Известия НАН Армении. Математика, том 44, н. 1, 2009, стр. 8-16

SOME MATHEMATICS

K. KRICKEBERG

Basically, I was a geometer. I liked to, and often had to, visualize mathematical objects and relations when learning about a new topic or area, and when trying to solve problems. Thus Erhard Schmidt was the perfect teacher for me. He introduced me to complex functions via the geometrical Riemann approach and to measure theory in the geometrical spirit of Caratheodory; see also 'My encounters with martingales' in this volume.

It was therefore natural that the subject of my Doctoral Thesis, viz. the Gauss-Stokes integral theorems, combined measure theory and geometry. Part 1 [3] was motivated by the desire to obtain the classical Gauss-Green formula in $\mathbb{R}^d$ under conditions that are necessary, too. This led me to a different way of looking at the theorem. For example, given an open set G in $\mathbb{R}^d$ with boundary F, necessary and sufficient conditions on G were found for the existence of a measure m on F (generalizing the $(d-1)$-dimensional surface measure) and a function s defined on F (generalizing one of the components of the outer normal to F) with which the formula holds for all functions defined on the closure of G such that the integrals in question make sense. Here, m and s determine each other uniquely except for trivial modifications.

Part 2 [4] contains the first definition and study of locally Lipschitzian manifolds, which were to be investigated in the sequel by several topologists. They are situated between continuous and differential manifolds, allow a natural definition of 'almost everywhere', and are indeed differentiable almost everywhere. StokesŸ theorem is proved for differential forms on locally Lipschitzian manifolds under minimal assumptions.

Finally, part 3 [5] is purely historical. It traces the ideas underlying the proofs of the various forms of the Gauss-Stokes theorems, starting with early papers by

Lagrange (1760), Gauss (1813), Green (1828), Ostrogradsky (1831 and 1838), and Stokes (1854).

The paper [12] took the Gauss-Green theorem up again, but under a very different angle, viz. via distributions in the sense of Laurent Schwartz. As the main tool it employed the decomposition of measures that was to play once more a decisive role in the solution given in [31] of a problem formulated by Rollo Davidson.

Let $\mathcal{D}$ be a linear differential operator in $\mathbb{R}^d$ and f a locally integrable function defined on $\mathbb{R}^d$. A necessary and sufficient condition is given in order for $\mathcal{D}f$, in the sense of Schwartz, to be a measure. This generalizes the theorem concerning the case $d = 1$ whereby the derivative of f is a measure if and only if f is locally of bounded variation (more precisely: almost everywhere equal to such a function, but this fine point will be disregarded in the sequel).

Four applications of this theorem are given. Firstly, it allows one to get an insight into the nature of the various definitions of functions of bounded variation of several variables. These definitions looked rather arbitrary before and are not equivalent. It turns out that they simply correspond to different differential operators $\mathcal{D}$. In particular, f is locally of bounded variation in the sense of Tonelli if and only if its d first partial derivatives are measures. For comparison (not proved in [12]), f is locally of bounded variation in the sense of Vitali if and only if the derivative of f with respect to all variables $x_1, \dots, x_d$ together, i.e. $\frac{\partial f}{\partial x_1, \dots, \partial x_d}$, is a measure.

The second application deals with the concept of an absolutely continuous function in the sense of Tonelli. It is proved that f has this property if and only if its d first partial derivatives are functions.

Thirdly, a very general form of the Gauss-Green formula for any open subset G of $\mathbb{R}^d$ follows immediately from the Schwartz definition of a first derivative of the indicator function f of G. This derivative is a Schwartz distribution carried by the boundary of G. The usual form of the formula, similar for example to that discussed in [3], is obtained when this derivative is a measure, and the third application of the theorem above consists in necessary and sufficient conditions on G in order that this be the case.

The last application concerns the Lebesgue surface measure a of a non-parametric surface in $\mathbb{R}^{d+1}$ given by $x_{d+1} = f(x_1, \dots, x_d)$ where f is defined and locally integrable in an open subset G of $\mathbb{R}^d$ but not necessarily continuous. Let l be the Lebesgue measure in G. Then, a is finite if and only if $l(G)$ is finite and f is of bounded variation in the sense of Tonelli. In this case, a is the total variation of the vector measure $(l, m_1, \ldots, m_d)$ where m_i denotes the $i - th$ partial derivative measure of f. This generalizes the classical formula, which holds for an absolutely continuous function f.

The article [22] deals with stochastic convergence of generalized sequences of random variables (nets, Moore-Smith sequences). While every ordinary sequence that converges stochastically contains an almost surely convergent subsequence, it is shown, among other results, that the analogous statement is not true for nets: there exist stochastically convergent nets that have no essentially convergent subnets.

The papers [24, 25, 27, 28] were originally motivated by a problem stated by Eberhard Hopf in §17 of his classical book on ergodic theory 'Ergodentheorie (Springer 1937)'. While the so-called baker's transformation in the unit square was well understood, and in particular known to be mixing, the nature of the corresponding transformation in the entire plane was hardly elucidated and the problem of its mixing properties open.

The main contribution of [24] is twofold. Firstly, it was recognized that the natural setting for defining mixing properties of transformations (endomorphisms) of measure spaces with *infinite* total measure are *topological* measure spaces, not pure (abstract) measure spaces, and the endomorphisms in question are to be not only measure preserving but also *almost everywhere continuous.*

Examples come from the theory of Markov chain whose state space $\mathbb{Z}$ is a set of integers such that there exists a positive invariant measure l on $\mathbb{Z}$. The measure l together with the given transition probabilities determines a measure m on the space X of all 'trajectories', i.e. all sequences $(x_n), n = 0, \pm 1, \pm 2, \ldots$ with x_n in $\mathbb{Z}$, topologized by the product topology where each factor $\mathbb{Z}$ is discrete. Then, the shift transformation T in X is a homomorphism of the topological measure space (X, m). It turns out that the strong ratio limit properties of the original Markov chain as defined by Kai Lai Chung and Pruitt are intimately connected with mixing properties of T. Next, isomorphisms in the sense of topological measure spaces are defined as maps that are measure preserving and *almost everywhere* continuous in both directions. The second main contribution of the paper is the construction of isomorphisms between a subset Y of the plane endowed with (infinite) Lebesgue measure and the measure space (X, m) derived from a suitable Markov chain as above, such that, for example, the baker's transformation in Y corresponds to the shift T in X . By applying known results from the theory of Markov chains to T, one finally obtains a precise description of the type of mixing including the ergodic index of the baker's transformation.

The paper [25] deals with the question of the abundance or paucity of mixing transformations of an infinite topological measure space (X, m) in the space of all measure-preserving transformations of (X, m), endowed with the weak topology. Analogously to the case of a finite measure m, it turns out that the set of all mixing transformations is dense but of first category.

The isomorphisms constructed in [24] with a view of solving a specific problem then gave rise to a general reflection on the role of topological measure spaces in integration and probability theory. Bourbaki's dogma that the only reasonable measure theory is the one in locally compact spaces had already been contested because, while it is true that the measure spaces used in the representation of stochastic processes often have a natural topology, this topology does not make them locally compact; they are mostly Polish spaces. Nevertheless, it was shown in [27] and [28] that these topological measure spaces are usually isomorphic to the Lebesgue measure in the unit interval. The isomorphisms as defined above form the natural category of isomorphisms of topological measure spaces. They preserve neither the dimension of the space in any sense nor local compactness. If, finally, we recall LebesgueŸs classical theorem to the effect that a bounded function defined in an interval is Riemann integrable if and only if it is almost everywhere continuous, we see that the natural setting for Riemann integration is a general topological measure space, in contrast to Lebesgue integration that belongs to abstract measure theory. The isomorphisms defined above preserve Riemann integrability and the Riemann integral.

In the paper [31] the method of decomposition of measures was used to solve a problem posed by Rollo Davidson about the correlation measure **g** of a second order line process in the plane. He had proved that if **g** is stationary (isotropic, i.e. invariant under rotations and translations), it is also invariant under reflections provided that it has a density with respect to the Lebesgue measure, the so-called **g**−function. He had asked whether the latter assumption was superfluous; the answer given in [31] is affirmative.

Davidson had also stated a conjecture to the effect that every non-degenerate strictly stationary second order line process in the plane is a Cox (doubly stochastic) process. Much later, Olav Kallenberg constructed a counterexample but Davidson showed that for every second order line process with stationary correlation measure which has a density, there exists a Cox process with the same correlation measure. This was extended in [34] to higher order point processes in a fairly general space $X$and an equally general transformation group G acting in X. Let k be a positive integer. Then for any point process in X with a locally finite $G-$invariant $k-th$ moment measure there exists a Cox process that has the same $k-th$ moment measure.

The paper [32] had already supplied some techniques needed to deal with these problems. It also initiated the use of functional analytic methods in the theory of point processes, to be elaborated in [41], [45] and [55]. These allow, for example, to derive the Radon-Nikodym integrand of a point process with respect to another one in a very simple and transparent way, and to investigate more easily certain problems around Palm measures.

In [54] and [55] there is a proof, using conditioning arguments, of the general $'0-\infty\ law'$ of stochastic geometry. Given a stationary (translation invariant) point process in $\mathbb{R}^d$ and a positive integer k, let C be any set of '$k-$configurations', i.e. a subset of $(\mathbb{R}^d)^k$, which is invariant under the 'diagonal'translation group (maps of the form $(x_1,\ldots,x_k)\longmapsto(x_1+u,\ldots,x_k+u)$). An example: $k=2$ and $C=\{(x,y):|x-y|\geq 1\}$. Then the realizations of any stationary point process in $\mathbb{R}^d$ contain are almost surely no or infinitely many configurations of C. Rollo Davidson has treated a particular case by L^2-methods for stationary second order processes having a $\mathbf{g}-$function.

Finally, problems around the statistical analysis of point processes were treated in the book [41] and in a series of papers, in particular [44], [45], [54] and [55]. They culminated in the construction of unbiased estimators of moments of point processes that are only assumed to be translation invariant but not stationary; such processes often appear in applications. The main problem is the correction of edge effects.

Список литературы

[1] K. Krickeberg, "Zur Theorie des oberen und unteren Integrals," Math. Nachr. **9**, 86-128 (1953).
[2] K. Krickeberg, "Darstellungen oberer und unterer Integrale durch Integrale meßbarer Funktionen," Arch. der Math. **6**, 432-436 (1953).
[3] K. Krickeberg, "Über den Gaußschen und den Stokesschen Integralsatz. I," Math. Nachr. **10**, 261-314 (1953).
[4] K. Krickeberg, "Über den Gaußschen und den Stokesschen Integralsatz. II," Math. Nachr. **11**, 35-60 (1954).

[5] K. Krickeberg, "Über den Gaußschen und den Stokesschen Integralsatz. III," Math. Nachr. **12**, 341-356 (1954).

[6] K. Krickeberg, "La nećessite de certaines hypothèses de Vitali fortes dans la théorie de la dérivation extreme de fonctions d'intervalle," C. r. Acad. Sci. Paris **238**, 764-766 (1954).

[7] Charakterisierung oberer und unterer Integrale durch Additivitäts- und Mittelwerteigenschaften. Math. Zeitschr. 61, 374-385 (1955)

[8] K. Krickeberg, "Über die asymptotische Darstellung der Aufspaltung von Paaren benachbarter Eigenwerte der Differentialgleichung der Sphäroidfunktionen," Z. angew. Math. Phys. **6**, 235-238 (1955).

[9] K. Krickeberg, "Extreme Derivierte von Zellenfunktionen in Booleschen σ-Algebren und ihre Integration," S.-ber. Bayer. Akad. Wiss., math.-naturw. Kl. **19**, 217-279 (1955).

[10] K. Krickeberg, "Convergence of martingales with a directed index set," Trans. Amer. Math. Soc. **83**, 313-337 (1956).

[11] K. Krickeberg, "Stochastische Konvergenz von Semimartingalen," Math. Zeitschr. **66**, 470-486 (1957).

[12] K. Krickeberg, "Distributionen, Funktionen beschränkter Variation und lebesguescher Inhalt nichtparametrischer Flächen," Ann. Mat. pura appl. **44** (IV), 105-133 (1957).

[13] K. Krickeberg, "Stochastische Derivierte," Math. Nachr. **18**, 203-217 (1958).

[14] K. Krickeberg, "Semi-martingales *à* base filtrante décroissante, Le calcul des probabilités et ses applications," Paris, 15-20 juillet 1958. Colloques internationaux du CNRS LXXXVII, 133-138 (1959).

[15] K. Krickeberg, "Absteigende Semimartingale mit filtrierendem Parameterbereich," Abh. math. Sem. Univ. Hamburg **24**, 109-125 (1960).

[16] K. Krickeberg, "Notwendige Konvergenzbedingungen bei Martingalen und verwandten Prozessen," Trans. 2nd Prague Conf. Information Theory, Statist. Decision Functions, Random Processes, Liblice, June 1 to 6, 1959, 279-305 (1960).

[17] K. Krickeberg, "Allgemeine Theorie der reellen Funktionen," "Differential- und Integralrechnung," and "Ergodentheorie" in: Mathematisches Wörterbuch (Berlin-Stuttgart, Teubner, 1961).

[18] K. Krickeberg, and C. Pauc, "Martingales et dérivation," Bull. Soc. Math. France **91**, 455-544 (1963).

[19] K. Krickeberg, *Wahrscheinlichkeitstheorie* (Stuttgart, Teubner, 1963). English translation by the author: *Probability Theory* (Reading, Mass., Addison Wesley, 1965). Spanish translation: *Teoria de la Probabilidad* (Barcelona, Teide, 1973).

[20] K. Krickeberg, "Convergence of conditional expectation operators (in Russian)," Teor. Verojatn. Primen. **9**, 595-607 (1964).

[21] K. Krickeberg, "Wahrscheinlichkeitsoperatoren von Verteilungen in Vektorräumen," Trans.3rd Prague Conf. Information Theory, Statist. Decision Functions, Random Processes, Liblice, June 5 to 13, 1964, 441-452 (1964).

[22] K. Krickeberg, "Bemerkungen zur stochastischen Konvergenz," Bull. Soc. Math. Greece **5**, 81-92 (1964).

[23] K. Krickeberg, "On Cramer's theorems concerning weak convergence of distributions," Metrika **10**, 179-181 (1966).

[24] K. Krickeberg, "Strong mixing properties of Markov chains with infinite invariant measure," Proc. Fifth Berkeley Symp. Math. Statist. Probability 1965, **II** (2), 431-446 (1967).

[25] K. Krickeberg, "Mischende Transformationen auf Mannigfaltigkeiten unendlichen Maßes," Z. Wahrscheinlichkeitstheorie verw. Gebiete **7**, 235-247 (1967).

[26] K. Krickeberg, "Markoffsche Ketten," Der Math. u. Naturw. Unterricht **20**, 337-342 (1967).

[27] K. Krickeberg, "Ein Isomorphiesatz über topologische Maßräume," Math. Nachr. **37**, 59-66 (1968).

[28] W. Böge, K. Krickeberg, and F. Papangelou "Über die dem Lebesgueschen Maß isomorphen topologischen Maßräume," Manuscripta math. **1**, 59-77 (1969).

[29] K. Krickeberg, "Recent results on mixing in topological measure spaces," in: Probability and Information Theory, Proc. International Sympos. McMaster University, Canada, April 1968, Lecture Notes in Mathematics **89** 178-185 (1969).

[30] K. Krickeberg and H. Urmitzer, translation of the book Yu. V. Prohorov, Yu. A. Rozanov, *Probability Theory* from Russion into English (Berlin-Heidelberg-New York, Springer, 1969).

[31] K. Krickeberg, "Invariance properties of the correlation measure of line processes," Izvestija Akad. Nauk. Armjan. SSR, Ser. Matematika **5**, 251-262 (1970). Reprinted in: Stochastic Geometry (ed. E. F. Harding and D. G. Kendall), 76-88 (New York: Wiley 1974).

[32] K. Krickeberg, "The Cox process," Symp. Math. 9, Calcolo Probab., Teor. Turbolenza **9** 151-167 (1972).

[33] K. Krickeberg, "Theory of hyperplane processes," 514-521 in: Stochastic Point Processes (ed. P.A.W. Lewis), (New York, Wiley, 1972).

[34] K. Krickeberg, "Moments of random measures," Probability and Information Theory II, Lecture Notes in Mathematics **296**, 70-101 (1973). Reprinted in: Stochastic Geometry (ed. E.F. Harding and D. G. Kendall), 89-113, (New York, Wiley, 1974).

[35] K. Krickeberg, "Statistical analysis of hyperplane processes," International Conference on Probability Theory and Mathematical Statistics. Vilnius, 335-338, 1973.

[36] K. Krickeberg, *Fundamentos del Analisis Estadistico de Procesos Puntuales* (Santiago de Chile, CIENES, 1973).

[37] K. Krickeberg, "L'estimation du spectre de processus de droites," Ann. Scient. Univ. Clermont, ser. Math. **51**, 35-42 (1974).

[38] K. Krickeberg und A. Zassenhaus, "Mathematik in der Demokratischen Republik Vietnam," Blätter für Deutsche und Internationale Politik **4**, 3-11 (1975).

[39] B. Booss und K. Krickeberg, *Mathematisierung der Einzelwissenschaften* (Basel-Stuttgart, Birkhäuser, 1976).

[40] K. Krickeberg, "An alternative approach to Glivenko-Cantelli theorems," Empirical Distributions and Processes. Lecture Notes in Mathematics **566**, 57-67 (1976).

[41] K. Krickeberg, *Lectures on Point Processes* [in Vietnamese] (Hanoi, Mathematical Institute 1976).

[42] K. Krickeberg, "Glivenko-Cantelli theorems in geometrical statistics," Second Vilnius Conference on Probability and Mathematical Statistics, 117-118 (1977).

[43] K. Krickeberg and H. Ziezold *Stochastische Methoden* (Berlin-Heidelberg-New K. York, Springer, 1977). 2nd ed. 1979, 3rd ed. 1988, 4th completely revised ed. 1994. Translation into French: *Méthodes Stochastiques: Introduction aux Probabilités et a la Statistique* (Collection DIA, Paris: Diffusion Berlin, 1980).

[44] K. Krickeberg, "Statistics of point processes," Advances Appl. Probab. **10**, 267-268 (1978).

[45] K. Krickeberg, "Statistical problems of point processes," (in Polish) Rosz. Pol. Tow. Mat., Ser. III, Mat. Stosow. **13**, 29-57 (1978). English version: Banach Center Publications **6**, 197-223 (1980).

[46] K. Krickeberg, "Analyse statistique des processus spatiaux," Inf. Sci. Hum. **40-41**, 179-186 (1979).

[47] K. Krickeberg, "Filtering spatial processes," Advances Appl. Probab. **11**, 256-266 (1979).

[48] K. Krickeberg, "Vision conjunta de la estadistica," 14 p. XXVIII Convenciyn Anual de la Asociaciyn Venezolana para el Avance de la Ciencia, Maracay (1978). Translated into English by the International Statistical Institute, Den Hague (1979).

[49] K. Krickeberg, "La Sociedad Bernoulli," Boletin Informativo de la Regional Latinoamericana de la Sociedad Bernoulli para la Estadнstica Matematica y la Probabilidad, **1** 7-13 (1980).

[50] K. Krickeberg, "Statistics, a bridge between reality and mathematics," (in Vietnamese) Tвp chi thфng ke (Statistical Review) **5**, 34-39 (1980).

[51] K. Krickeberg, "Role of Jerzy Neyman in the shaping of the Bernoulli Society," Mathematical Statistics and Probability Theory (Proc. Sixth International Conf., Wisla, 1978). Lecture Notes in Statistics 2, xx-xxii. (New York, Springer, 1980).

[52] K. Krickeberg, “Moment analysis of stationary point processes,” Colloquia Mathematica Societatis Janos Bolyai, Point Processes and Queuing Problems, Keszthely (Hungary), **24**, 227-229 (1981).

[53] K. Krickeberg, “Quelques résultats récents de la statistique géométrique. Pp. 171-176 in: Proceedings of the 6th Conference on Probability Theory, 10-15 September 1979, Brasov. Bucarest 1981

[54] K. Krickeberg, “El papel de los procesos puntuales en la estadнstica. Simposio de probabilidades y Estadнstica, Universidad Simon Bolivar, Caracas 1980

[55] K. Krickeberg, “Processus ponctuels en statistique,” Ecole d’Eté de Probabilités de Saint Flour X - 1980. Lecture Notes in Mathematics, **929**, 206-313 (1982).

[56] K. Krickeberg, “Reasonable structures for mathematical activities in developing countries (in Danish),” Proceedings of the National Meeting of the Danish Mathematical Society, Vejle (1981).

[57] K.X. Dinh, K. Krickeberg, and T.T. Nguyen, “A contribution to the application of statistical sampling survey methods to the study of the situation of shigellosis (in Vietnamese),” Y hoc Viet Nam (Vietnamese Medicine), 43-46, (1982).

[58] K. Krickeberg, “Bernoulli Society,” 219-220 in: Encyclopedia of Statistical Sciences, Vol. 1. (New York, Wiley 1982).

[59] K. Krickeberg, “La statistique medicale, vue par un statisticien-mathematicien,” Seminaire de Statistique Médicale, Université de Paris V, 1987-88, 1-28. Vietnamese version in: Tailieu tham khao cho thay thuoc (Reference Materials for Physicians), november, 102-135 (1989).

[60] K. Krickeberg, “Zeitschrift für Wahrscheinlichkeitstheorie und verwandte Gebiete,” Pp. 668-670 in: Encyclopedia of Statistical Sciences, Vol. 9. (New York, Wiley, 1988).

[61] K. Krickeberg, “Schmetterer und die "Zeitschrift",” Österreichische Zeitschr. für Statistik und Informatik 19, 221-223 (1989).

[62] K. Krickeberg, “Moderne Epidemiologie und ihre Anwendungen,” Leopoldina Reihe 3.35.1989, 149-160 (1992).

[63] K. Krickeberg, “Intégration des soins de santé primaires,” Lecture at the Faculty of Medicine of Phnom Penh, January 1989. Séminaire de Statistique Médicale, Universitéde Paris V, , 45-69 (1989-90).

[64] K. Krickeberg, “Mathematics, and strategies to fight tropical diseases,” Abh. Math. Seminar Hamburg, 1013-1021 (1992).

[65] K. Krickeberg, (organizer) Statistical methods for measuring and analyzing infectious diseases. Lectures by L. Abel, E. Halloran, P. Aaby, with comments by S. Debanne, K. Krickeberg. In: Bull. Intern. Statist. Inst. 54, Proceedings of the 48th Session Cairo, book 1, topic 9, and book 4 (A), 107-112 (1991).

[66] K. Krickeberg, “Statistics, epidemiology, and public health (in Greek),” O Philelevtheros (Nicosia). 8/9/10 July (1993).

[67] K. Krickeberg, “Health Information in developing countries,” Frontiers in Mathematical Biology. Lecture Notes in Biomathematics **100**, 550-568 (1994).

[68] Vo Van Nhan, K. Krickeberg, and C. Fischer “Population and family planning in the provinces of Nghк An and Ha Tinh: a pilot survey,” NCPFP, GTZ: Reproductive Health Survey 1995. Promotion of Family Health in 5 provinces of Vietnam. Hanoi: National Committee for Population and Family Planning of Vietnam and Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ). GmbH. Hanoi, (1995).

[69] K. Krickeberg, “AIDS und Familienplanung in Vietnam,” Vietnam Kurier **3**, 12-13 (1995). Translation of an article in French in Bulletin de lŸAAFV 11 (1995).

[70] K. Krickeberg, *Petit cours de statistique* (Berlin-Heidelberg, Springer, 1996).

[71] K. Krickeberg, “Etude, du point de vue statistique, des rapports sur "La Hague",” Journ. de la Soc. Franзaise de Statist. **140**, 45-51 (1999).

[72] K. Krickeberg, “Statistical methods in primary public health care,” Revista Investigaciyn Operacional **22**, 107-114 (2001).

[73] K. Krickeberg, “Health information systems in developing countries,” Bull. International Statist. Inst. 54th Session Proceedings, Invited Paper Meeting **54** (2003).

[74] K. Krickeberg, "Health information systems," in: H. Becher, B. Kouyatй (eds.) Health Research in Developing Countries, 43-49 (Berlin-Heidelberg, Springer, 2005).

[75] A. Kar, K. Krickeberg, and A. K. Chakraborty, "Epidemiology in developing countries," 1545-1589 in: Handbook of Epidemiology (Berlin-Heidelberg-New York, Springer, 2005).

[76] H. Zeile, K. Krickeberg, "Über Teodor Ryder, Dirigent, in Auschwitz ermordet, und Ida Ryder geb. Voth, Sängerin, im Ghetto von Lydz verhungert," Musica reanimata Ц Mitteilungen **57**, 14-16 (2005).

[77] K. Krickeberg, "Neue mathematisch-statistische Anwendungen von Gesundheitsregistern," Austrian J. Statistics **34**, 403-410 (2005).

[78] *Klaus Krickeberg* Pp. 144-158 in: A. Bödecker and Th. Dunskus (eds.).: Schüler erinnern sich an das Französische Gymnasium 1940-1950. (Berlin, Stapp, 2006).

[79] K. Krickeberg, "Entstehung eines Projekts: Von der Mathematik zum Öffentlichen Gesundheitswesen," VietNam-Info **14** (2), 1-3 (2007).

[80] K. Krickeberg, "Principles of health information systems in developing countries," Health Information Management J. **36** (3), 8-20 (2007).

[81] K. Krickeberg, "We cannot say we did not know (in Vietnamese)," Тифi tre (Ho Chi Minh-City)., week end edition 26/27January 2008

[82] K. Krickeberg, "Ein vietnamesisch-laotisch-deutsches Projekt: Curricula für das öffentliche Gesundheitswesen," Viet Nam-Info **15** (6), 10-11 (2008).

Поступила 25 ноября 2008