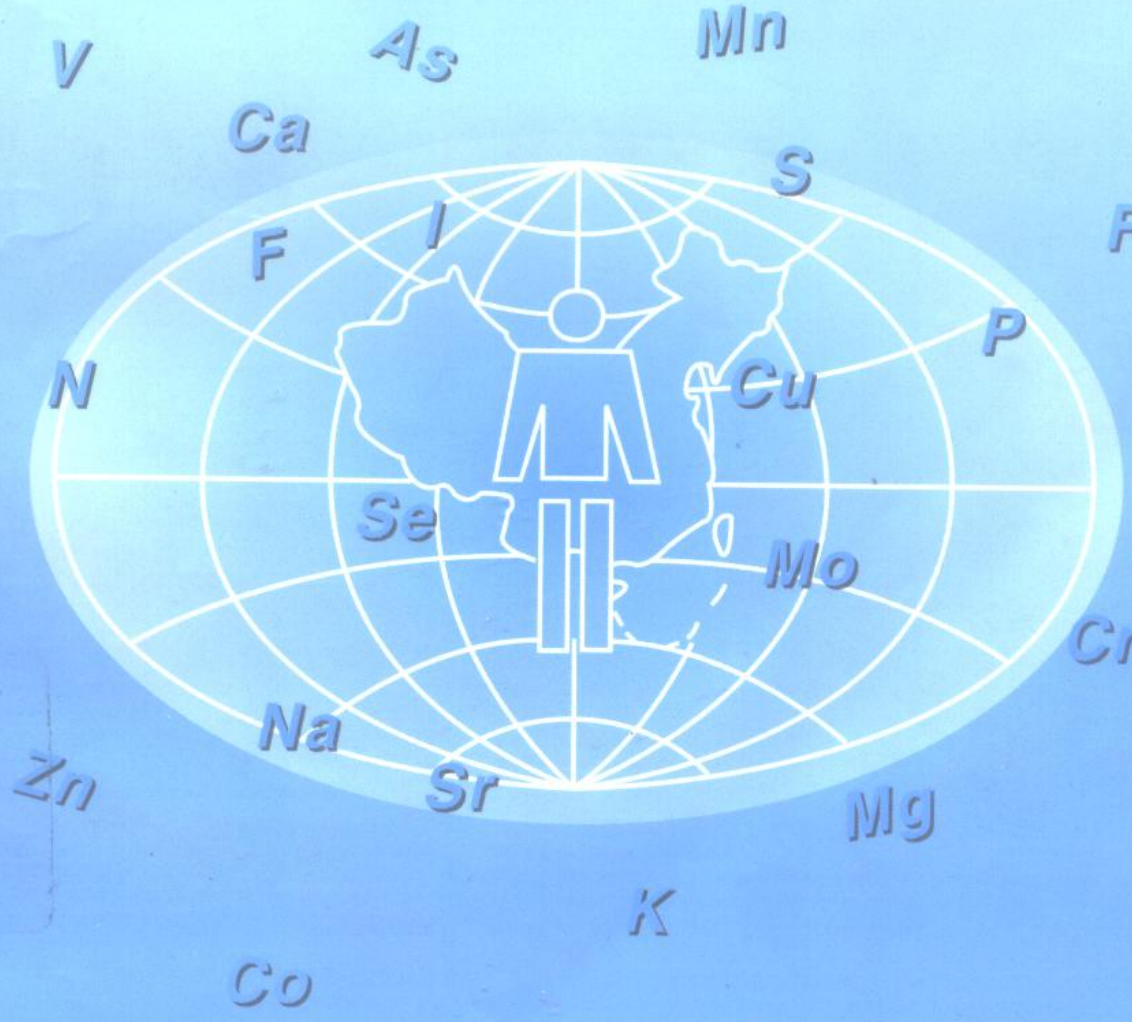
环境生命元素与克山病
——生态化学地理研究

Environmental Life Elements and Keshan Disease
—— A Study on Ecological Chemicogeography

谭见安　主编



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序　言

在竺可桢先生领导下，中国地理学界比发达国家约早30年提出研究地表物理过程、化学过程与生物过程的方向。谭见安教授在60年代积极响应这一号召，投身于化学地理工作，偕同所内同志与医学研究人员通力协作，跋涉修阻，探讨在中国分布很广的克山病因与防治问题，取得了显著的成就，工作告一段落之后，仍存在一些难关，又在"七五"期间，与战友们一起仆仆于荒山野岭，疑难涣然冰释。此书综述多年辛勤的成果，必将大有助于克山病的防治，造福于病区的人民。这反过来也是对研究人员莫大的奖励。同样可贵的是他们在工作中，举一反三，由此及彼，对疾病与环境中生命元素的复杂关系，可以应当如何进行综合研究，曾细细思索，已胸有成竹，一门人类生态化学地理已如日衔东山，冉冉而起。今后循此继续耕耘，一定会取得更丰硕的成果。

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1996.1.15

前　言

克山病病因过去长期不清，病死率极高，防治缺乏针对性的有效方法，在病区造成极大的恐惧感，严重危害着当地人民的生命与健康。在60年代末和70年代期间，由于医学、地学多学科结合，内外环境研究结合，在环境低硒与克山病病因研究和防治方面取得了公认的进展，相对来说，比较全面系统地、内外环境相互映证地揭示了低硒环境与克山病的密切关系。尽管如此，仍有一些问题需要深入研究和探索。其中最普遍关注的是：为何在低硒环境中，自80年代以来各地发病率普遍下降？即使在有些未采取投硒防治措施的地区也有如此趋势。本研究是在以往研究的基础上，从地理生态系统出发，力图对克山病与环境低硒关系的性质作更全面和深入的研究，并探讨环境中与硒复合致病的因素和防治新对策，以期对上述有关问题的解答得到更有力的科学依据。

我们早期的研究已经证实，克山病的分布格局在我国是存在一个病带和两个非病带[1]。病带居中，由东北向西南形成一条断续的长带。两个非病带分布在它的西北、东南两侧。同时，已经证实我国的病带与低硒带的分布相吻合，即两个非病带生态系物质（从土壤--人体）的硒均显著高于病带[2-7]，这是无庸置疑的事实。因此，本专题主要集中研究病带内病区与非病区生态环境中硒等生命有关元素与克山病的关系。属“七五”国家重点科技攻关项目（75-62-03-05）。

研究疾病与环境生命元素的关系，涉及众多的环境要素，彼此交互影响，且因地而异，有明显的地域分异性。因此，环境化学元素对人的作用和影响是错综复杂的。就以环境硒与克山病来说，显然，只分别单独研究岩石、土壤、水、大气、粮食、动物或人发中的硒往往难以完整地说明克山病的发生及其动态变化，必须进行综合系统的研究，才能达到较好的预期目标，故本研究采用了生态化学地理学的主导思想。生态化学地理学主要研究地理生态系统化学元素（物质）的地理分异和生态平衡及其对人和生物的影响，以及改善元素生态平衡，促进人类健康，提高动植物产品数量和质量的途径[8-10]。它的特点：第一，以人为中心，把人与其所处的地理环境作为一个整体（地理生态系统）来研究，研究它们之间的化学联系和物质交换与平衡；第二，地理生态系物质指一定地域系统中人及地理环境各成分的物质总体，一般包括有岩石、风化壳、土壤、大气、水、植物（作物）、动物（牲畜）和人体等一系列物质（它比饮食链更广泛，下延至岩石—风化壳—土壤等，上延至食者本身）；第三，在地理生态系物质的众多化学元素（物质）中，以生命必需元素，生化物质（蛋白质、维生素、酶等）及有害元素（物质）为主要研究对象；第四，同时研究元素输入人体的直接途径和间接途径；第五，研究元素在环境要素间的传输平衡，区域间迁移平衡，人与环境间的供需平衡，最终探讨其循环规律；第六，进行地理生态系物质的匹配采样分析。这种思想和方法是在长期研究地方病与环境生命元素的关系中，于化学地理和地球化学的基础上，根据实际需要吸收和融汇地理学、生态学、流行病学、营养学、生物化学等各学科的思想和原理逐渐形成的，可以说本研究的设计技术路线和方法均与之有关，因此本研究也是一种目的性、针对性和应用性都很强的生态化学地理研究。从更高更广、而且是更深、更远的视角来看，也是发展环境-生命元素学的基础。

本研究结果表明：所研究的各种环境因子中，仍然表明低硒是克山病发生的主要因素；同时从全国范围内证实，克山病病情从80年代以来的普遍下降与人体摄硒水平的普遍提高有关，这对于澄清硒与克山病关系方面当前存在的某些疑问提供了有力的科学依据。并通过多种方法分析，对克山病提出了与环境低硒复合致病的可能因子，使病因研究向前推进了一步。其间除系统分析了生态系物质中的硒以外，还相应地分析了其他24种生命有关元素和水中有机物与克山病的关系。并首次从全国不同地域类型分析了粮食中各种氨基酸的含量水平和分布规律及其与克山病的关系；地理研究所关于低硒环境成因的系列研究，揭示了我国低硒环境的形成机理，为克山病、大骨节病的地理分布规律，硒的生态循环趋向和硒缺乏区的预报治理，提供了理论指导和资料基础，并根据上述研究结果，提出了防治克山病的新对策——经济生态法。在上述研究基础上，本研究还为环境生命元素与生物和健康的理论探讨提供了新资料和新依据。

编　者

1995年7月

Foreword

Keshan disease is an endemic disease with unknown origin, terribly heavy case fatality rate and unavailable efficient measures to it's prevention and treatment in its long history, so the terrible panic from the disease occurrence existed in the people of disease areas, and their health and life were seriously threatened. During the periods of late 1960s and 1970s, due to adopting the technical routine of both combination of multi-discipline research such as Medicine,Geoscience, Chemistry, Biochemistry, Biology and combination of internal and external environment research, generally acknowledged advances have been made in the relationship of low selenium in environment with the cause of Keshan disease and it's control. In other words, the close relation of low selenium environment with Keshan disease had been mutually demonstrated from both studies of internal and external environments. The research results are quite complete and systematic, compared with other studies of aetiology. Even so, some questions remain to be studied and explored further, and the mostly concerned one among them is why from 1980s on, disease incidence of different areas has been decreasing universally, and even in those areas where the measure of selenium supplementation had not been adopted, such trend exists as well. On the basis of preceding research results and from the view point of geographical ecosystem, present study tried to further study the property of Keshan disease occurrence in relation to low selenium environment, and to explore other possible factors in environment which cause disease by combination with low selenium, finally to find new ways to the prevention and treatment of Keshan disease. It should be expected that more reasonable scientific proofs may be provided to answer the questions remained.

In our previous study, it has been proved that one disease belt and two non- disease belts existing in China make up the main distribution pattern of Keshan disease. The disease belt locates in the middle, and forms an intermittent long belt running from Northeast to Southwest of China and two non- affected disease belts lie on both northwest and southeast sides of it. At the same time,it had been verified that the distribution of disease belt in our country coincides well with that of low selenium belt, and selenium content level in ecosystem substances(from rock- soil to human tissuses) in two non-disease belts are usually higher than that of disease belt significantly. Present study, therefore, puts its emphysis on the study of life related elements, including selenium, in ecological environment of both disease and non-disease areas and their relation with Keshan disease.

With regards the relationship of diseases and their environmental life elements, a lot of environmental factors, which affects each other and have significant regional differentiation,are involved. Consequently, the influence and effects of chemical elements in environment on human health are complex. As so far as environment selenium in relation

to Keshan disease is concerned, apparently, it is not complete to explain the occurrence and dynamical variation of Keshan disease if only by respectively, alonely and simply using selenium status in rock, soil, water, air, grain, hair or bio-tissue, not by comprehensively and integrately using them. To approach the expected result,comprehesive and systematic research must be carried out. The guide idea of ecochemicogeography was adopted in this research. Ecochemicogeography, as a discipline, is mainly dealt with geographical differentiation and ecological balance of chemical elements in geographical ecosystem(geo-ecosystems) and their impacts on human kind and organisms, ultimately, the ways to improvement of ecological balance of elements, promotion of man's health and to raising the quality of plant or animal products as well as increasing their quantity. Its main features are as follows. Firstly, regarding man as a natural product, ecochemicogeography takes the studies of man and geographical environment as a whole body(geoecosystem), so that it could study directly the chemical correlation between man and environment and their exchange / balance of materials and energy. Secondly,ecosystem materials mean especially the sum of substances from human and each component of geographical environment in a specific region landscape including a series of such materials as parent rocks, weathering crusts, soil, air, water, plants(crops), animals(livestocks), and human body, etc. Apparently,Its notion is more wider than food chain,for its top layer has get up to human body itself. Thirdly, among so many chemical elements in geo- ecosystem, it consider such materials as essential elements and toxical elements(matters) and some biochemical matters(eg. protein, vitamines, enzymes, etc.), as its main studying objects. Fourthly,the direct and indirect pathways of elements entering into human body should be studied simultaneously. Fifthly, by studying such three balances as element transportation balance between environmental components, element migration balance between regions and the element balance of demand and supply between human and environment, then the element eco-cycle laws could be deepened. Sixthly, implementing match sampling and assays to geo- ecosystem materials are important for studying element cycle in geo-ecosystem and their effects on health. After long term study in endemic diseases and their relation with environmental life elements,on the basis of chemicogeography and geochemistry,and through the absorption and blend of the ideas and methology of such multidisciplines as geography, ecology, biochemistry, epidemiology, nutriology, etc., the new ideas and methods mentioned above have been formed in practical works. It may be said that present research's technical routine design and methods are all relavance to it. So, it is an ecochemicogeographical study with remarkable aim, application, and direction. From the viewpoint of higher position, wider angle and deeper layer, these kinds of studies are building the foundation for new envorinment-life elementology.

The result obtained in present study project showed that, among all environmental factors studied, low selenium still is the most vital factor for causing the disease; At the same time, the national wide scale investigation has proved that the commonly decreasing trend

of Keshan disease status from 1980s on is related to the universally increasing selenium intake of people lived in disease areas. It provides more forceful scientific basis to clarify some questions regarding the selenium in relation to Keshan disease. Futhermore, the possible factors which might combines with low selenium environment to cause diseases have been suggested through multimethod analysis and this is a new step have been put forward in the study of disease cause. In addition to systematic analysis of selenium in ecosystem materials, other 24 life related elements and water organic matters and their relations with Keshan disease have been analysed accordingly. Based on different regional types , the content level and distrbution law of different kinds of amino acides in crops and their relation with Keshan disease has analysed for the first time. A series of studies regarding the genesis of low selenium environment by Institute of Geography, CAS, have revealed the fomative mechanism of low selenium environment in China. It provides the theoretical guide and basic data for explaining the geogrophical distribution law of Keshan disease and Kaschin-beck disease, the trend of selenium ecological cycle and forecast of selenium deficient areas. Finally, according to the results mentioned above, a new way to prevent and cure Keshan disease, eco-economic measure, has been suggested. So, on the basis of them,new scientific materials and bases have been provided for the theoretical study on environmental life elements, organisms and health.

Editor
July 1995

目　录

CONTENTS