BLOOD PARASITES OF BIRDS IN CENTRAL EUROPE.
1. SURVEY OF LITERATURE. THE INCIDENCE IN DOMESTIC BIRDS AND GENERAL REMARKS TO THE INCIDENCE IN WILD BIRDS

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Dedicated to Academician B. Ryšavý on the occasion of his 60th birthday

Abstract. This paper constitutes an introduction to the forthcoming series of publications summing up the present store of knowledge on the incidence and ecology of avian haematozoa in Central Europe. The paper contains bibliography dealing with the incidence of these parasites in the region studied. The problem of the incidence of blood parasites in domestic birds is discussed in detail. The incidence of blood parasites in wild birds is only briefly outlined as it is to be treated in detail in forthcoming papers.

In recent years a few papers have appeared dealing with the incidence of haematozoa in birds in vast geographic regions. Greiner et al. (1975) summarized the information collected to date about the incidence of these blood parasites in North America, Galád et al. (1974, 1975, 1976 and 1978) carried out extensive research in South America and McCleure et al. (1978) examined tens of thousands of birds during an international expedition to various countries of South-East Asia.

In Europe haematozoa of birds have been studied since the eighties of the last century. An enormous body of data, primarily on the prevalence of these parasites, was accumulated and it would be therefore advisable to sum up the results obtained. The first attempt in this respect is the planned series of publications about the present knowledge of the incidence and ecology of avian haematozoa in Central Europe. This paper is the first and introductory part of the series.

A bibliography of works dealing with the incidence of blood parasites in birds of Central Europe is presented and methods used in examining the particular bird groups are outlined. The incidence of blood parasites in domestic birds is treated in detail. A brief general survey of the situation in wild birds is given as a preliminary to the planned series of papers in which particular genera of blood parasites will be treated in view of their incidence in different systematic and ecologic groups of birds.

MATERIAL AND METHODS

As a first stage of this study the bibliography of papers dealing with the incidence of haematozoa in birds in Central Europe was elaborated, covering the territories of the Austria, Czechoslovakia, the Federal Republic of Germany, the German Democratic Republic, Hungary, Poland and Switzerland. As a basis served the data from the following publications: 1. Herman et al. (1976) who compiled the bibliography of works on avian haematozoa, but omitted a few references of authors from Central Europe. 2. Zoological Records (Zoological Society of London), 1910—1970. 3. Wenyon (1928) who compiled a list of blood parasites found until 1925 according to their hosts. 4. Biological Abstracts (Philadelphia) as from 1970. 5. Fendrych (1966) who compiled parasitological bibliography in Czechoslovakia until 1961. 6. Bibliography of parasitological literature in Czechoslovakia between 1962 and 1966 (Academia, Praha, 1969). 7. References cited in above papers.
As a second stage the results presented in the above papers were summed up and evaluated. Particular reports on the incidence of haematozoa in birds of Central Europe were filled in a card-index. Digital data on the parasite prevalence were used only from those papers in which the total number of examined birds as well as the number of infected birds of particular species were recorded. In case that some authors published more papers on the basis of same material, only data from one paper were used for computerization. In order to keep up a certain standard, only data obtained by studying blood smears were used for the evaluation of parasite prevalence. Other methods for the detection of blood parasites (e.g. cultivation of trypanosomes) employed by some authors, will be pointed out in subsequent paper.

Papers dealing with the incidence of avian haematozoa in Central Europe are marked out in the list of literature as follows: Papers from which only data on positive findings of the parasites could be used and the results could not be computerized (see above), are marked with one asterisk (*). Papers from which digital data on the incidence of the parasites were used in the total summarization of prevalence of particular haematozoan genera in individual bird groups, are marked with two asterisks (**). Papers which do not deal with blood parasites directly, but record examinations for the presence of haematozoa with negative results and from which the data were used for computerization, are marked with three asterisks (**). This last batch of papers actually does not belong into the bibliography on the blood parasites, but they often contain important though negative data on the parasite prevalence.

The bibliography of papers concerning blood protozoa from the period between 1890 and 1977 is practically complete, but the papers on the incidence of other blood parasites (spirochaetes and microfilariae) are not yet exhaustive. The works of Nieschulz (1921) and Borrani (1937) were not verified in original and are included for the sake of completeness. However, it is evident that Nieschulz treated the same material in his subsequent paper (1922). Borrani's thesis has not been published.

The systematic and scientific names of Central European birds are adopted from Makatsch (1974, 1976). The classification of birds in ecological groups was arranged mainly on the basis of data from Makatsch (1974, 1976), Moreau (1972), Ferianc (1964, 1965) Hudec and Černý (1972, 1977) and Gotzmann and Jabłoński (1972). Information on seasonal dynamics and incidence of particular parasites in birds of different ages were obtained on the basis of the author's material from 750 passerines examined in localities with very similar biotopes (growths along the banks of streams).

RESULTS AND DISCUSSION

Over 12 thousand birds were examined for the presence of haematozoa by different authors in Central Europe (see the list of literature). The data from 11 984 birds could be used for the evaluation of prevalence of these parasites on the basis of blood smears collected from particular bird groups. It should be stated beforehand that the percent value of the incidence of haematozoa based on the numbers of positive and negative blood smears does not give the actual percentage of birds infected with these parasites. Due to the fact that blood smears cannot reveal birds with chronic infections, the actual infection rate of the bird population is much higher. It is therefore necessary to consider the data on the incidence of haematozoa obtained in this way as certain relative data which can be well used for the comparison of prevalence of these parasites in particular systematic and ecological groups of birds.

Of the above mentioned total number of birds examined 1790 were domestic birds (see Table 1). However, the actual number of domestic birds examined in Central Europe was several times as much, as some authors did not give exact numbers of domestic birds examined due to the fact that no haematozoa were found in them. These parasites were evidently very rare in the region studied, causing no economic problems and therefore attracting very little interest.

The only and a low epizootic of leucocytozoonosis in geese and turkeys was recorded in the twenties in Silesia (Knuth 1922, Knuth and Magdeburg 1922, 1924, Knuth and David 1928, and Stephan 1922). More recently the parasites of the genus Leucocytozoon have been reported from Cairina moschata in the Federal Republic of Germany (Commichau and Jonas 1977). Other haematozoa detected in Central Europe were
*Haemoproteus* in hens (Sýkora 1976) and spirochaetes in hens and geese (see Table 1). In the spring and summer 1977 the author himself (Kučera 1978a) examined 252 domestic ducks and 60 geese which were kept in open fishponds. Although the passerine populations from the same areas were heavily infected with blood parasites, the presence of the latter in domestic birds was never found.

*Leucocytozoon* and spirochaetes belong to the economically most important blood parasites of domestic birds. Spirochaetosis is associated with tropical and subtropical regions and therefore its low incidence in Central Europe is no surprise. *Leucocytozoon*, on the other hand, is quite widespread in free-living birds of Central Europe (see below). However, its incidence in Anseriformes, even in wild ones, is very sporadic. This fact is quite interesting, because it is in Anseriformes that *Leucocytozoon* is very abundant in North America (Greiner et al. 1975) causing grave epizootics in domestic ducks and geese (Herman 1963). Both in North America and Central Europe the species *Leuco-

Table. 1. A survey of domestic birds in Central Europe and blood parasites found

<table>
<thead>
<tr>
<th>Bird species</th>
<th>Examined(*)</th>
<th>Parasites found</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Anas domesticca</em></td>
<td>452</td>
<td></td>
</tr>
<tr>
<td><em>Anser domesticus</em></td>
<td>324</td>
<td><em>Leucocytozoon</em>: Knuth (1922), Knuth and David (1928), Knuth and Magdeburg (1922, 1924), Stephan (1922) — Silesia spirochaetes: Nižnánsky and Stricker (1947) — Czechoslovakia</td>
</tr>
<tr>
<td><em>Meleagris gallopavo</em></td>
<td>44</td>
<td><em>Leucocytozoon</em>: Stephan (1922) — Silesia</td>
</tr>
<tr>
<td><em>Columba domesticus</em></td>
<td>235</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1 790</td>
<td><em>Haemoproteus, Leucocytozoon, spirochaetes</em></td>
</tr>
</tbody>
</table>

* Only data based on blood smears. The actual total number of domestic birds examined in Central Europe is far higher, as most authors do not state the exact number of birds examined.

** Recorded according to findings in histologic preparations.

cytozoon simondi* (Mathis et Leger, 1910) parasitizes Anseriformes (Levine 1973). The reason why there is a difference both in prevalence and virulence of this parasite in birds from these regions, has not yet been elucidated. It is possible that the centre of the distribution area of this parasite is in North America and its sporadic incidence in Anseriformes of Central Europe is due to the fact that the parasite has been brought into this region with imported birds. The brought-in parasites may cause disease in ducks and geese, but there is no suitable ecological environment here (vectors?) and therefore these parasites are not permanently harboured by the populations of wild Anseriformes. Yet another, in my opinion more probable explanation is possible. Herman (1968) noted an interesting fact that *L. simondi* is transmitted in North America only from the latitude 43° North, and higher. This boundary line of incidence
is quite sharp and is running slightly below the state border between the USA and Canada. Analogically it may be assumed that the distribution area of this parasite is situated somewhere in the north of Europe or in Siberia, because climatically similar regions such as in Canada are in Europe shifted north under the influence of the Gulf Stream. This assumption is supported by previous findings of Tartakowskii (1913) who reported leucocytozoonosis in domestic ducks from the present Leningrad, Novgorod and Pskov regions. This author also found *Leucocytozoon* in wild ducks from Lake Ladoga. In recent years Eide et al. (1969, 1972) and Fallis and Eide (1970) have

<table>
<thead>
<tr>
<th>Genus of parasites</th>
<th>Number of birds infected</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Non-Passeriformes</td>
<td>Passeriformes</td>
</tr>
<tr>
<td>Trypanosoma</td>
<td>exam.</td>
<td>3 537</td>
</tr>
<tr>
<td></td>
<td>inf.</td>
<td>179</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>5.1</td>
</tr>
<tr>
<td>Plasmodium</td>
<td>exam.</td>
<td>3 550</td>
</tr>
<tr>
<td></td>
<td>inf.</td>
<td>903</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>25.4</td>
</tr>
<tr>
<td>Haemoproteus</td>
<td>exam.</td>
<td>3 550</td>
</tr>
<tr>
<td></td>
<td>inf.</td>
<td>375</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>10.6</td>
</tr>
<tr>
<td>Leucocytozoon</td>
<td>exam.</td>
<td>3 633</td>
</tr>
<tr>
<td></td>
<td>inf.</td>
<td>322</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>8.9</td>
</tr>
<tr>
<td>Atoxoplasma</td>
<td>exam.</td>
<td>492</td>
</tr>
<tr>
<td></td>
<td>inf.</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>0.6</td>
</tr>
<tr>
<td>microfilariae</td>
<td>exam.</td>
<td>1 252</td>
</tr>
<tr>
<td></td>
<td>inf.</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>2.0</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>3 649</td>
</tr>
</tbody>
</table>

**Note.** Sporadic findings of lankesterelles and spirochaetes are not given in the table.
Non-Passeriformes: other than passerines
Passeriformes: song-birds
exam.: number of birds examined
inf.: number of birds infected with given genus of parasites
%: percentage of infected birds in the number of birds examined

proved that *Leucocytozoon simondi* occurs in wild ducks in Norway and that it is also transmitted here by vectors. If that is the case, that *L. simondi* is distributed in the north, then it might be brought into Central Europe from the north, this fact being an explanation for its accidental reports from this region.

Surprising is also a zero incidence of haematozoa in the domestic fowl (*Gallus domesticus*). The infection rate in free-living gallinaceous birds in Central Europe is namely quite high (see further paper in this series). It is possible that there is a higher
specificity of haematozoan species in Galliformes to host species (Levine 1973) and therefore the domestic fowl cannot be naturally infected with parasite species from free-living Galliformes. To a certain extent this assumption, however, is refuted by a single finding of parasites of the genus *Haemoproteus* in hens in Slovakia (Sýkora 1976).

Of certain practical importance are also the so-called “aberrant leucocytozoonoses of parrots kept in open-air cages”. The etiology of this disease was elucidated by Frank (1965) and Walker and Garnham (1972). The disease is caused by local species of the genus *Leucocytozoon* which may, under certain conditions, infect the parrot young after their contact with infected vectors. The development of parasites in the unusual host, however, is suspended on the level of megaloschizonts in the interior organs of parrots which usually succumb to the disease. In Central Europe the cases of this disease have become manifest in the last decade. They were disclosed in the Federal Republic of Germany (Frank 1965, 1967, 1974, Frank and Kaiser 1967), in the German Democratic Republic (Kronberger and Schüppel 1976, Schüppel and Kronberger 1976) and lately also in Czechoslovakia (Minárik and Dymel 1972, Roudná, pers. com.). Garnham (1977) reported a similar case in black swans kept in England.

**Table 3.** Comparison of blood parasite incidence in birds in Central Europe, North America, South America (Venezuela) and South-East Asia

<table>
<thead>
<tr>
<th>Region</th>
<th>Number of birds examined</th>
<th>Percentage of birds infected with parasites of the genus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central Europe</td>
<td>10 194</td>
<td>2.2</td>
</tr>
<tr>
<td>North America</td>
<td>57 026</td>
<td>3.9</td>
</tr>
<tr>
<td>Venezuela</td>
<td>21 201</td>
<td>0.1</td>
</tr>
<tr>
<td>South-East Asia</td>
<td>55 289</td>
<td>0.2</td>
</tr>
</tbody>
</table>

**Note.** Data from North America, Venezuela and South-East Asia are adopted from papers of Greiner et al. (1975), Gabaldon et al. (1974, 1975, 1976, 1978) and Mc Clure et al. (1978)

The revealed fact that parasite species of the genus *Leucocytozoon* from Central European birds may also infect introduced birds, if conditions are favourable, and cause affliction in them, is of considerable importance for the introduction of new breeds and species of domestic and game birds.

Apart from domestic birds, over 10 000 free-living birds were examined in Central Europe by different authors (see Material and methods). A general survey is given in Table 2. The Table shows that blood smears most frequently contain parasites of the genera *Haemoproteus*, *Plasmodium* and *Leucocytozoon*. The different incidence of these parasites in passerines and non-passerines indicates a considerable difference in the incidence of blood parasites in different systematic bird groups. A deeper analysis of the incidence of blood parasites in particular systematic and ecological groups of birds will be given in subsequent papers of this series.

Interesting is a comparison between the incidence of blood parasites in birds from Central Europe and from some other world regions as given in Table 3. The Table shows that *Haemoproteus* belongs to the common parasites in all regions studied, i.e. in Central Europe, North America, Venezuela and South-East Asia. *Leucocytozoon* is most abundant in North America and *Plasmodium* in Central Europe. Other parasites are found in blood smears from birds of all regions mentioned less frequently than
parasites of the genera *Plasmodium*, *Haemoproteus* and *Leucocytozoan*. The results show, that the method of blood smears proves to be effective only in detecting *Plasmodium*, *Haemoproteus* and *Leucocytozoan*, while other blood parasites are sporadically found in blood smears. If a more suitable method is used than blood smears, these parasites can be far easily detected. A classic example is the cultivation of trypanosomes from the avian blood, often revealing a surprisingly high infection rate of bird hosts with these protozoans (see more e.g. Kučera 1979a). The limited possibility of detecting chronic infections by means of blood smears has been pointed out above. It should be repeated that only the presence of blood parasites in the peripheral blood of birds can be detected in blood smears, and not always (see bird trypanosomes: Kučera 1979a). Notwithstanding, the method of blood smears is the most suitable one for the detection of avian blood parasites and its results make it possible at least as far as *Plasmodium*, *Haemoproteus* and *Leucocytozoan* are concerned, to compare the incidence of these parasites within different groups of hosts. Such studies, however, require a sufficient quantity of material, which can be obtained by e.g. summarizing all existing data on the prevalence from a certain region. The present paper and its sequels attempt to do so. In this way the inaccuracies, caused by different individual approaches of different authors examining birds on the presence of blood parasites, are considerably eliminated.

**Acknowledgement.** I am grateful to Mrs. M. Křížová, the librarian of the Institute of Parasitology, Czechoslovak Academy of Sciences in Prague, who kindly provided less available literature.

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In memoriam of Prof. Dr. Gheorghe Lupașcu

Prof. Dr. G. Lupașcu, Corresponding Member of the Academy of the Socialist Republic of Romania, member of the editorial council of our journal, former head of the Parasitology Department at the Institute of Medicine and Pharmacy, University of Bucharest, and chief of the Parasitology Department, Cantacuzino Institute, Bucharest died suddenly on 29 November 1979.

He was born on 22 March 1908 in Notoșani in Moldavia. Since his youth he was attracted to the study of nature. In 1945 he received his doctor degree from the Faculty of Natural Sciences, University of Bucharest. He began his teaching activities at the Institute of Medicine, University of Timișoara, in 1946 as lecturer and next year as professor of parasitology. In 1948, Prof. Lupașcu was elected Corresponding Member of the Academy of the Socialist Republic of Romania, in 1952, he was appointed professor at the Parasitology Department in the Institute for Postgraduate Training of Physicians and Pharmacists and in the same year director of the Cantacuzino Institute. In 1954, he became deputy director of the Institute of Medical Parasitology and two years later head of the Department of Parasitology in the Cantacuzino Institute. Since 1960, he worked as president of the national section for parasitology in the Union of societies of medical sciences.

Prof. Lupașcu was a member of several scientific societies: Société de Pathologie Humaine et Compareé, The Royal Society of Tropical Medicine, American Society of Parasitologists, World Federation of Parasitologists. He was active in various branches of medical parasitology, but his main field of interest was the malaria both in scientific investigations and in the malaria control programmes. In connection with these problems he participated in many meetings and events organized by the World Health Organization.

Prof. Lupașcu published alone or with coauthors several monographs and more than 200 scientific papers. He was an outstanding personality of Romanian parasitology. His colleagues and friends, in his country and abroad will never forget him. Dr. V. Černý, C.Sc.