

ALOJZ KRAJČÍR

TICK-BORNE ENCEPHALITIS AND ITS DISTRIBUTION
IN SLOVAKIA

Alojz Krajčír: L'encéphalite par l' *Ixodus ricinus* et son extension en Slovaquie. *Geografický časopis*, Bratislava 1972, XXIV, 2; 1 carte, 12 lit. cit.

L'encéphalite par *I. ricinus* est une maladie dont l'extension dépend du milieu géographique. Il est évident de la carte annexée qu'en Slovaquie s'étendent deux zones de son existence, c'est à dire près de la transition entre la plaine et les montagnes, concrètement à l'ouest, entre les abaissements intérieures des Carpathes (Plaine Danubienne et celle de Záhorie) et les Carpathes intérieures de côté septentrionale (Považský Inovec, Tribeč, Pohronský Inovec) et à l'est, entre la plaine de la Slovaquie orientale et les montagnes adjacentes du côté nord (Slanské pohorie, Slovenské rudohorie). Les zones ont un caractère intermédiaire (souvent montagneux) avec des associations des chênaies et un élevage spécial de bétail qui représente un réservoir pour l'infection. Les vaches, chèvres et moutons se trouvent ici à la frontière des biocénoses des tiques (chênaies) et de l'home (habitations). La conception est importante pour la réduction de la maladie, ainsi que pour la prognose dans des pays inconnus.

Tick-borne encephalitis is one of diseases strongly bound with geographical environment, especially with its physico-geographical components, namely with the so called natural foci of infections. Encephalitides (inflammations of the brain) are mostly acute inflammatory diseases of the brain with various resources — reservoirs (man, animals), with various ways of transmission (bite of animal, contaminated food, mosquitoes, ticks, alimentarily especially goat milk) as well as with a different distribution in the world, which is a part of the object proper of medical geography as a part of geography, while the previous aspects are an object of biological or medical scientific sphere (parasitology, epidemiology et al.). Of course, in the study of distribution we do not limit ourselves to its mechanical representation only, but by scientific approach it is put to an analysis as well as a synthesis is made by watching connections, by questing relations and by explaining dependences within the categories of geographical environment. The given problem (distribution of disease) is set, at the same time, in a respective historical framework and directed towards questing setting possibilities of a reduction, resp. wiping out of disease. All the series of problems is based, at the same time, especially on the cartographical method.

All encephalitides are divided into some groups by the above mentioned aspects. One of them is constituted by encephalitides, which have their cause in the so called arboviruses.* The transmitting agents (vectors) are here especially mosquitoes and ticks.

* arthropod-borne viruses.

The group comprises Japanese, St. Louis, Russian spring-summer, and Central-European (European) encephalitides. By ticks merely two latter kinds are carried. The identity of viruses from the individual geographical regions of the world is doubtful in some cases, as the viruses are often very similar mutually, if not quite equal. By D. Clark's method, however, viruses from the individual geographical regions may be distinguished reliably (5). In such a way, within the above mentioned groups of encephalitides variants of the virus of sheep's (Scottish) encephalitis (louping ill), virus of Omsk haemorrhagic fever, virus of the Kyasanur Forest in India (in the state Mysore) et al. are distinguished more. D. Blaškovič (5) has laid out Czechoslovak virus more.

In this contribution we want to deal with the distribution of Central-European (alias European) tick-borne encephalitis more in detail, the resources (reservoirs) of which are represented by rodents, cattle, sheep, deer (red deer, roe-deer) and some kinds of birds. Transmission is made by ticks (by sticking) even alimentarily (by non-boiled contaminatel goat milk, much less by cow milk, resp. by sheep cheese of non-boiled milk or also after bruising tick by non-washed hands). Human may be infected by tick in any development stage (larva, nymph, imago). The development of tick lasts for 2—5 years in natural conditions. The disease occurs in the ČSSR, Austria, Yugoslavia, Poland, Roumania, Bulgaria, Sweden, Finland, Ukraine, and Belorussia (2, 5, 7). The distribution of tick-borne encephalitis in the world is relatively well-represented on one of the plates of an American medico-geographical atlas (2, Plate 13). Unfortunately, the representation is neither differentiated sufficiently, nor completed, because the authors had evidently no complete basic material at their disposal. As to the vector, in all the above mentioned regions in Europe it is common tick (*Ixodes ricinus*).

From the historical point of view, the beginnings of occurrence of tick-borne encephalitis in Czechoslovakia are not clear. Evidentially the disease appeared in our territory in the spring 1949, namely in the areas of Beroun near Prague, when also it was found that even ticks from the forests of Beroun are carriers of this virus. In the same year the disease appeared also in the surroundings of Strakonice and of Vyškov in Moravia. Among the specialists it was talked then about the possibility of transmission of the ticks together with the virus tick-borne encephalitis on military horses when the front passed across our territory. Ultimately, however, it was settled as a hypothesis only, because some seasonal inflammations of the brain were recorded in the Czech literature as soon as the period before the Second World War (5).

In Slovakia the most important explosive epidemic of tick-borne encephalitis up to this time was in the May 1951, namely in the area of Rožňava, where in the time more than 600 people fell ill (5). The infection focus was then in the surroundings of the community of Hrušov. From 1948 to 1961 about 10 000 cases were registered in Czechoslovakia altogether and the largest (most intensive) occurrence falls on 1953, when allegedly all the districts were affected (7).

Our own geographical research of the distribution of tick-borne encephalitis in Slovakia have been directed towards the decade 1971—1970. We have based on the original sources of the regional hygienic-epidemiological stations (records of cases, annual reports etc.) in the former regional towns, namely Bratislava, Banská Bystrica, and Košice. On the basis of this material it may be stated that the disease occurrence is much lesser and totally it is of a tendency to fall compared to the whole previous period. This fact could suggest perhaps the assumption that the disease was truly brought in here when the front was passing, in some areas it found a suitable ground for its own existence, owing to the fact, however, that the conditions for it were not quite the most suitable, it exploded, it is true, in a respective lapse of time necessary

for the development cycle of pathogenic factors, very explosively, while resulted perhaps from the amount and virulence of the disease agent, but during the whole period 1948—1970 it is a strongly falling tendency. During the whole decade 1961—1970 tick-borne encephalitis occurred in Slovakia in 300 odd cases and its incidence is relatively slight and neglectable just in latest years of the period studied. Besides, this whole development and thus also the amount and distribution are to be taken under some reserve, namely in view of the fact that during the first years of the decade 1961—1970 tick-borne encephalitis was not distinguished in the records in some places, but it was implied within a larger group of encephalitides at all. Here is also possible, if not probable, some inaccuracy in diagnostics, simply already for the reason that the matter was a relatively unknown disease in our territory, if we mean the whole period since the end of the Second World War. The fact that there is no necessary differentiation in the registration of encephalitides (about up to 1963) is to be taken into consideration perhaps also in evaluating the amount of cases in Western Slovakia as well as in evaluating the sporadic distribution in the more northern areas of Slovakia (see the map). Consequently, we have indicated some cases on the map as doubtful.

From the cartographic illustration of the disease watched, however, in any case an apparent dependence of the distribution (perhaps even the amount) of the disease upon the geographic environment may be observed. It is suggested by an aggregation of the incidence in certain areas, resp. belts. A presupposition for the spread of tick-borne encephalitis just as in any other disease is a continued tie-up of certain factors existential for it itself, and in this case there are factors, which are strongly bound just on certain features of the geographical environment. Thus in our case the areas with the spread of disease afford conditions for existence, e. g. for all the links of the development cycle of virus up to the possibility to infect human (agent, vector, reservoir, resp. human).

Possessing all such conditions seems to be afforded by areas with the spread of oak as it is illustrated in the Atlas of the Czechoslovak Socialist Republic (1), resp. by areas with oak forests together with beech and hornbeam forests (Fageto-Quercetum, Carpineto-Quercetum) and other groups of forest types sensu A. Zlatník (12) as they are illustrated, in turn, on the maps of the groups of forest types (9), the spatial overlap of the spread of disease as compared with the spread of the groups of forest types mentioned being striking.

The enclosed map of the distribution of tick-borne encephalitis in Slovakia for the decade 1961—70 presents a morbidity according to communities and years, the directions running out from the place of incidence (community) representing the years of incidence according to the rule of watch dial. Thus, e. g. direction to east represents the year 1963, the direction vertically downwards (to south), in turn, the year 1966 etc., and the length of 0,5 cm represents 1 case. The doubtful cases are represented by broken lines. It is obvious from the map, that the prevailing part of diseases falls to Western Slovakia, resp. it is distributed in the southern half of Slovakia. Also this latter feature suggests the probability of dependence of the incidence of disease upon the vegetation tier of oak forests and allied combinations of growths (e. g. combined with beech, hornbeam forests and the like, namely Fageto-Quercetum, Carpineto-Quercetum, and Querceto-Fagetum, 9). There is, obviously, not only a spatial bond between the disease and the kind of growth proper, but at the same time a bond to the latter as a height tier with certain climatologic accent.

With reference to a condition rate of the disease prevailingly from the side of physico-geographical factors (natural foci), we want setting the analysis of distribution

into the physico-geographical framework and relating it basically to morphographic categories, and only exceptionally e. g. to administrative units (e. g. to districts), upon the configuration of which the distribution of morbidity depends indirect only, when we are aware of the role played here by the distribution of population.

Thus it is to be said that in the course of the decade studied the disease occurred above all within the area of *the Tribeč Mts., Nitrianska Pahorkatina Hills, Pohronský Inovec Mts., and Považský Inovec Mts.*, where it is bound, of course, with the settlement for the most part along the periphery of these orographic units, but also with wider surroundings. The foci (localities) especially in the communities Žirany (1962), Jarok (1962, 1968), Nitra (1962, 1968), Horné Lefantovce (1963), Súlovce (1962), Červeník (1961), and Bojná (1963) are well known here. At the same time, Červeník (1961) and Súlovce (1962) represent new foci. In Červeník (1961) there was the disease of pupils and in Jarok (1968) were family epidemics in question. The localities of this area on the whole fall in groups of forest types Fageto-Quercetum and Carpineto-Quercetum (9).

The second important area of incidence is *the Ipelská Pahorkatina and Pohronská Pahorkatina Hills* with wide surroundings. The most known localities are here Pavlová (1962, 1963), Malé Kosihy (1962, 1963), and Salka. Within the area a group of forest type Carpineto-Quercetum (9) dominates.

A less important area is represented by *the Malé Karpaty Mts. and Myjavská Pahorkatina Hills*. Bratislava was affected by a stronger incidence in the year 1961 (in Lamač) only and some laboratorial infections were registered here. In Dobrá Voda the focus was active in 1953 and 1954, and afterwards as late as in 1966. In this area a group of forest type Fageto-Quercetum (9) dominates, too.

In all these areas, in general, the disease occurred in forest workers, employees of unified agricultural co-operatives (JRD) and state farms (ŠM), pupils and students at brigade-works, hunters, resp. holiday-makers. The affected humans, for the most part, had been bitten by ticks or had drunk non-boiled goat, resp. cow milk before they were ill. The laboratorial infections make a special group. Such characteristics are true practically for the whole territory of Slovakia.

As to Central Slovakia there are only few cases demonstrated. For the most part, they are the cases unconfirmed (serologically). In diagnosing medicine had to put up with anamneses and clinical symptoms preliminarily. And this fact is true, perhaps, not only for Central Slovakia. Consequently, we have registered cartographically the incidence in Central Slovakia, for the most part, as doubtful. However, even in these areas of incidence could be indeed the conditions for incidence, e. g. in the area between Banská Bystrica, Kremnica, and Žiar nad Hronom, where groups of forest types Querceto-Fagetum and Fageto-Quercetum prevail (9). Similarly the sporadic incidence of disease in the southern part of Central Slovakia has conditions for the spread of disease as for the distribution of vegetation factor, groups of forest types Fageto-Quercetum and Carpineto-Quercetum prevailing here (9). In addition just this area has an ample breeding of sheep (border zone of districts beginning from Levice up to Rožňava), see (1).

In Eastern Slovakia two major and one second-class areas of incidence may be observed. Above all there is the area of the *Slovenský Kras (Slovak Karst) with the Rožňavská Kotlina Basin*. The most known localities are here in Rožňava, Lipovník, and Silická Brezová. Fageto-Quercetum, resp. Fagetum quercinum (9) are distributed here dominantly, too. Significant is here the breeding of sheep.

The second major area in Eastern Slovakia is a belt stretching away from the *Košická Kotlina Basin up to the upper part of the Laborec Valley*. Significant are the localities

of Košice (1965, 1967), Nižný Hrabovec, and Brestov. Groups of forest types Fageto-Quercetum and Fagetum quercinum (in the Košická Kotlina Basin) and Querceto-Fagetum (in the other part) are bound with the incidence (9). Questionable is the area of the Spišská Kotlina Basin, where a group of forest type Fageto-Quercetum and also other combinations with oak (9) are distributed.

From the analysis of the map certain chronological connection between neighbouring localities, resp. between those lying near one another is obvious. In this way in Western Slovakia we can find parallel next one another the direction of 1961 in several sites in the surroundings of Červeník (in the Považský Inovec Mts.), the direction of 1962 between Jarok, Žirany, resp. Súlovce (in the Tríbeč Mts.), the direction of 1963 between Hlohovec and Bánovce nad Bebravou (the Upper Nitra), further the directions of 1962 and 1963 in the Ipeľská Pahorkatina Hills, the direction of 1962, in turn, in the Slovak Karst (Slovenský kras) in Eastern Slovakia. This fact is, at the same time, an evidence of the influence of the geographical environment upon the disease incidence.

On the basis of *the analysis* made about the distribution of tick-borne encephalitis in connection with geographical factors certain *synthetic regularities* appear. When the facts mentioned considered on the whole, we can catch sight of all the areas of distribution practically, in fact, to be bound with a *hilly morphographic step between lowlands and mountain ranges*, whether there is the landscape of a hilly nature or of that of a basin. For the disease are thus well-disposed *intermediary geographical landscapes* — in Slovakia located above all in the west *along the boundary between the Inner Carpathian Depressions* (Podunajská Nížina and Záhorská Nížina Lowlands) *and the Inner Carpathians* (Považský Inovec, Tríbeč, Pohronský Inovec, resp. Malé Karpaty Mts.), while in the east, in turn, along the boundary between *the Východoslovenská Nížina together with the Košická Kotlina Basin and adjacent orographic units from north*, like the Slovenské Rudohorie, Slanské Pohorie, resp. Nízke Beskydy, and Vihorlat Mts. At the same time, for these intermediary belts between the lowlands and mountain ranges also the communities of oak forests together with various combinations of oak forests with other growths are characteristic. Besides, this intermediary zone is noted for certain typical manner in the breeding of cattle, goats and sheep. This reservoir of viraemic ticks (cows, goats, sheep and others) has, in fact, the most suitable conditions in these intermediary areas, namely for the function of a go-between related to the tick-carrying biocoenoses of oak forests and to the settlements (population). In addition it may be supposed just these intermediary zones have a typical respective feature, namely the grazing up along the boundary between the forest, resp. bushy growths and the arable land, along the boundary between the biocoenosis of ticks and that of humans (in settlements). On this basis the more extensive as well as the more intensive distribution of tick-borne encephalitis especially within *the western intermediary zone* in contrast with *the eastern intermediary zone* can be explained just owing to the greater extent of the zone in the west, which is caused, in turn, by the greater extent and thus even by a longer contact area of the Podunajská Nížina Lowlands. The occurrence in *the other territory of Slovakia* thus may be related to a respective degree of intermediarity between the lowland-like and mountainous types of the landscape in a respective part of Slovakia. Examples of this are provided by the Košická, Rožňavská, Spišská, and Žiarska Kotlinas, further the Horehronské Podolie Depression and the like. In general, we may observe the intensity and extensity of the distribution of tick-borne encephalitis also proportionally to the intensity, extensity as well as separateness (isolation rate) of all these orographic belts or units.

Such a conception like this could be significant in assignment of potential areas of

the disease as well as in evaluating unknown countries from the medico-geographical point of view as well as from that of tick-borne encephalitis. Besides, it may signalize a need of change in agricultural breeding system, in forestry practice within these intermediary areas and the like.

From the Slovak translated by A. K r a j č i r

LITERATURE

1. Atlas Československej socialistickej republiky. ÚSGK Praha 1966. — 2. Atlas of Diseases. Amer. Geogr. Soc. (J. M. May), New York 1950—55, 17 pp. — 3. BĀRDOŠ, V., ADAMCOVĀ, A., ŠIMKOVĀ, A. et al.: Přírodní ohniskové kliešťovej encefalitidy vo Vysokých Tatrách. Čsl. epidemiol., mikrobiol. a imunol. VIII, 1959, 3, 145—152. — 4. BĀRDOŠ, V., ROSICKÝ, B.: Prírodnaja očagovosť nekotorych vírusovych infekcij čelovička v Slovakkii. Žurnal gigieny, epidemiol., mikrobiol. i imunol., III, 1959, 16—28. — 5. BLÁŠKOVÍČ, D.: Kolobeh vírusov. SAV Bratislava 1963, 132 pp., figs. — 6. ČERNÝ, V., MAČIČKA, O., ROSICKÝ, B.: Poznámky k bionómii, vývoju, zdravotníckemu a hospodárskemu významu pijaka stepného (*Dermacentor marginatus* Sulz.) v strednej Európe. Práce 2. sekcie SAV, séria biol., zv. 1, zoš. 1, Bratislava 1955. — 7. Lékařské repetitorium (Charvát J. et al.), SZN Praha 1967, 1540 pp. — 8. MAČIČKA, O., NOSEK, J., ROSICKÝ, B.: Poznámky k bionómii, vývoju, zdravotníckemu a hospodárskemu významu pijaka lužného (*Dermacentor pictus* Herm.). Biol. práce SAV, Bratislava 1956, zv. 2, zoš. 12, 49 pp. — 9. Přehled stanovištných pomerov lesov Slovenska (Randuška D., Hatiar A., Vidák J.). Lesprojekta Zvolen 1957—1959. — 10. ROSICKÝ, B.: Učení akademika J. N. Pavlovského o přírodní ohniskovosti nákaz. Čsl. biologie, III, 1954, 6, 321—326.

11. Theoretical Questions of Natural Foci of Diseases. Proceedings of a Symposium Held in Prague, November 26—29, 1963. Edit. by Rosický B., Hayberger K., ČSAV Praha 1965, 533 pp. — 12. ZLATNÍK, A.: Přehled slovenských lesů podle skupin lesních typů. Lesnická fakulta VŠZ, Brno 1959, 92 pp., 196 encls. — 13. Výročné správy (jednotlivých) KHES. 1961—70.

Alojz K r a j č i r

KLIEŠŤOVĀ ENCEFALITĪDA A JEJ ROZŠĪRENIE NA SLOVENSKU

Kliešťová encefalitída je jedným z ochorení, ktorých rozšírenie javí veľkú závislosť od geografického prostredia. Vyplýva to predovšetkým z rozšírenia tohto ochorenia vo svete, ale i v jednotlivých krajinách. Poznáme dva druhy encefalitíd prenášaných kliešťami. Sú to ruská jarno-letná a stredoeurópska (európska) encefalitída. Prvá sa v Európe nevyskytuje. Druhú prenáša kliešť *Ixodes ricinus* a postihuje prakticky celú strednú Európu až po Škandináviu, Bielorusko, Ukrajinu, Bulharsko a Juhosláviu.

V Československu sa kliešťová encefalitída objavila prakticky až po prechode frontu v druhej svetovej vojne. Dovtedajšie prípady nie sú potvrdené ako tento druh ochorenia. V príspevku sa zaoberáme štúdiom rozšírenia kliešťovej encefalitídy na území Slovenska za obdobie roku 1961—1970. Podľa príslušných prameňov (3,4) však k najväčšej intenzite ochorenia dochádza na našom území práve od roku 1948 do roku 1961, najmä okolo roku 1950 (berounská, vyškovská a rožnovská explózia r. 1948 a 1951). V študovanom desaťročí 1961—1970 došlo asi k 300 prípadom ochorenia. Z priloženej mapy je zjavné, že ochorenie sa vyskytovalo na Slovensku v určitých pásmach. Na základe podrobnej analýzy sme dospeli k záveru, že na študovanom území možno zhruba rozlíšiť dve pásma. Prvé a hlavné pásmo sa rozprestiera na západnom Slovensku, a to, ako sme v syntéze zistili, práve na rozhraní medzi vnútornými karpatskými zníženinami (Podunajská nížina, Záhorská nížina) a vnútornými Karpatmi, kde

(vo vzťahu k rozhraniu) prilahlé karpatské pohoria zo severu predstavuje Považský Inovec, Tríbeč a Pohronský Inovec. V tomto prechodnom, často svojrázne pahorkatinnom pásme (Nitrianska pahorkatina, Pohronská pahorkatina) sa geografická krajina vyznačuje viac alebo menej rozsiahlymi rastlinnými spoločenstvami určitého charakteristického druhu. V zmysle Zlatnikovej koncepcie (12) možno povedať, že tu ide o skupiny lesných typov, ako sú dubiny v rôznych kombináciách, najmä s bučinami a hrabinami (*Fageto-Quercetum a Carpineto-Quercetum*). Osobitný charakter tu iste má tiež chov dobytky, keď plní vlastne funkciu prostredníka medzi viremickými kliešťami dubín ako vektormi a medzi človekom, ktorý sa môže infikovať buď samým kliešťom obsahujúcim vírus, buď nakazeným mliekom. Systém chovu dobytky tu má prechodný ráz. Kravy, kozy a ovce sa pohybujú na rozhraní biocenózy kliešťa a človeka, na rozhraní dubín a sídel. Najvýznamnejšou oblasťou je tu okolie Tríbeča, Nitrianskej pahorkatiny, Považského a Pohronského Inovca a oblasť Ipelskej pahorkatiny.

Druhé a vedľajšie pásmo sa rozprestiera analogicky na rozhraní medzi Východoslovenskou nížinou a prilahlými orografickými jednotkami na severe, konkrétne Slovenským rudohorím, Slanskými vrchami, Vihorlatom, resp. Nízkymi Beskydami. V tomto pásme sú najvýznamnejšie oblasti výskytu v Slovenskom krase (Rožňavská kotlina) a po južnom obvode Slanských vrchov (vrátane Košickej kotliny).

Ostatné priestory rozšírenia kliešťovej encefalitídy na Slovensku odpovedajú svojou intenzitou a distribúciou stupňu príbuznosti prechodnému — pahorkatinnému rázu geografickej krajiny, ako aj stupňu izolovanosti od hlavných dvoch pásem.

Koncepcia získaná na základe analýzy a syntetického vyhodnotenia má význam pre redukciu postihovaných území, pre určenie potenciálnych priestorov, ako aj pre výskum nepoznaných krajín z tohto aspektu.

Mapa 1. Rozšírenie kliešťovej encefalitídy na Slovensku za desaťročie 1961—1970 (podľa obcí a rokov).