serotypes *icterohaemorrhagiae* or *copenhageni*, *sorex-jalna*, *bratislava*, *sejroe* and *saxkoebing*. In addition, antibodies were confirmed against *L. bataviae*, *L. pomona*, *L. tarassovi* and *L. bulgarica*, but the titres wer insignificant. Of the animals examined, 7.2% gave positive reactions in titres of 1 : 800 and above (for dogs and cats 1 : 100 and more); positive reactions were obtained from 8.8 % of cattle serum, 6.8 % of pig-, 1.1 % of sheep-, 3.3 % of dog-, 18.2 % of cat serum. A positive reaction was obtained with the serum of one out of the 9 horses examined, the sera of the two goats examined were negative. The percentage of positivity in animals from the individual districts ranged from 1.0 to 17.0, and variations were found also in the distribution of serotypes in the individual districts. The results indicate that the percentage of positivity in domestic animals from Tyrol decreases as the altitude of the localities increases.

Austria is one of the European countries, in which little attention has been given to problems of leptospirosis. Babudieri (1967) explained in his survey of literary data on the research of leptospirosis in Austria that the scarcity of statistical data on leptospirosis research in this country should be ascribed to a lack of specialists and centres to collect the reports and evaluate them.

There are a few studies only available on leptospirosis of domestic animals from Austria. Wirth (1935, 1937, 1939) studied leptospirosis in the dog and other domestic and production animals; Gratzl (1957) was concerned with the distribution and epizooties in dogs from Vienna. Willinger (1966, 1971, 1972) examined serologically cattle from different parts of Austria including Tyrol for the incidence of leptospirosis; Silber (1973) reported the result of a serological investigation of cattle and pigs from several parts of Austria. In the Steyermark, Šebek et al. (1973a, b), examined the sera of the dog, cat, cattle and pig for the incidence of leptospirosis. It has been confirmed by these studies that leptospirosis occurs in domestic animals in Austria, and that a number of leptospiral serotypes participates in its etiology. They disclosed considerable variation in the rate of infestation of domestic animals in the various regions.

Our brief survey indicates that, apart from the report by Willinger (1966), no data are available on leptospirosis in domestic animals from Tyrol. We have tried to fill in this gap by examining serologically domestic animals from Tyrol in order to disclose the incidence of leptospirosis. The results of our investigations are presented in this study.

MATERIALS AND METHODS

We examined domestic animals from all 9 northern and eastern districts of Tyrol, to obtain the most accurate picture of the incidence and distribution of leptospirosis in domestic animals from this part of Austria (the numerals in brackets indicate the number of villages from which the animals were examined): 1. Landeck (11), 2 Imst (18), 3. Reutte (6), (4). Innsbruck-country (32), 5. Innsbruck town (1), 6. Schwaz (9), 7. Kufstein (14), 8. Kitzbühel (21), 9. Lienz (19).

Venous blood was placed on strips of filter paper and examined serologically by means of the microagglutination-lysis test. A description of this method has been given in an earlier paper (Šebek et al. 1972). The sera were examined in the basic dilution of 1 : 100 for dog and cat, 1 : 800 for the remaining animals. Since a high percentage of unspecific reactions is generally obtained in lower titres in large domestic animals we decided to use for them this higher dilution. The serotypes used in the basic dilution were these: 1. *icterohaemorrhagiae* Fryšava, 2. *sorex-jalna* Sorex Jalna, 3. *canicola* Canis 7, 4. *arboreae* M 7, 5. *grippotyphosa* P 125, 6. *bataviae* Moldava, 7. *jalna* Jalna, 8. *bratislava* Jež Bratislava, 9. *pomona* Šimon, 10. *tarassovi* S 42, 11. *bulgarica* Nikolaevo, 12. *sejroe* M 84. Whenever a positive reaction in the basic dilution was obtained with the serotype *icterohaemorrhagiae*, the serotype *copenhageni* R.n. 1160 was used parallelly in the examination of the titre; for *sorex-jalna* we used the strain D 148 of the same serotype, for *canicola* the strain S 392 of the same serotype, for arboreae the serotype *castellonis* strain Castellón 3, for *grippotyphosa* the strain Ž 6 of the same serotype, for *bataviae* the strain Swart van Tienon of the same serotype, for *pomona* the strain BP of the same serotype, for *tarassovi* the strain (hyos) Mitis Johnson, for *sejroe* the strain J 20 of the same serotype, and the serotype *saxkoebing* the strains M 24 and Šaca.

We did not record evident coagglutinations such as lower titres with *L. canicola* at high titres with *L. icterohaemorrhagiae* or *copenhageni*, with *L. saxkoebing* at high titres with *L. sejroe*, and vice versa. For antigenically closely related serotypes such as *icterohaemorrhagiae* and *copenhageni*, *L. arboreae* and *L. castellonis*, *L. sejroe* and *L. saxkoebing*, we recorded the results of serotypes with the higher titre. Although this might not be an absolutely reliable confirmation of serotype etiology we have found by experience with particularly *L. sejroe* and *L. saxkoebing* that on the average values obtained in this way were similar to those of the actual incidence and distribution of these serotypes. In Czechoslovakia, this has been confirmed by a comparison of serological examination with cultures of leptospiral strains from reservoir animals. Whenever titres with *L. sejroe* and *L. saxkoebing* were of the same value, the results in the table were recorded for both serotypes.

RESULTS

We examined a total of 1,547 specimens of domestic animals: 861 specimens of cattle, 352 pigs, 189 sheep, 9 horse, 2 goats, 90 dogs and 44 cats. The sera of 111 animals (7.2 %) reacted positively with a total of 14 serotypes: 1. *icterohaemorrhagiae*, 2. *copenhageni*, 3. *sorex-jalna*, 4. *canicola*, 5. *castellonis* or *arboreae*, 6. *grippotyphosa*, 7. *bataviae*, 8. *jalna*, 9. *bratislava*, 10. *pomona*, 11. *tarassovi*, 12. *bulgarica*, 13. *sejroe*, 14. *saxkoebing*. The highest percentage of positivity was recorded for the cat, i.e., 18.2 %; for cattle 8.8 %, for the pig 6.0 %, for the dog 3.3 %, for sheep 1.1 %; of the 9 horses examined one was positivite; both goats gave negative reactions. The results are shown in Table 1. The participation of the individual serotypes in the total serological positivity was this: *sejroe* — 29.7 %, *icterohaemorrhagiae* — 21.6 %, *sorex-jalna* — 16.2 %, *bratislava* — 16.2 %, *sejroe-saxkoebing* (the same titre) — 9.0 %, *grippotyphosa* — 3.6 %, *canicola* — 1.8 %, *castellonis* or *arboreae*, *bataviae*, *tarassovi*, *pomona*, *jalna*, *bulgarica* — 0.9 % respectively. A concomitant positive reaction to two serotypes (no coagglutinations) was found in 10 animals. Antibodies to *L. sejroe* were demonstrated in 7 out of the 9 districts of Tyrol, to *L. icterohaemorrhagiae* and *L. sorex-jalna* in 6, *L. sejroe* and, concomitantly, *L. saxkoebing* (same titre) in 5, *L. bratislava* and *L. saxkoebing* (same titre) in 3, *L. copenhageni* in 2, *canicola*, *castellonis* or *arborea*, *grippotyphosa*, *bataviae*, *jalna*, *pomona*, *tarassovi*, *bulgarica* in one district each. The results are shown in Table 2. The highest number of serotypes occurred in the district Kitzbühel (13), then in Innsbruck-town (5), Innsbruck-country

Table 1. List of species, number and results of serological examination of 1,547 specimens of domestic animals from Tyrol for leptospirosis

Species	No. of		%	No. of positive reactions to *Leptospira*														
	exam.	posit.		icter.	copen.	sorex	canic.	cast.	grip.	bat.	jalna	brat.	pom.	taras.	bulg.	soj.	sax.	soj? sax?
Cattle	861	76	8.8	14	1	8	1	1	0	1	1	10	1	1	0	32	4	10
Pig	352	21	6.0	7	1	4	1	0	1	0	0	8	0	0	0	0	0	0
Sheep	189	2	1.1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Horse	9	1		1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Goat	2	0	—	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dog	90	3	3.3	1	0	0	0	0	0	0	0	0	0	0	1	1	0	0
Cat	44	8	18.2	0	0	5	0	0	3	0	0	0	0	0	0	0	0	0
Total	1547	111	7.2	24	2	18	2	1	4	1	1	18	1	1	1	33	4	10

icter. = *icterohaemorrhagiae*, copen. = *copenhageni*, sorex = *sorex-jalna*, canic. = *canicola*, cast. = *castellonis*, grip. = *grippotyphosa*, bat. = *bataviae*, brat. = *bratislava*, pom. = *pomona*, taras. = *tarassovi*, bulg. = *bulgarica*, soj. = *sejroe*, sax. = *saxkoebing*

The same applies to the following Tables.

Table 2. List of the localities examined, species of domestic animals and positive reactions with the individual serotypes in the 9 investigated districts of Tyrol

District	Landeck	Imst	Reutte	Innsbruck country	Innsbruck town	Schwaz	Kufstein	Kitzbühel	Lienz
No. of localities examined	11	17	6	33	1	9	14	21	19
Animal species examined	1, 4, 6	1, 2, 3, 4, 6	1, 2, 7	1, 2, 3, 5, 6	1, 2, 3, 4, 6, 7	1, 2, 3	1, 6	1, 2, 4, 6, 7	1, 3, 4
Serotype									
icterohaemorrhagiae	—	+	+	+	+	—	—	+	+
copenhageni	—	—	—	—	+	—	—	+	—
sorex-jalna	—	—	+	+	+	—	+	+	+
canicola	—	—	—	—	—	—	—	+	—
castellonis	—	—	—	—	—	—	—	+	—
grippotyphosa	—	—	—	—	—	—	—	+	—
(*bataviae*)	—	+	—	—	—	—	—	—	—
jalna	—	—	—	—	—	—	—	+	—
bratislava	—	—	—	+	+	—	—	+	—
(*pomona*)	—	—	—	—	—	—	—	+	—
(*tarassovi*)	—	—	—	—	—	—	—	+	—
(*bulgarica*)	—	—	—	—	—	—	—	+	—
sejroe	+	+	+	+	—	+	+	+	—
saxkoebing	—	—	—	—	—	+	—	+	+
sejroe? saxkoebing?	—	+	—	—	+	+	—	+	+

1 = cattle, 2 = pig, 3 = sheep, 4 = horse, 5 = goat, 6 = dog, 7 = cat

( ) = in the lowest titre of 1 : 800 only, for *L. bulgarica* 1 : 400.

Table 3. Serological positivity in cattle from the individual districts of Tyrol (in %)

District	No. of exam.	No. of posit.	%	Serotype														
				ict.	cop.	sor.	can.	cast.	grip.	bat.	jal.	brat.	pom.	tar.	bulg.	sej.	sax.	sej? sax?
Landeck	97	1	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
Imst	111	12	10.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.2	0.0	2.7
Reutte	30	6	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.0	0.0	0.0
Innsbruck country	129	4	3.1	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6	0.0	0.0
Innsbruck town	18	2	—	—	—	—	—	—	—	—	—	1*	—	—	—	—	—	1*
Schwaz	67	4	5.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	1.5	3.0
Kufstein	54	4	7.4	0.0	0.0	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.6	0.0	0.0
Kitzbühel	238	39	16.4	5.0	0.4	2.5	0.4	0.4	0.0	0.0	0.4	3.4	0.4	0.4	0.0	4.6	0.8	1.3
Lienz	117	4	3.4	0.9	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.9
Total	861	76	8.8	1.6	0.1	0.9	0.1	0.1	0.0	0.1	0.1	1.2	0.1	0.1	0.0	3.7	0.5	1.2

* = absolute number

Table 4. Serological positivity in domestic animals from the individual districts of Tyrol (in %)

District	No. of exam.	No. of posit.	%	Serotype														
				ict.	cop.	sor.	can.	cast.	grip.	bat.	jal.	brat.	pom.	tar.	bulg.	sej.	sax.	sej? sax?
Landeck	100	1	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
Imst	127	13	10.2	0.8	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0	6.3	0.0	2.4
Reutte	82	8	9.8	1.2	0.0	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.3	0.0	0.0
Innsbruck country	363	7	1.9	0.8	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.6	0.0	0.0
Innsbruck town	271	11	4.1	1.9	0.4	0.7	0.0	0.0	0.0	0.0	0.0	1.1	0.0	0.0	0.0	0.0	0.0	0.4
Schwaz	80	4	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	1.3	2.5
Kufstein	55	4	7.3	0.0	0.0	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.5	0.0	0.0
Kitzbühel	348	59	17.0	3.7	0.3	3.5	0.6	0.3	1.2	0.0	0.3	4.0	0.3	0.3	0.3	3.5	0.6	0.9
Lienz	121	4	3.3	0.8	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.8
Total	1547	111	7.2	1.6	0.1	1.2	0.1	0.7	0.3	0.07	0.07	1.2	0.07	0.07	0.07	2.1	0.3	0.7

(4), Imst and Lienz (3 — or 4*), Reutte (3), Schwaz and Kufstein (2 each), Landeck (1).

Data on serological positivity in cattle with the individual serotypes in 9 districts of Tyrol are given in Table 3, data on all animal speciet examined in Table 4.

Interesting differences in the incidence of leptospiral antibodies in domestic animals in relation to the altitude of the locality were disclosed by a provisional evaluation of our results. Therefore, we arranged the villages from which the animals were taken

Table 5. Leptospiral antibody in domestic animals from Tyrol in 3 categories of altitude

1. 400—800 m

Species	Cattle	Pig	Sheep	Horse	Dog	Cat	Total
Total no. examined	375	279	30	7	82	36	809
No. of posit.	43	19	0	0	3	8	73
in %	11.5	6.8	0.0	—	3.7	22.2	9.0

2. 801—1,200 m

Species	Cattle	Pig	Sheep	Horse	Dog	Cat	Total
Total no. examined	371	73	158	2	8	8	620
No. of posit.	30	2	2	1	0	0	35
in %	8.1	2.7	1.3	—	—	—	5.7

3. 1,201—2,000 m

Species	Cattle	Pig	Sheep	Horse	Dog	Cat	Total
Total no. examined	115	0	1	0	0	0	116
No. of posit.	3	0	0	0	0	0	3
in %	2.6	—	—	—	—	—	2.6

for examination, into three altitude categories: Category I (400—800 m), Category II (801—1,200 m), Category III (1,201—2,000 m). The relationship between serological positivity and altitude is shown in Tables 5a, b, c. Table 6 gives records of the highest titres with the individual serotypes.

DISCUSSION

In spite of the fact that a considerably high number of animals was examined in most of the districts the picture obtained on the incidence and distribution of serotypes in this area was, evidently, not a completely true reflection of existing

*) If titres with *L. sejroe* and *L. saxkoebing* were of similar height, there was the possibility of an additional incidence of *L. sejroe* or *L. saxkoebing*.

Table 6. Highest titres with the individual serotypes in inspected domestic animals from Tyrol

Species	Highest titre with													
	icter.	copen.	sorex	canic.	cast.	grip.	bat.	jalna	brat.	pom.	taras.	bulg.	sej.	sax.
Cattle	6400	3200	6400	1600	1600	0	800	1600	3200	800	800	0	50000	12800
Pig	1600	800	1600	3200	0	3200	0	0	1600	0	0	0	0	0
Sheep	800	0	800	0	0	0	0	0	0	0	0	0	0	0
Horse	800	0	0	0	0	0	0	0	0	0	0	0	0	0
Goat	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dog	200	0	0	0	0	0	0	0	0	0	0	400	400	0
Cat	0	0	800	0	0	1600	0	0	0	0	0	0	0	0

conditions. On the other hand, the picture of the serotype etiology of leptospirosis seems to be fairly accurate of those domestic animals which were examined in sufficiently large numbers. According to significant titres recorded for the areas under consideration, we found at least 10 serotypes of leptospirae in domestic animals which should be considered. These were: 1. *icterohaemorrhagiae*, 2. *copenhageni*, 3. *sorex-jalna*, 4. *canicola*, 5. *arboreae*, 6. *grippotyphosa*, 7. *jalna*, 8. *bratislava*, 9. *sejroe*, 10. *saxkoebing*. In one instance each we obtained reactions with *bataviae*, *pomona*, *tarassovi* and *bulgarica* in the lowest titre, i.e., 1 : 800 (1 : 400 in the dog) which is insignificant in our opinion. Of these four serotypes, the incidence of *L. pomona* and *L. tarassovi* might possibly occur in pigs from Tyrol. The existence of foci of *L. bataviae* and *L. bulgarica* seems unlikely in view of the fact that antibodies to these serotypes could not be demonstrated in significant titres either in Tyrol or in any other part of Austria (Šebek et al. 1973a, b). In addition, an endemic incidence of *L. bulgarica* has not as yet been confirmed in central Europe.

Of interest is a comparison of our results with those of Willinger's obtained from cattle of Tyrol. He recorded positive reactions to leptospirosis in titres of 1 : 1.000 and more in 1.6 % of clinically healthy specimens and even in 14.1 % of aborting cows. The serotypes used by this author were *icterohaemorrhagiae*, *canicola*, *australis*, *grippotyphosa*, *pomona*, *autumnalis*, *ballum* and *sejroe*. Clinically healthy cattle was positive in 1.0 % with *L. grippotyphosa*, and in 0.6 % with *L. sejroe*; aborting cows in 12.9 % with *L. sejroe* and 1.3 % with *L. grippotyphosa*, in 0.3 % with *L. icterohaemorrhagiae* and in 0.4 % with the remaining serotypes. In our investigation, we had a considerably higher percentage of positivity (8.8 %) in clinically healthy cattle, this being highest with *L. sejroe* — 3.7 %; positivity with *L. icterohaemorrhagiae* was 1.6 %, with *L. bratislava* 1.2 %, *L. sejroe* and *L. saxkoebing* (at the same titre) 1.2 %, *L. sorex-jalna* 0.9 %, *L. saxkoebing* 0.5 %. With *L. copenhageni*, *L. canicola*, *L. castellonis*, or *L. arboreae*, *L. jalna*, *L. pomona* and *L. tarassovi*, the percentage of positivity was 0.1 each. In view of the fact that the titre of the positive reaction with *L. pomona* and *L. tarassovi* was as low as 1 : 800 only and, in our opinion, a borderline case of specificity, we do not consider this finding to be a confirmation of the incidence of these serotypes in cattle in Tyrol. By contrast to the reports by Willinger (1966) and Silber (1973), we did not find *L. grippotyphosa* antibody in cattle from Tyrol.

Having regard to the fact that a heterologous serotype might, sometimes, react in a higher titre than a homologous serotype if antigenically closely related serotypes such as *icterohaemorrhagiae* and *copenhageni* were concerned, the serotype *copenhageni* might be present in Tyrol although this has not been confirmed. The situation is

similar with the serotypes *castellonis* and *arboreae*. According to our experience from Czechoslovakia, where all isolated strains of the serological group *Ballum* belong to the serotype *arboreae* (Kmety 1967), the presence of the serotype *arboreae* in Tyrol appears to be more likely than that of *castellonis*. Although also the serotypes *sejroe* and *saxkoebing* are much alike in their antigenic properties, and this paradox reaction is similar to that of the foregoing case, we assume in analogy with our experience that in most cases the etiology of the serotype can be determined from the level of the titres. This criterium is not absolutely reliable and cannot be employed for individual cases; it might be useful in an evaluation of a larger number of examinations.

It might be of interest to compare the results of examinations of cattle from Tyrol with those obtained in Czechoslovakia and, particularly in Bohemia and Moravia, where the position of the serotype *grippotyphosa* is dominant (Pokorný et al. 1958, 1959, 1960; Šebek and Janíček 1964; Vošta and Tesařík 1971, Šebek 1972). The fact that the frequency of the serotype *grippotyphosa* is considerably lower has been supported by the results of examinations of wild living animals (Šebek et al. 1976).

Our results of an examination of the remaining species of domestic animals from Tyrol could not be compared with those of other authors, because they either did not examine these animal species or examined them in insignificant numbers only. Positive reactions were given by 6.0 % of the pigs examined; of these 2.3 % reacted with *L. bratislava*, 2.0 % with *L. icterhaemorrhagiae*, 1.1 % with *L. sorex-jalna*, 0.3 % with *L. canicola*, 0.3 % with *L. grippotyphosa*. No positive reaction was obtained with the two serotypes typical of leptospirosis in the pig, i.e., *L. pomona* and *L. tarassovi*. Silber (1973) did not succeed in the demonstration of antibodies to *L. pomona* in pigs from various localities in Austria; Šebek et al. (1973b) obtained significant titres with this serotype in pigs from the Steyermark, although the percentage of positivity was very low (1.4). Considerable differences in the incidence of the serotypes pomona and tarassovi have been disclosed by the results of investigations in Czechoslovakia: these serotypes were frequent in pigs from Slovakia (Kmety et al. 1956, Halaša 1958, Halaša et al. 1969), but practically absent in Bohemia and Moravia (Šebek and Rosický 1974).

The low percentage of positivity in sheep (1.1 %) might partly be ascribed to the fact that in Tyrol the four localities examined are mainly sheep-breeding areas and that there is a minimum of contact with other species of domestic and wild living animals.

A remarkable fact is the absence of *L. canicola* antibodies in the 90 dogs investigated, although in previous years this serotype had been reported to be dominant in dogs from other parts of Austria, e.g., from Vienna (Gratzl 1957). The situation might be analogous to that in Czechoslovakia where, at present, *L. canicola* is almost absent in dogs from Bohemia and Moravia, while antibodies to *L. grippotyphosa*, *L. sejroe* and *L. icterohaemorrhagiae* are very frequent in these areas (Šebek and Wurst 1972). Surprizingly low is the percentage of positivity of dogs (3.3). For the afore given reasons we consider a reaction with the serotype bulgarica at a titre of 1 : 400 to be unspecific. In Tyrol, the low percentage of positivity in the dog might be ascribed to the fact that *L. canicola*, the typical serotype of the dog, is not present in this country, and that there is a low rate of infestation in wild living and, possibly, synanthropic rodents, from which the dog acquires infection with particularly the serotypes *grippotyphosa*, *sejroe* and *icterohaemorrhagiae*. However, the presence of the serotype *canicola* in Tyrol in spite of its scarce occurrence has been confirmed by the significant titres with this serotype in cattle and pig.

The results of our examination of cattle from Tyrol indicate that the activity of

both natural and synanthropic foci of leptospirosis is lower in this country than it is, e.g., in Czechoslovakia. The same situation has been pointed out for *L. grippotyphosa* earlier in the text. With *L. icterohaemorrhagiae* and *L. sejroe,* positive reactions have been obtained in 2.7 and 7.6 % respectively (Šebek 1972) from the Bohemian-Moravian Upland in Czechoslovakia, in Tyrol in 0.9 and 3.7 % of the cattle examined.

A comparison of the percentage of serological positivity of domestic animals from the individual districts of Tyrol examined could be made for cattle only, since the number of examined animals of this group was highest with the exception of cattle from the district Innsbruck-town. The range of positivity (from 1.0 % to 20.0 %) (Table 3) indicates considerable differences.

Also a comparison of serological positivity in relation to the altitude of the locality under consideration could be made for cattle only, because the number of the remaining animal species examined was too low in either all three or at least in one of these categories. Tables 5a, b, c show that the percentage of positivity, and also the number of serotypes, decreased with increasing altitude of the locality. In Category I we detected antibodies against 13 (or, with regard to the significance of the titres, against 10) serotypes: *icterohaemorrhagiae, copenhageni, castellonis* or *arboreae, grippotyphosa, jalna, bratislava, sejroe, saxkoebing*); in Category II against 6 (or rather 5) serotypes: *icterohaemorrhagiae, sorex-jalna, bratislava, sejroe, saxkoebing*: in Category III against 2 (or rather 3) serotypes *copenhageni, sejroe,* in the same titre simultaneously *sejroe* and *saxkoebing*.

We feel that the distribution and activity of leptospiral foci in Tyrol are as yet little understood and that, therefore, no definitive conclusions can be made on the laws responsible for differences in the individual districts, and on a relation between the altitude of the locality and the serological positivity in domestic animals.

The generally low serological positivity in domestic animals from Tyrol answers to the situation described by Babudieri (1967) from West Austria. According to this author local conditions in this area were similar to those in Switzerland; this indicates that they are not too favourable for the distribution of leptospirosis.

The results of our serological examination of domestic animals might be used as a fairly reliable indication of the possible incidence of leptospirosis in man. In that we hope to have contributed to both the veterinary and medical practice.

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АНТИТЕЛА К ЛЕПТОСПИРАМ У ДОМАШНИХ ЖИВОТНЫХ В ТИРОЛЕ

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Резюме. Авторами серологически исследовано на лептоспироз 1547 домашних животных (скот, свиньи, овцы, лошади, козы, собаки и кошки) из 9 районов Тироля (Австрия). Значительные титры (реакция MAL) были получены у серотипов *icterohaemorrhagiae* или *copenhageni, sorex-jalna, canicola, castellonis* или *arboreae, grippotyphosa, jalna, bratislava, sejroe* и *saxkoebing*. Кроме того в более низких титрах получены еще антитела к *L. bataviae, L. pomona, L. tarassovi* и *L. bulgarica*. Положительные реакции в титрах 1 : 800 и выше (у собак и кошек 1 : 100 и выше) наблюдали у 7,2 % обследованных животных (скот 8,8 %, свиньи 6,0 %, овцы 1,1 %, собаки 3,3 % и кошки 18,2 %). Положительная реакция была получена также с сывороткой от 1 из 9 исследованных лошадей; сыворотки обеих исследо-

ванных коз были отрицательны. Процент положительных реакций колебался от 1.0 до 17.0 в отдельных районах и также распространение серотипов было разнообразно. Было обнаружено, что процент положительных реакций понижается с повышением высоты над уровнем моря в обследованных районах Тироля.

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