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DEVELOPMENT OF VIEWS ON THE GEOGRAPHY OF  
HUMAN INFECTIOUS DISEASES

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With the victory of the Great October Socialist Revolution broad opportunities emerged for radical transformation of the political, economic, and cultural life of the Soviet peoples. The Soviet regime created all the necessary prerequisites for the rapid development of various sciences, medicine in particular. Medicine received a dialectical-materialistic, methodological foundation with emphasis on prevention. On the practical level it was asked to meet the demands of public health. Medicine has now achieved considerable progress, as is also evident in the field of the geography of infectious diseases of man.

The accumulation of data on the infectious pathology of man started back in prerevolutionary times, but the process was intensified by the health agencies established by the Soviet authorities. It was necessary to provide a theoretical generalization of the material as a basis for sound measures to prevent disease and eradicate infections. The first works of this kind dealt largely with nosogeographic and regional investigations.

The foundation of the present-day understanding of the nosogeography of infectious diseases was laid by the outstanding Soviet epidemiologist D. K. Zabolotnyy. After analyzing the geographic distribution of many infections and the main features of the ecology of the causative agents, Zabolotnyy convincingly showed (1919-1929)

that the natural and social characteristics of the life of the people (climate, ranges of the natural carriers and vectors, everyday conditions, etc.) are the factors responsible for infectious diseases becoming established in given areas. In his investigation of the epidemiological features and distribution of infectious diseases, Zabolotnyy strove to uncover the underlying factors. He urged that the various factors in the origin of epidemics be evaluated individually and as a whole in order to institute effective control measures. "To prevent epidemics and other mass diseases," Zabolotnyy wrote, "we must not only know the endemic foci, but elucidate all the conditions that promote their spread."

Zabolotnyy fought against the racist theories advanced to account for the distribution of infectious diseases. He resisted attempts at explaining the rapid spread of plague and cholera in Asia by the national characteristics of the Asian peoples, noting that the main reasons are to be found in the various national and social conditions affecting the life of the people.

The ideas on landscape parasitology (landscape epizootology), first put forward and expounded in detail by Soviet researchers, are of particular relevance to the teaching on the geography of infectious diseases of man. In 1919 K. I. Skryabin (together with Zakharov) set before Soviet helminthologists the task of making a comprehensive study of helminth geography in Russia and suggested ways of doing so, describing the helminthic flora of Donetsk Oblast by way of illustration. On the basis of the factual data accumulated on the prevalence of helminths, Skryabin in 1923 stated that the lives of parasitic worms are inseparably bound up with the natural conditions in their habitat. Accordingly, as Skryabin emphasized, one can speak of the specific helminthic fauna of steppe, desert, tundra, taiga, etc. The correctness of this view was later demonstrated by Ye. S. Shul'man (1945) in an extensive work Gel'mintozy naseleniya razlichnykh geograficheskikh zon Ukrainy (Helminthic Diseases of the Population in the Various Geographic Zones of the Ukraine), in A. K. Krotov's book (1955) Paraziticheskiye chervi domashnikh i okhotnich'ye-promyslovykh zhiivotnykh Sakhalina (Parasitic Worms of Domestic and Game Animals of Sakhalin), and by other investigators.

The connection between infections, especially malaria, and certain geographical landscapes was mentioned back in 1925 by V. N. Beklemishev, who pioneered in the field of landscape malariology (V. N. Beklemishev, 1939, 1947; V. N. Beklemishev and P. G. Sergiyev, 1949). Beklemishev's studies played a major control in controlling and eradicating malaria in the USSR. From them were drawn the

principles and methods of landscape-malariological regionalization of large areas in the USSR (G. I. Kanchaveli, 1954; A. Ya. Lysenko et al., 1956; M. G. Bagramyan et al., 1958) and abroad (L. M. Isayev, A. Ya. Lysenko, and Wang Van Ngi, 1965).

In 1930 N. A. Gayskiy pointed out the relationship existing between the occurrence of certain infections and the landscape often to the point where the range of a parasite completely coincides with landscape regionalization units.

However, the main credit for the detailed treatment of the problem of landscape parasitology goes to Ye. N. Pavlovskiy who in 1939 set forth the basic ideas on natural focus diseases. In 1944 he described the most important patterns in the distribution of natural focus zoonoses. He emphasized that such diseases occur exclusively in the lands of certain geographic landscapes and that they are bound up with these lands, but originate independently of man. Formed in wild nature, these foci have potential epidemiological significance. An epidemiologically latent state can be said to exist in a focus as long as human diseases are absent. Once the appropriate conditions arise, however, the focus may become epidemiologically active.

In 1964 Pavlovskiy set forth his thinking on the subject in a systematic fashion in his monograph Prirodnaya ochagovost' transmissivnykh bolezney (Natural Focalization of Transmissible Diseases), which was awarded the Lenin Prize. He convincingly showed that every natural focus of a disease is associated with a definite biocenosis and through it with a distinctive geographical landscape. However, the epidemiological significance of a locality is determined both by the landscape character of the natural foci of the diseases in the populated and cultivated places and by the degree and nature of the contact between the people and the surrounding environment. Pavlovskiy also formulated the principles for ecogeographical and paleogeographical analysis of natural foci of diseases.

Pavlovskiy's theories gained wide recognition and they now constitute the basis for the study of the epizootiology, epidemiology, and geography of natural focus zoonoses. Many of his students and followers like P. A. Petrishcheva, N. G. Olsuf'yev, A. A. Maksimov, V. v. Kucheruk, N. P. Naumov, and A. G. Voronov in elaborating these theories clearly demonstrated that the parasitic system in a particular biocenosis is an inseparable part of a definite geographical landscape. Further support came from Petrishcheva's studies on the natural focus and epidemiological peculiarities of the regions where different landscapes meet.

Many research institutes and teams of scientists worked on problems concerning the geography of zoonoses, zoonoses of domestic and synanthropic animals, and the nosogeography of anthroponoses. In 1946 at the suggestion of P. G. Biryayev, the USSR Academy of Medical Sciences included the geography of infectious diseases in its research program as a subject of all-union significance.

V. N. Beklemishev made an important contribution to the geography of infectious (mostly transmissible) diseases. This distinguished scientist's work on the population structure in the ranges of various causative agents, on comparative parasitology, on the geography of malaria and tick-borne encephalitis and his investigation of the nosogeography of obligate-transmissible diseases of man uncovered the major laws governing the origin and distribution of these diseases.

Pavlovskiy's and Beklemishev's ideas served as a solid foundation for the study of problems in the geography of a variety of natural focus and transmissible infections. Individual nosological forms have been thoroughly studied. N. A. Gayskiy (1930), I. G. Ioffe (1936, 1957), N. I. Kalabukhov (1949, 1961), Yu. M. Rall' (1944-1965), V. V. Kucheruk (1945-1965), N. P. Naumova (1954-1964), and many others studied the geography of plague. Much research in recent years has been conducted on the geography of tularemia (N. G. Olsuf'yev, 1960, 1964; N. G. Olsuf'yev and B. P. Dobrokhotoy, 1965; A. A. Maksimov, 1960; Yu. A. Myasnikov, 1964; others). Considerable progress has been made on the geography of tick-borne encephalitis (M. P. Chumakov and V. D. Solov'yev, 1944; S. P. Karpov, 1955; L. I. Zalutskaya, 1959; V. M. Netorov and L. M. Ivanova, 1965; others), mosquito encephalitis (V. Ya. Podolyan, 1961), North Asian tick-borne rickettsiosis (G. P. Somov, 1966), tick-borne spirochetosis (M. V. Pospelova-Shtrom, 1953-1959); (N. N. Dukhanina, 1959; I. A. Moskvin, 1960; P. A. Petrishcheva, 1961; others), cutaneous leishmaniasis (P. A. Petrishcheva, 1946-1962; P. B. Kozhevnikov, N. V. Dobrotvorskaya, N. I. Latyshev, 1947; others), rabies (M. A. Selimov, 1962; B. A. Kantarovich, 1965), and several other zoonoses.

It is worth noting that for a long time investigators were engaged in inventorying natural foci so that study of the geography of natural focus zoonoses was limited mostly to investigating the ranges of their causative agents. This material is exceptionally important for understanding the geography of this group of infections. Pavlovskiy emphasized the fact that the distribution and structure of the natural foci of diseases are the basis of the nosogeography of natural focus zoonoses. This approach helps to uncover both the regions that have manifested themselves epidemiologically

and the regions which contain natural foci but have not manifested themselves epidemiologically. Ecologoparasitological and microbiological analysis of the conditions in which natural foci exist helps to establish the indices by which one can ascertain the existence of natural foci in regions where the corresponding diseases have not hitherto been observed in human beings.

This approach also led to the virtual disappearance of the epidemic process from the visual field of the investigators. As a result, Beklemishev noted (1961) that the epizootiology and geography of natural foci of infections were accorded full attention for a long time, while the study of epidemiology was largely fragmentary. Regarding the epidemic process as an interaction between groups of people and the population of the causative agent, Beklemishev (1961) suggested that the nosogeography of transmissible diseases be handled from the standpoint of the formation of populations of the causative agent among human associations. He regarded the foci of infection in terms of a complex spatial and functional differentiation into enzootic foci, formed in natural biocenoses or inhabited localities among animal hosts, and foci formed among associations of people ("pseudofoci" in "dead-end" zoonoses and dependent foci in zoonoses whose causative agents can at some time circulate among human beings). Beklemishev stressed the fact that the study of dependent foci (e.g., foci of cutaneous leishmaniasis of the rural type in inhabited localities) and "pseudofoci" (accumulations of micropopulations of the causative agent among human beings in tick-borne encephalitis or scrub typhus, their epidemiological analysis, and inventory are the best way of ensuring the proper choice of preventive measures and of disinfecting the regions affected. On the basis of these ideas, I. I. Yelkin and V. K. Yashkul' (1966) identified regions of interaction between groups of people and population of the causative agent, calling these "nosofoci".

The causative agents of the commonest and most persistent anthroponoses represent a group of infections whose range is not governed, as a rule, by the law of landscape exclusiveness. Only a few anthroponoses (malaria, several forms of helminthiasis) take root in certain climatic-geographic zones because the prevalence of the causative agents is directly related to the presence of such factors as temperature and geographic range of the transmitters. However, the establishment of even these anthroponoses in given areas is dependent on the distribution of the people and the social and economic characteristics of their way of life, i.e., on environmental factors external to the causative agent which are not governed by the law of landscape exclusiveness. The geography of the population and the development of economic regions are determined by the increased production of material goods, the creative and transforming

role of which in the evolution of human society was demonstrated by the classics of Marxism-Leninism. The physical and geographic characteristics of the environment are of secondary importance in the spread of most anthroponoses, for they influence for the most part only the morbidity rate, seasonal fluctuation, and some other epidemiological indices. Study of the nosogeography of these anthroponoses must obviously be based on principles and methods different from those used in studying the nosogeography of natural focus zoonoses and some transmissible anthroponoses.

Summaries and maps based on statistical data are of undoubted value in promoting the nosogeography of anthroponoses. O. V. Baroyan (1962, 1967) made full use of them in his Ocherki po mirovomu rasprostraneniyu vazhneyshikh zaraznykh bolezney cheloveka (Essays on the World Distribution of the Most Important Infectious Diseases of Man). Of value too are the studies on the geographic distribution of individual nosological forms -- influenza (O. V. Baroyan, 1956; V. M. Zhdanov, 1964; others), smallpox (O. V. Baroyan and A. F. Serenko, 1960; N. I. Makarov, et al., 1962), cholera (Ye. I. Korobkova and L. F. Zykin, 1966; others), typhoid and paratyphoid (Yu. P. Solodovnikov, 1964, 1965), malaria (A. I. Yakusheva, 1956; M. G. Rashina, 1959; L. I. Prokopenko and N. N. Dukhanina, 1964), and others. However, these works are not all adequately grounded on a detailed causal analysis of the geographic distribution of anthroponoses. Yet, as Beklemishev (1959) emphasized, it is not enough for us to know about the nosoareals, we must understand them.

The principles of causal analysis of the geographic distribution of anthroponoses were established in recent years by Soviet investigators. Of particular interest are Beklemishev's ideas (1961) on the population structure in the ranges of the etiologic agents of anthroponoses. Beklemishev showed that populations of parasitic organisms are a true territorial phenomenon. Owing to the fragmentation of the habitat of the causative agents of anthroponoses (especially by human settlements), the parasite populations, in Beklemishev's view, are physically separated. However, the functional isolation that can easily be traced in populations of the etiologic agents of natural focus zoonoses is not very apparent in the etiologic agents of anthroponoses because of the unusually intense passive migration. Thus, an organic species, the etiologic agent of a specific anthroponosis, is normally represented by a vast and functionally more or less single superpopulation. The functional isolation of its individual parts may be due solely to the enormous size of the superpopulation in remote parts of which biological processes may occur quite independently of one another. The physical separation of the individual parts of such a superpopulation may give rise to functionally interrelated subpopulations capable of independent existence (independent populations).

I. I. Yelkin and V. K. Yashkul' (1963-1967) undertook to elaborate Beklemishev's ideas on the focalization of anthroponoses. They put forward the view that these infections persist in epidemic foci (individual inhabited localities) in which the etiologic agent multiplies continuously.

Regional epidemiology has also played an important part in advancing the teachings on the distribution of human infectious diseases. Pavlovskiy (1944, 1954, 1956) thinks that the geography of diseases can be studied not only by determining the factors in the geographic distribution of the individual nosological forms (i.e., nosogeography), but also by ascertaining the medicogeographic state of the individual regions. This approach was given the name of regional epidemiology back in the 1930s.

After the victory of the Great October Socialist Revolution the tasks assigned to Soviet public health made it necessary to study in detail the pathology of the various areas of the country and to generalize the experience gained in the struggle against disease. Antiepidemic practice required a clarification of the causes and characteristics of the epidemiology of formerly unknown infectious diseases discovered within the various regions. This subsequently led to the view among investigators that regional pathology is a branch of science concerned only with diseases of limited spread ("natural endemic" diseases). However, the studies of the Soviet epidemiological school, which laid a firm foundation for materialistic ideas in epidemiology, showed that the physical conditions of the life of society are the moving forces in the epidemic process. They also demonstrated that the development of the epidemic process is affected by the concrete conditions of the geographic environment, which sometimes are responsible for the peculiar spread of infections within individual regions.

In view of the parasitic nature of the causative agents as exogenous environmental factors and the characteristics of the distribution of infections in relation to the existing causative agents, I. I. Yelkin (1951) suggested that regional epidemiology be made a special branch of regional pathology. Regional epidemiology, according to Yelkin, should: (i) uncover the laws of movement of infectious morbidity under the specific conditions of a particular region, city, or oblast; (ii) elucidate the characteristics of the epidemiology and clinical aspects of infectious diseases still prevalent; (iii) study the factors that help to maintain morbidity at a given level; (iv) devise effective preventive measures with due regard for the course of the epidemic process in a given region. "It would be wrong," Yelkin wrote, "to reduce the problem of regional epidemiology to the study of natural focus diseases or

diseases of limited spread alone." Sh. D. Moshkovskiy (1957) thinks that the study of the "susceptibility" of infectious diseases in a particular locality to certain chemical agents ("regional chemotherapy") should be part of regional epidemiology. A thorough knowledge of regional epidemiology is the scientific basis for effective prevention and eradication of infectious diseases in a given locality.

Of importance in studying regional epidemiology are the views advanced by Pavlovskiy and Petrishcheva on interrelated foci of natural focus diseases, the existence of two or more natural foci of different diseases (e.g., tropical ulcer, tick-borne spirochetosis, and plague in Central Asia) on the same territory within a particular geographic landscape. These views provide a solid scientific foundation for the development of medical landscape science and they are of value in systematic efforts to prevent these diseases by the use of associated vaccines.

Soviet investigators have done a great deal of work in recent years on the medicogeographic description of foreign countries and territories. The geography of infectious diseases is an essential element of such descriptions. The work is coordinated by the medical geography division (Leningrad) and medical geography committee (Moscow) of the Geographic Society of the USSR. Several collections such as the Geograficheskiy sbornik (Geographical Collection), No. 14, 1961, Meditainskaya geografiya tropicheskikh stran (Medical Geography of Tropical Countries), 1965, etc. and some journals have published detailed medicogeographic characteristics of foreign and especially developing countries. The first original Soviet medicogeographic maps of foreign lands showing the distribution of infectious diseases have already been compiled ("Medicogeographic Classification of African Territories", "Schistosomiasis in Africa", "The Risk of Malarial Infection in Africa," etc.). Medicogeographic descriptions of individual regions, establishment of the distribution of human infectious diseases therein, and the underlying factors are of primary significance in the development of regional epidemiology. But this line of research in epidemiological geography cannot be limited to the study of the regional characteristics of the prevailing infections (epidemiological complexes). A major task of regional epidemiology is the typing of epidemiological complexes and determination of the nature and causes of the spread of similar epidemiological complexes over the earth (A. A. Keller, 1965; A. Ya. Lysenko, 1965; I. I. Yelkin and V. K. Yashkul', 1965, 1966).

The development of epidemiological geography is directly connected with the evolutionary, historical approach to the study of the problems involved. In biology the historical method was

most fully elaborated by K. A. Timiryazev (1922). On the basis of the historical method in epidemiology, V. M. Zhdanov (1953, 1964) made a profound analysis of the directions and stages in the evolution of human infectious diseases. There is no doubt that the use of the evolutionary, historical method in epidemiological geography will promote further advances. It is the principal way of studying regional (historicogeographic) epidemiology (I. I. Yelkin and V. K. Yashkul', 1963-1967).

The works of the geographers engaged in comprehensive study of the environment in relation to socially organized man are highly relevant to epidemiological geography. The studies of the Irkutsk medicogeographers headed by Ye. I. Ignat'yev are particularly important. They provide the scientific basis for the ideas on the natural preconditions of human diseases, which are definite properties of geosystems (natural territorial complexes) that exert or are capable of exerting a beneficial or harmful influence on man's health. Ignat'yev's findings also confirmed the importance of territorial-industrial complexes in the geography of human diseases. Successful research on the relationship between the geographic environment, landscape, and health of the population is essential for the development of epidemiological geography since such research will yield important data on the distribution of the factors responsible for the spread of infectious diseases.

An indicator of the progress made by epidemiological geography is the steady improvements made in the methods used. Among those specially proposed or employed to evaluate the effect of various factors on the prevalence of infectious diseases, we must mention bioclimatograms (Z. I. Martynova and A. V. Kondrashin, 1966) and information analysis (D. K. L'vov et al., 1966).

The introduction of quantitative methods of evaluating the effect of physico-geographic factors on the distribution of infectious diseases has provided epidemiological geography with broad opportunities for moving quickly from the descriptive stage to the stage of logical analysis.

Epidemiological geography is now evolving at a rapid pace. Whereas several decades ago investigators treated the problems on an isolated basis (these problems were generally of secondary importance in the study of the epidemiology and etiopathology of infectious diseases), many present-day Soviet epidemiological geographers are seeking to determine the factors underlying the distribution of human infectious diseases in the Soviet Union and elsewhere in order to assist in the eradication of these diseases as soon as possible.