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NEWS AND NOTICES

MIROSLAV KATĚTOV 1918–1995

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Shortly before the end of 1995, Czech mathematical community lost one of its most prominent members, a distinguished mathematician, a worldwide known specialist in general topology, the founder of the interdisciplinary seminar now called the Katětov seminar.

Miroslav Katětov was born on March 17, 1918 in Bělinskij (originally Čembar) near Penza as a son of POW Czech legionnaire and Russian mother. Since 1923 he lived with his mother in Czechoslovakia. After finishing his studies at secondary school 1927–35, to which he was admitted at the early age of nine years, he studied at the Faculty of Science, Charles University in Prague (1935–39). Here he made friends with L. S. Rieger, later a prominent Czech logician, this friendship lasted till Rieger's death in 1963. It was after he submitted his thesis but before he passed the final examinations that the Nazis closed the Czech universities, so that he graduated only after the World War II in June 1945. The official oponent of his thesis was Prof. V. Jarník who unofficially asked Prof. E. Čech, then in Brno, for his opinion since the regulations did not allow oponents or examiners from another university.

During World War II M. Katětov worked in the Institute of Human Labour. His task was to help in mathematical-statistical part of work in standardization of psychological tests and in the analysis of the data obtained. Among other, he intensively used the factor analysis which was then a new method in psychology. Here Katětov got acquainted with applications of mathematical methods in psychology, and he began to be interested in psychology proper. He returned to this field in the seventies when he founded the Seminar on mathematical methods in psychology.

Since June 1945 Katětov was employed as Assistant at Faculty of Science of Charles University, later at the newly established Faculty of Mathematics and Physics. In 1961 he joined the Mathematical Institute of Czechoslovak Academy of Sciences where he worked as a Principal Scientific Officer till his retirement. However, even then he remained a fellow of the Institute, as well as Professor Emeritus of Charles University.

From the long list of offices and degrees of M. Katětov let us mention only the most important ones. He defended his habilitation thesis in 1947 and was appointed Associated Professor (Dozent) on February 4, 1948. On October 1, 1953 he was appointed Full Professor. In 1952–53 he was the first Dean of Faculty of Mathematics and Physics, while in 1953–57 he was Rector of Charles University, he resigned from the office on his own request. In 1962 he was elected Ordinary Member of the Czechoslovak Academy of Sciences (having been its Corresponding Member since the foundation of the Academy in 1953). In 1960–70 he was Director of the Mathematical Institute of Charles University after its founder Prof. Eduard Čech. Let us note that the generation gap between Čech and Katětov never affected their friendship or Čech's respect of Katětov as a mathematician.

When the Scientific Board for Mathematics of the Academy was established, Katětov held its chair 1962–64. During 1965–69 he was member of Presidium of the National Committee for Scientific Degrees. He was awarded State Prize in 1953 for his results in Mathematics.

An integral part of Katětov's personality was his active interest in political life. He joined the Czechoslovak Communist Party in 1945. In 1970, his membership was cancelled. In spring 1989 he was one of the founders of the Circle of Independent Intelectuals and after the revolution he took part in the transformation of the Czechoslovak Academy of Science.

Beyond the field of Mathematics, Katětov was well known as a chess player. He actively cultivated chess since his young years, represented Czechoslovakia during 1946–51 and gained the title of International Master. Later he quitted playing chess for lack of time, but always had a chess journal on his desk.

Katětov's scientific activity falls within general topology, functional analysis and general theory of entropy. A "common denominator" of almost all works of M. Katětov is the notion of the "covering property", even if this fact is not always immediately apparent from the formulation of the result. As an example let us mention the now famous Katětov-Morita theorem claiming that $\dim X = \operatorname{Ind} X$ for any metric space X. Indeed, the crucial point of the proof is the construction of a special countable sequence of coverings, which allows to prove that $\dim X \geqslant \operatorname{Ind} X$.

Papers belonging to general topology concern extremal properties of spaces, which are conceptually linked to papers on filters and ultrafilters, works on dimension theory and on properties similar to that of paracompactness, and are topped by a study of general structures of continuity. Many of Katětov's results got ahead of their time so much that only after their later re-discovery the mathematical community realized and acknowledged Katětov's priority.

The first decade of Katětov's publication activities can be characterized by a slogan "each paper—a fundamental contribution to general topology".

In paper [1], which is the German translation of Katětov's RNDr. thesis, he constructed the maximal H-closed extension of the Hausdorff space, now termed the Katětov extension $\varkappa X$.

Let us recall: A Hausdorff space is said to be H-closed if it is a closed set after being embedded into any Hausdorff space Y. It is well known that every compact Hausdorff space is H-closed, which had been proved already by Alexandrov and Uryson in [AU]. Katětov knew both fundamental papers on the β-envelope [Č], [S] and used maximal centered systems of open sets in a context beyond the framework of Boolean algebras. Katětov's extension consists of the original points of the space X and of the ideal points, which are the maximal centered families of open sets nonconvergent in the space X. The subspace of all ideal points in $\varkappa X$ is discrete. This guarantees the most important property that makes the extension X similar to the Čech-Stone extension βX: every continuous mapping from X onto a dense subset of the Hausdorff space Y can be continuously extended to a subspace $Z \subseteq \varkappa X$ sufficiently large as to satisfy $Y = f[Z]$.

Stone's assertion that a Hausdorff space X is compact if and only if each of its closed subspaces is H-closed is proved in [1], Katětov's proof in the context of the whole theory requires practically null effort and at present represents a standard proof in monographs.

Other types of H-closed extensions (Katětov's, Fomin's and Wallman's, or the Čech-Stone compactification) are dealt with in [5]. The main result is a full innner characterization of these hulls by the combinatorial properties of the embedding of the given space into the corresponding extension. Always we have a mutual relation between the intersection of closed sets in a subspace and the intersection of their closures in the extension.

The existence and properties of Hausdorff spaces without isolated points in which there exist no two disjoint dense subsets, now called irresolvable spaces, represented a problem since the times of Čech's seminar (1936–39). The answer was given by E. Hewitt in 1943 and independently by M. Katětov [4] in 1947. Not only such spaces do exist, but moreover they have further remarkable properties many of which characterize them:

— every bounded real function defined on an irresolvable space has a limit at every point, this property is characteristic for irresolvable spaces,

— every bounded continuous real function defined on a dense subset can be continuously extended to the whole space,

— there exist H-closed irresolvable spaces,

— every regular irresolvable space is totally disconnected and hence completely regular,

— for any infinite κ, there exists a regular irresolvable space of cardinality κ.

In his paper Katětov also formulated the famous problem whether any real function defined on an irresolvable space has at least one point of continuity. This problem was solved only in 1986 by K. Kunen, A. Szymański and F. D. Tall: it is undecidable in ZFC (see [KST]).

This problem was attached from the other side in a paper [27] from 1962 where sufficient conditions are given for at least κ disjoint dense sets to exist in a given space. Similarly, also κ-resolvable spaces are an object of interest even nowadays.

In [15] M. Katětov was the first to publish the solution of Birkhoff's problem whether there exists an infinite rigid Boolean algebra, i.e. a Boolean algebra whose only automorphism is the identity. Katětov solved the problem very elegantly using the Stone representation theorem. His rigid Boolean algebra is dual to the Čech-Stone compactification of a certain rigid countable normal space whose each point is the limit of a nontrivial sequence. Rigid algebras proved important fifteen years later after the discovery of the forcing, especially in the context of complete algebras.

During the World War II, after the Nazis closed the Czech universities, M. Katětov attended meetings of mathematicians which took place in the house of Prof. V. Jarník. He got interested in functional analysis and at these seminars gave a report on Banach's book "Théorie des opérations linéaires". These lectures gave rise to the papers [2], [3] published in Czech parallelly with a shorter German version. Their character is not that of a modern original research paper. It is rather a systematical exposition of fundamental notions for topological vector spaces, intended for the wider nonspecialized public. Nevertheless, the exposition smoothly passes into original author's results. It is remarkable that Katětov in these papers developed all tools needed for the proof of Mackey-Arens theorem [A], [M]. The topology of uniform convergence on w-compact convex symmetric sets in the dual agrees with the duality, the convexity being essential. Katětov proved this assertion independently in [10] in 1948. Papers [2], [3] formed the basis for the lecture notes [77].

A compact space X is metrizable if and only if X^3 is hereditarily normal. This theorem is denoted as Corollary 2 in [9]. Although the properties of the space X as related to the properties of the space X^2 were studied by tens of authors, until now not a single further proposition has been found which would deduce some property of a space from an information of the properties of its cube. Many topologists are still amazed by the fact that it is at all possible to think of such a theorem.

Since 1947 Katětov has systematically studied covering properties of topological spaces. This is easily understandable if we take into account the fact that paracompactness was at the time a new and evidently perspective notion. His results led both to the dimension theory and to the normal, paracompact, uniform and proximity spaces.

A comprehensive survey of all facts connected with the covering was published in Czech in a supplement to the monograph of E. Čech "Topological Spaces" [23], except for the assertion concerning dimension. The supplement "Fully normal spaces" contains all which is essential in the papers [9, 16, 17, 21].

Let us present some of the results:

A topological space X is normal if and only if for every pair of real functions $f \leqslant g$ where f is upper- and g lower semicontinuous there exists a continuous function h such that $f \leqslant h \leqslant g$, if we require for $f < g$ the existence of a function h such that $f < h < g$ then we obtain a characterization of normal countably paracompact spaces.

The contents of the next result (Katětov theorem) reminds the Tietze theorem for normal topological spaces: every uniformly continuous bounded real function defined on an arbitrary subspace of a uniform space can be uniformly continuously extended to the whole space.

A paracompact space is realcompact if and only if the same is true for each of its closed discrete subspace, that is, if the cardinality of any closed discrete subspace is less than the first measurable cardinal.

Countably paracompact normal spaces were investigated by Katětov independently and simultaneously with C. H. Dowker [D], he found their characterization and posed the problem whether each normal space is countably paracompact. (The problem was solved negatively by M. E. Rudin in 1971.) The term "countable paracompactness" itself belongs to Dowker as well as the assertion that a normal space X is countably paracompact if and only if $X \times [0,1]$ is normal.

Theory of dimension was Katětov's lifelong affection. His result from the fifties deeply influenced the progress of this discipline. From various definitions of the notion of dimension, three are the most important, namely the small inductive dimension $\operatorname{ind} X$ (Menger-Uryson), large inductive dimension $\operatorname{Ind} X$ (Brouwer-Čech), and the covering dimension (Čech-Lebesgue).

The paper [12] contains a suprising characterization of the dimension of a compact topological space X in terms of the ring $\mathcal{C}(X)$ of continuous real-valued functions on X. The key role in the proof of the Stone-Weierstrass theorem is played by a system of functions separating points. It was Katětov who posed himself the question what this system can tell about the properties of the space X, and answered it in the following way: For a compact metric space X we have $\dim X \leqslant n$ if and only if there exist n functions $f_1, f_2, \dots, f_n \in \mathcal{C}(X)$ such that the least subalgebra containing all f_n's, all constant functions, and closed with respect to square roots (i.e. $f^2 \in \mathcal{A} \Longrightarrow f \in \mathcal{A}$) is dense in the algebra $\mathcal{C}(X)$.—Chapter 16 in the monograph of Gillman and Jerison [GJ] is fully devoted to a detailed account of Katětov's result.

Already Uryson knew that a compact metric space X satisfies $\dim X = \operatorname{ind} X = \operatorname{Ind} X$. The same identity was known to hold for separable metric spaces since late twenties (L. A. Tumarkin, W. Hurewicz). In the paper [19] the definitive general theorem is established: $\dim X = \operatorname{Ind} X$ for all metric spaces X. This result was proved independently by K. Morita, and it is now usually referred to as the Katětov-Morita theorem. It was for this research that Katětov received the State Prize in 1953. The situation for general metric spaces was fully described only after P. Roy in 1962 constructed a complete metric space X with $\operatorname{ind} X < \dim X$.

It is not generally known that the change in the original definition of the notion of dimension dim, namely the replacement of open coverings with coverings which are functionally open (cozero), which makes it possible to extend the whole theory from normal to fully regular spaces, is also Katětov's contribution [14]. The identity $\dim X = \dim \beta X$ is an easy consequence of Katětov's definition.

The paper [22] studies a less known type of dimension of a metric space X, the metric dimension $\mu \dim X$. It is proved that $\mu \dim X \leqslant \dim X \leqslant 2\mu \dim X$. This paper marks further, much later papers devoted to metric spaces from the viewpoint of invariants similar to dimension (Bolzano dimension, Dushnik-Miller dimension, entropy).

From the ideas contained in the lecture [30] delivered at the International Congress of Mathematicians 1962 in Stockholm let us mention two. Trying to define a notion of "continuous structure" as general as possible, Katětov explicitly gives the following method of forming a new structure from the given one by means of the covariant functor Φ from the category of sets into itself: The new structure is the set X equipped with the old structure on ΦX, a mapping of the new structured sets $F\colon \mathcal{X} \longrightarrow \mathcal{Y}$ is continuous if and only if $\Phi(F)$ is a continuous mapping of ΦX into ΦY equipped with the old structures. This idea was widely developed in the categorial theory of structures. Katětov himself studied as an example the free real module ΛX over the set X equipped with a compatible locally convex topology [28, 32]. Another example will be mentioned in the next paragraph. The other idea was the stressing of the importance of the projective and inductive generation of continuous structures. In Prague this led to the introduction of the so called amnestic functor and the S-functor ([Hu]) which is now used under the name of the topological functor, see [AHS].

Merotopic spaces are structures of continuity more general than the current topological, uniform and proximity spaces. Merotopy is determined by a filter Ξ consisting of a covering of the set X, that is, $\bigcup \mathcal{V} = X$ for all $\mathcal{V} \in \Xi$, if $\mathcal{V}_1, \mathcal{V}_2 \in \Xi$, then also the cover $\{V_1 \cap V_2 \colon V_1 \in \mathcal{V}_1, V_2 \in \mathcal{V}_2, V_1 \cap V_2 \neq \emptyset\} \in \Xi$, if $\mathcal{V} \in \Xi$, $\mathcal{W}$ is a covering of the set X and $\mathcal{V}$ refines $\mathcal{W}$, then $\mathcal{W} \in \Xi$. Unlike in the case of uniformity there is no requirement of openness of the elements of the covering here, and therefore merotopies can be equivalently described by families of "small" sets as well as by families consisting of mutually "near" sets. Let us note that these notions had been used by some authors before Katětov, but Katětov proved fundamental theorems on these spaces, two of which we will present here:

Merotopic spaces are exactly the quotients of uniform spaces.

A subcategory of the so-called filter merotopic spaces is Cartesian closed, i.e. the space of functions X^Y can be canonically equipped with a structure in such a way that $X^{Y\times Z}$ be isomorphic to $(X^Y)^Z$.

Katětov's term "merotopic spaces" later gave way to Herrlich's term "nearness spaces". The intensity of research of the successors can be documented by the survey paper [He].

It was already in 1960 that Katětov demonstrated the importance of the cardinal characteristic $\mathfrak{d}$, the dominating number, the least cardinality of a set F of sequences of positive integers such that each sequence is majorized by a sequence from F. In the papers [25, 26] he investigated the following cardinal numbers: the character of the set of integers in the space of reals, the least cardinality of the cofinal part of the family of compact subsets of rational numbers ordered by inclusion, the least cardinality of a covering of irrationals by compact sets, and proved that they are all equal to $\mathfrak{d}$. If rationals are replaced by irrationals in the above consideration, then the pseudocharacter will evidently be countable, but the character, as Katětov showed, is again equal to $\mathfrak{d}$.

Not a single one of the above presented results was omitted by E. K. van Douwen in his Handbook of Set Theoretic Topology article [vD].

In the sixties the interest in filters and ultrafilters increased rapidly. This trend did not skip Prague. It was then that Katětov became friends with the young Zdeněk Frolík, and filters and ultrafilters were a frequent topic of their discussions. Frolík then proved nonhomogeneity of the space $\beta\mathbb{N}\setminus\mathbb{N}$. Katětov was interested in the operations on filters and in convergence with respect to a filter. In the paper [37] Katětov investigated products of filters. Let us recall: If $\mathcal{F}$ is a filter on a set A, $\mathcal{G}$ a filter on a set B, then the filter $\mathcal{F}\cdot\mathcal{G}$ on the set $A\times B$ consists of all $X\subseteq A\times B$ such that $\{a\in A\colon \{b\in B\colon (a,b)\in X\}\in\mathcal{G}\}\in\mathcal{F}$, i.e. the product in the current Fubini sense. If $\mathcal{F}$ is a filter on A and $\mathcal{G}$ a filter on B, then $\mathcal{F}$, $\mathcal{G}$, have the same type ($\mathcal{F}\sim\mathcal{G}$) if there is a bijection $f\colon A\longrightarrow B$ such that $F\in\mathcal{F}\iff f[F]\in\mathcal{G}$. For filters Katětov studied the two transitive relations which are now called Rudin-Keisler and Rudin-Frolík orderings in the case of ultrafilters ([CN]—Comfort and Negrepontis were apparently not aware of [37]) and proved that for ultrafilters they really represent orderings of types. To this end he used a lemma on three sets, proved and published in [35]. It is true that the lemma is a special case of de Bruijn-Erdős theorem [BE] which Katětov did not know at the time, but he was the first who demonstrated the importance of this special case for the theory of ultrafilters. Katětov also proved that for an ultrafilter $\mathcal{F}$ and an arbitrary filter $\mathcal{G}$ with an empty intersection neither $\mathcal{F} \sim \mathcal{F} \cdot \mathcal{G}$ nor $\mathcal{F} \sim \mathcal{G} \cdot \mathcal{F}$ can hold, similarly as $\mathcal{N} \sim \mathcal{N} \cdot \mathcal{N}$ does not hold for the Fréchet filter $\mathcal{N}$. Naturally a question arose whether there can at all exist a nontrivial filter $\mathcal{F}$ with the property $\mathcal{F} \sim \mathcal{F} \cdot \mathcal{F}$, in the paper [47] it is proved that such a filter does exist on any infinite set, and it is constructed there.

In [39], [40] the convergence with respect to a filter is studied. The main theorem in both the papers asserts that—if we assume CH—there exists a special filter $\mathcal{F}$ on a countable set such that for every topological space X all $\mathcal{F}$-limits of sequences of continuous functions are exactly all Baire functions on X. The theorem fails to hold, which is proved by the diagonalization method in [43]. The main result then is the description of the class of spaces for which the theorem is correct.

In the course of the activities of the Seminar of mathematical methods in Psychology a number of psychological experiments turned Katětov's attention to the notion of information. His effort to grasp this notion mathematically resulted in a numerous series of papers [45, 49, 52, 53, 57, 58, 59, 60] which was interrupted only by his death. Roughly speaking, if $\langle X, \varrho, \mu \rangle$ is a set equipped with a semimetric ϱ, i.e. $\varrho(x,x) = 0$ and $\varrho(x,y) = \varrho(y,x)$, and a finite measure μ for which ϱ is $\mu \times \mu$-measurable, he posed the question of existence of functionals defined on the class of such spaces which in two important special cases, namely those of X finite and the metric satisfying $\varrho(x,y) = 1$ for all $x \neq y$, and of X without measure but with a metric, result in the Shannon entropy or the Kolmogorov entropy, respectively. Functionals of this type with further reasonable properties Katětov called the extended Shannon entropy. The passage from the finite to the infinite situation Katětov solved by a tree sequence of binary decompositions first of the given space and then of the elements of the decomposition into sets of lesser and lesser diameter, the branches of the tree end at the moment when the diameter is less than ε.

Now the connection with various types of dimensions, which were dealt with by Katětov in [54], [61], is no more a surprise.

However, Katětov desired to achieve more than we have just described. Step by step he developed a unified theory covering as special cases various further kinds of known entropies (beyond already mentioned Kolmogorov entropy of totally bounded metric spaces, e.g., differential entropy, entropy in the sense of Posner, Rodemich and Humphrey, topological entropy, entropy of a mapping, Bowen's entropy). This research was extremely demanding from the technical point of view and differed essentially from procedures used in the information theory. The importance of this monumental activity can be justly evaluated only by the future.

In 1970, M. Katětov founded Seminar on mathematical methods in Psychology in the Faculty of Mathematics and Physics. He opened it as a specialized seminar from Applied Mathematics, having had prepared for it many years before.

At the beginning, the seminar was devoted to the mathematical problems in psychology (theory of information, mathematical linguistics, neurolinguistics, artificial inteligence, problem solving, theory of perceptrons, theory of complexity, probability, plans and the structure of behavior, genetic epistemology, theory of measurement, perception etc.) M. Katětov wrote then a series of huge texts devoted to various aspects of using mathematical methods and structures in psychology, but mostly copied for the seminar use only. From that period (seventies), also Katětov's papers on modelling of multiple sclerosis by means of the catastrophe theory came [50], [q], [r]. A remarkable paper [48] models a seemingly alogical behavior of a subject in a certain standard psychological test; the model has a surprising predictive power. As already said, the study of theory of information in psychology inspired a series of Katětov's mathematical papers on entropy theory for metric spaces.

Since the end of seventies, the contents of the seminar widened in further areas of applications of mathematics (biology, medicine) and, contrary to original Katětov's intentions, it opened also to the philosophical questions in eighties, becoming thus transdisciplinary.

It is possible that Katětov was not the best lecturer for introductory courses. On the other hand, by his lectures of advanced parts of Mathematics and by his seminars he aroused interest in scientific work in more than one generation of Czech mathematicians. He was a peerless paragon for all his students and students of his students. His unfailing memory, comprehensive knowledge, the ability to see and to precisely and pregnantly formulate the essentials, these were gifts given only to few.

Unlike most of his colleagues, Miroslav Katětov believed all his life that Mathematics is communicable and everybody is able to grasp it. This is probably the reason why he wrote so many articles and texts popularizing Mathematics or explaining some parts of it to laymen or specialists from remote professions. This concerns papers [64, 67, 72, 79], [b]–[p], [s]–[v], all written with anxious care for mathematical precision combined ideally with easy-to-grasp presentation. The last paper that Katětov finished immediately before his death was a contribution for the Handbook from the history of general topology devoted to his most favorite topic, dimension theory [76]. He verified with extraordinary care all historical facts, thus avoiding the frequently cited inaccuracies. This of course concerns all the other Katětov's papers devoted to the history and development of Mathematics [66, 66, 67, 68, 70, 71, 73, 74, 79, 80, 84].

Miroslav Katětov passed away on December 15, 1995. On his desk he left manuscripts of papers to be completed...

[AHS] *J. Adámek, H. Herrlich, G. Strecker*: Abstract and concrete categories. John Wiley & Sons Inc., New York, 1990.

[A] *R. F. Arens*: Duality in linear spaces. Duke Math. J. *14* (1947), 499–528.

[AU] *P. S. Alexandrov, P. S. Urysohn*: Mémoire sur les espaces topologiques compacts. Verh. Akad. Wetensch. Amsterdam *14* (1929).

[BE] *N. G. de Bruijn, P. Erdős*: A colour problem for infinite graphs and a problem in the theory of relations. Nederl. Akad. Wetensch. Proc. Sec. A 54 = Indag. Math. *13* (1951), 369–373.

[Č] *E. Čech*: On bicompact spaces. Ann. of Math. *38* (1937), 823–844.

[CN] *W. W. Comfort, S. Negrepontis*: The Theory of Ultrafilters. Springer-Verlag, Berlin-Heidelberg-New York, 1974.

[vD] *E. K. van Douwen*: The integers and topology. Handbook of Set-Theoretic Topology, Chapter 3 (K. Kunen and J. E. Vaughan, eds.). pp. 111–167.

[D] *C. H. Dowker*: On countably paracompact spaces. Canad. J. Math. *3* (1951), 219–224.

[E] *R. Engelking*: General Topology. Polish Scientific Publishers, Warszawa, 1977.

[GJ] *L. Gillman, M. Jerison*: Rings of Continuous Functions. Van Nostrand, New York, 1960.

[He] *H. Herrlich*: Categorical topology 1971–1981. General Topology and its Relations to Modern Analysis and Algebra, Prague 1981. Heldermann, Berlin, 1982, pp. 279–383.

[H] *E. Hewitt*: A problem of the set-theoretic topology. Duke Math. J. *10* (1943), 309–333.

[Hu] *M. Hušek*: S-categories. Comment. Math. Univ. Carolin. *5* (1964), 37–46.

[KST] *K. Kunen, A. Szymański, F. D. Tall*: Baire irresolvable spaces and ideal theory. Ann. Math. Sil. *14* (1986), 98–107.

[M] *G. W. Mackey*: On convex topological linear spaces. Trans. Amer. Math. Soc. *60* (1946), 519–537.

[S] *M. H. Stone*: Applications of the theory of Boolean rings to general topology. Trans. Amer. Math. Soc. *41* (1937), 375–481.

Bibliography of M. Katětov

A. Original research papers

[1] Über H-abgeschlossene und bikompakte Räume, *Časopis Pěst. Mat. Fys. 69* (1940), 36–49.

[2a] O normovaných vektorových prostorech (On normed vector spaces), *Rozpravy II. třídy České Akad. 53* (1943), no. 45, 27 pp.

[2b] Über normierte Vektorräume, *Bull. Internat. Acad. Tchèque Sci. Cl. Sci. Math. Natur. 44* (1943), 594–598.

[3a] K theorii topologických vektorových prostorů (To the theory of topological vector spaces), *Rozpravy II. třídy České Akad. 53* (1943), no. 46, 12 pp.

[3b] Zur Theorie der topologischen Vektorräume, *Bull. Internat. Acad. Tchèque Sci. Cl. Sci. Math. Natur. 44* (1943), 599–605.

[4] О пространствах, не содержащих непересекающихся плотных множеств (On spaces not containing disjoint dense sets), *Mat. Sb.* (H.C.) *21 (63)* (1947), 3–11.

[5] On H-closed extensions of topological spaces, *Časopis Pěst. Mat. Fys. 72* (1947), 17–32.
[6] A note on semiregular and nearly regular spaces, *Časopis Pěst. Mat. Fys. 72* (1947), 97–99.
[7] On the equivalence of certain types of extension of topological spaces, *Časopis Pěst. Mat. Fys. 72* (1947), 101–106.
[8] Remarque sur les espaces topologiques dénombrables, *Ann. Soc. Polon. Math. 21* (1948), 120–122.
[9] Complete normality of cartesian products, *Fund. Math. 35* (1948), 271–274.
[10] On convex topological linear spaces, *Acta Fac. Rer. Nat. Univ. Carolin. 181* (1948), 20 pp.
[11] On mappings of countable spaces, *Colloq. Math. 2* (1949), 30–33.
[12] О кольцах непрерывных функций и размерности бикомпактов (On rings of continuous functions and the dimension of compact spaces), *Časopis Pěst. Mat. Fys. 75* (1950), 1–16.
[13] On nearly discrete spaces, *Časopis Pěst. Mat. Fys. 75* (1950), 69–78.
[14] A theorem on the Lebesgue dimension, *Časopis Pěst. Mat. Fys. 75* (1950), 79–87.
[15] Remarks on Boolean algebras, *Colloq. Math. 2* (1951), 229–235.
[16] Measures in fully normal spaces, *Fund. Math. 38* (1951), 73–84.
[17] On real-valued functions in topological spaces, *Fund. Math. 38* (1951), 85–91; Correction, *ibid. 40* (1953), 203–205.
[18] О размерности метрических пространств (On the dimension of metric spaces), *Dokl. Akad. Nauk SSSR 79* (1951), 189–191.
[19] О размерности несепарабельных пространств I (On the dimension of non-separable spaces I), *Czechoslovak Math. J. 2 (77)* (1952), 333–368.
[20] О размерности несепарабельных пространств II (On the dimension of non-separable spaces II), *Czechoslovak Math. J. 6 (81)* (1956), 485–516.
[21] О продолжении локально конечных покрытий (Extensions of locally finite coverings), *Colloq. Math. 6* (1958), 145–151.
[22] О соотношении между метрической и топологической размерностью (On the relation between the metric and topological dimension), *Czechoslovak Math. J. 8 (83)* (1958), 163–166.
[23] Plně normální prostory (Fully normal spaces), in: E. Čech: *Topologické prostory*, Dodatek II, 407–495, NČSAV, Praha 1959.
[24] Über die Berührungsräume, *Wiss. Z. Humboldt-Univ. Berlin Math.-Natur. Reihe 9* (1959/1960), 685–691.
[25] Remarks on characters and pseudocharacters, *Comment. Math. Univ. Carolin. 1* (1960), fasc. 1, 20–25.
[26] On the space of irrational numbers, *Comment. Math. Univ. Carolin. 1* (1960), fasc. 2, 38–42.
[27] Характеры и типы точечных множеств (Characters and types of point-sets), *Fund. Math. 50* (1962), 369–380.
[28] On a category of spaces, in: *General Topology and its Relation to Modern Analysis and Algebra* (Prague, 1961), 226–229, Academia, Praha 1962.
[29] О квазиметрических свойствах (On quasi-metric properties), *Studia Math. (Seria Specjalna) 1* (1963), 57–68.
[30] Allgemeine Stetigkeitsstrukturen, in: *Proc. Internat. Congres Mathematicians* (Stockholm, 1962), 473–479, Institut Mittag-Lefler, Djursholm 1963.
[31] (with J. Vaníček) On the proximity generated by entire functions, *Comment. Math. Univ. Carolin. 5* (1964), 267–278.

[32a] On certain projectively generated continuity structures, in: *Simposio di topologia* (Messina, 1964), 47–50, Edizioni Oderisi, Gubbio 1965.
[32b] Projectively generated continuity structures: A correction, *Comment. Math. Univ. Carolin. 6* (1965), 251–255.
[33] On continuity structures and spaces of mappings, *Comment. Math. Univ. Carolin. 6* (1965), 257–278.
[34] Chapters I and II, in: E. Čech, *Topological Spaces* (revised by Z. Frolík and M. Katětov), 17–231, Academia, Praha 1966.
[35] A theorem on mappings, *Comment. Math. Univ. Carolin. 8* (1967), 431–433.
[36] Convergence structures, in: *General Topology and its Relations to Modern Analysis and Algebra II* (Prague, 1966), 207–216, Academia, Praha 1967.
[37] Products of filters, *Comment. Math. Univ. Carolin. 9* (1968), 173–189.
[38] Metrics on an arc, *Studia Math. 31* (1968), 547–554.
[39] On descriptive classes of functions, in: *Theory of Sets and Topology* (Berlin, 1972), 265–278, Deutscher Verlag der Wissenschaften, Berlin 1972.
[40] On descriptive classification of functions, in: *General Topology and its Relations to Modern Analysis and Algebra III* (Prague, 1971), 235–242, Academia, Praha 1972.
[41] Baire classification and infinite perceptrons, *Comment. Math. Univ. Carolin. 13* (1972), 373–396.
[42] On information in categories, *Comment. Math. Univ. Carolin. 13* (1972), 777–781.
[43] Baire functions and classes bounded by filters, *Comment. Math. Univ. Carolin. 16* (1975), 771–785.
[44] Пространства, определяемые заданием семейства центрированных систем (Spaces defined by means of the family of centered systems), *Uspekhi Mat. Nauk 31* (1976), № 5(191), 95–107.
[45] Quasi-entropy of finite weighted metric spaces, *Comment. Math. Univ. Carolin. 17* (1976), 797–806.
[46] Descriptive complexity of functions, in: *General Topology and its Relations to Modern Analysis and Algebra IV* (Prague, 1976), Part B, 214–219, Society Czechoslovak Math. Phys., Praha 1977.
[47] On idempotent filters, *Časopis Pěst. Mat. 102* (1977), 412–418.
[48] (with V. Břicháček, A. Pultr) A model of seemingly irrational solutions of a task to identify a critical set, *J. Math. Psych. 18* (1978), 220–248; Erratum, *ibid. 20* (1979), 89.
[49] Extensions of the Shannon entropy to semimetrized measure spaces, *Comment. Math. Univ. Carolin. 21* (1980), 171–192; Correction, *ibid. 21* (1980), 825–830.
[50] (with P. Jedlička, I. Vrkoč, J. Bočková) Matematické modelování průběhu roztroušené mozkomíšní sklerózy s použitím principů Thomovy teorie (Mathematical modelling of multiple sclerosis using the principles of Thom's theory), *Čs. neurologie a neurochirurgie 46* (1983), 41–50.
[51] A dimension function based on Bolzano's ideas, in: *General Topology and its Relations to Modern Analysis and Algebra V* (Prague, 1981), 423–433, Heldermann, Berlin 1983.
[52] Extended Shannon entropies I, II, *Czechoslovak Math. J. 33 (108)* (1983), 564–601, *35 (110)* (1985), 565–616.
[53] On extended Shannon entropies and the epsilon entropy, *Comment. Math. Univ. Carolin. 27* (1986), 519–534.
[54] On the Rényi dimension, *Comment. Math. Univ. Carolin. 27* (1986), 741–753.
[55] On dimensions of semimetrized measure spaces, *Comment. Math. Univ. Carolin. 28* (1987), 399–411.

[56] On universal metric spaces, in: *General Topology and its Relations to Modern Analysis and Algebra VI* (Prague, 1986), 323–330, Heldermann, Berlin 1988.
[57] On the differential and residual entropy, *Comment. Math. Univ. Carolin. 29* (1988), 319–349.
[58] On entropy-like functionals and codes for metrized probability spaces I, II, *Comment. Math. Univ. Carolin. 31* (1990), 49–66, *33* (1992), 79–95.
[59] Entropy-like functionals: conceptual background and some results, *Comment. Math. Univ. Carolin. 33* (1992), 645–660.
[60] Entropies of self-mappings of topological spaces with richer structures, *Comment. Math. Univ. Carolin. 34* (1993), 747–768.
[61] An approach to covering dimensions, *Comment. Math. Univ. Carolin. 36* (1995), 149–169.

B. Popularization and occasional papers

[62] *Jaká je logická výstavba matematiky?* (What is the Logical Set-up of Mathematics?), JČMF, Praha 1946; 2nd ed.: Přírodovědecké nakladatelství, Praha 1950.
[63] (with F. Vyčichlo) Le matematiche cecoslovacche durante la seconda guerra mondiale, *Boll. Un. Mat. Ital.* (3) *3* (1948), 78–80.
[64] Lineární operátory I, II (Linear operators I, II), *Časopis Pěst. Mat. Fys. 75* (1950), D9–D31, *76* (1951), 105–119.
[65] (with J. Novák, A. Švec) Akademik Eduard Čech (Academician Eduard Čech), *Časopis Pěst. Mat. 85* (1960), 477–491; Russian translation: Академик Эдуард Чех, *Czechoslovak Math. J. 10 (85)* (1960), 614–630; French translation: Edouard Čech, *Rendiconti Sem. Mat. Univ. Politec. Torino 19* (1959/1960), 58–88; revised English version: Life and work of Eduard Čech, *Topological Papers of Eduard Čech*, 9–25, Academia, Praha 1968, and *The Mathematical Legacy of Eduard Čech*, 9–25, Academia, Praha 1993.
[66] (with I. Seidlerová) Některé otázky současné vědy a historická zkušenost (Several questions of contemporary science and the historical experience), in: *Sborník pro dějiny přírodních věd a techniky 11*, 5–23, Academia, Praha 1967.
[67a] О некоторых аспектах развития функционального анализа (Some aspects of the development of functional analysis), in: *Actes XI Congrès Internat. Hist. Sci.* (Varsovie–Cracovie, 1965), Sect. III, 273–277, Wroclaw 1968.
[67b] Některé aspekty vývoje funkcionální analýzy (Some aspects of the development of functional analysis), *Dějiny věd a techniky 1* (1968), 17–23.
[68] Akademik Wacław Sierpiński (Academician Wacław Sierpiński), *Věstník ČSAV 79* (1970), 549–550.
[69] Matematické metody v psychologii (Mathematical methods in psychology), *Pokroky Mat. Fyz. Astronom. 19* (1974), 187–199.
[70] P. S. Uryson a počátky obecné topologie (P. S. Uryson and the origins of general topology), *Pokroky Mat. Fyz. Astronom. 19* (1974), 251–261.
[71] N. N. Luzin a teorie reálných funkcí (N. N. Luzin and the theory of real-valued functions), *Pokroky Mat. Fyz. Astronom. 20* (1975), 137–145.
[72] (with P. Jedlička) Teorie katastrof: souvislosti a aplikace I, II (Catastrophe theory: Coherences and applications I, II), *Pokroky Mat. Fyz. Astronom. 24* (1979), 1–20, 313–326.
[73] Topologie, teorie kategorií a kombinatorika v ČSR v období 1945–1985 (Topology, category theory and combinatorics in ČSR in the period 1945–1985), *Vývoj matematiky v ČSR v období 1945–1985 a její perspektivy*, 95–127, Universita Karlova,

Praha 1986; an almost identical text: Česká matematika v letech 1945–1985: topologie, teorie kategorií a kombinatorika, *Pokroky Mat. Fyz. Astronom. 32* (1987), 191–206.

[74] Dimension theory. E. Čech's work and the development of dimension theory, *The Mathematical Legacy of Eduard Čech*, 109–129, Academia, Praha 1993.

[75] (with J. Adámek) Věra Trnková's unbelievable 60, *Math. Bohem. 119* (1994), 216–224.

[76] (with P. Simon) Origins of dimension theory, to appear

C. Lecture notes and internal publications

[77] (with J. Jelínek) *Funkcionální analýza* (Functional Analysis), SPN, Praha 1967.

[78] *Úvod do moderní analýzy* (Introduction to Modern Analysis), SPN, Praha 1968.

[79] *Některé vývojové tendence současné matematiky* (Some development tendencies of contemporary mathematics), MÚ ČSAV, Praha 1975.

[80] Význam E. Čecha pro rozvoj československé a světové matematiky (The relevance of E. Čech to the development of Czechoslovak and world mathematics), *Informace MVS JČSMF 18*, 1980, 8–35.

[81] (with V. Břicháček) Structure of mathematical models and their role in psychology, in: *Causal and Soft Modeling*, Ergebnisband der 2. Bremer Methodenkonferenz 1984, 167–204, Bremer Beiträge zur Psychologie Nr. 43, Bremen 1985.

[82] Ze vzpomínek na dobu okupace (Memories on the times of occupation), *Informace MVS JČSMF 29*, 1987, 10–13.

[83] Za Zdeňkem Frolíkem (Following Zdeněk Frolík), *Informace MVS JČSMF 32*, 1989, 5–8; an English version: Excerpts from a memorial speech given in May 1989, *Topological, Algebraical and Combinatorial Structures. Frolík's memorial volume* (J. Nešetřil, ed.), xi–xii, North-Holland, Amsterdam 1992.

[84] Eduard Čech: doba, dílo, osobnost (Eduard Čech: The time, the achievement, the personality), *Informace MVS JČSMF 41*, 1993, 32–41.

D. Mimeographed materials, which have not appeared elsewhere

[a] *Vybrané kapitoly z algebry a topologie* (Selected chapters from algebra and topology), lecture course 1962/1963 (written by M. Hušek), pp. 55.

[b] *Úvod do studia vztahů mezi matematikou a zkoumáním psychických procesů* (An introduction to the relationship between mathematics and exploration of psychic processes), Preliminary version, Part 1, 1970, pp. 81.

[c] *Elementární výklad některých základních matematických pojmů* (Elementary exposition of some basic mathematical notions). Provisional version, parts 1–3, 1971–1972, pp. 49+26+34.

[d] *Poznámky k některým matematickým pojmům souvisícím s aplikacemi v psychologii* (Remarks on some mathematical concepts connected to applications in psychology), Studijní materiály k otázkám vztahů mezi matematikou a zkoumáním psychických procesů č. 1, 1970, pp. 9.

[e] *Úvodní přehled literatury o pojmu informace a jeho úloze v psychologii* (An introductory survey of the literature concerning the notion of information and its role in psychology), Studijní materiály k otázkám vztahů mezi matematikou a zkoumáním psychických procesů č. 2, 1971, pp. 5.

[f] *O preferenčních relacích* (On preferential relations), Studijní materiály k otázkám vztahů mezi matematikou a zkoumáním psychických procesů č. 4, 1971, pp. 8.

[g] *O pojmu selektivního procesu I* (On the notion of selective process I), Studijní materiály k otázkám vztahů mezi matematikou a zkoumáním psychických procesů č. 6, 1971, pp. 28.
[h] *O pojmu stochastické automatové transformace* (On the notion of stochastic automaton transformation), Studijní materiály k otázkám vztahů mezi matematikou a zkoumáním psychických procesů č.7, 1971, pp. 24.
[i] *Elementární pojmy teorie informace* (Elementary concepts of the theory of information), Studijní materiály k otázkám vztahů mezi matematikou a zkoumáním psychických procesů č. 8, 1972, pp. 24.
[j] *O pojmu selektivního procesu II* (On the notion of selective process II), Studijní materiály k otázkám vztahů mezi matematikou a zkoumáním psychických procesů č. 9, 1972, pp. 18.
[k] *Několik poznámek k přednáškám o matematických metodách v psychologii* (Several remarks to the lectures on mathematical methods in psychology), Studijní materiály k otázkám vztahů mezi matematikou a zkoumáním psychických procesů č. 10, 1972, pp. 8.
[l] *Elementární výklad přípravných pojmů matematické teorie procesů* (Elementary exposition of preparatory notions in mathematical process theory), Studijní materiály k otázkám vztahů mezi matematikou a zkoumáním psychických procesů č. 11, 1972, pp. 51.
[m] *Polydromní procesy I* (Polydrom processes I), Studijní materiály k otázkám vztahů mezi matematikou a zkoumáním psychických procesů č. 12, 1972, pp. 85.
[n] *O pojmu automatové transformace* (On the notion of automaton transformation), Studijní materiály k otázkám vztahů mezi matematikou a zkoumáním psychických procesů č. 13, 1973, pp. 51.
[o] *K problematice plánů a struktury chování I: O základech matematického vyjadřování plánu* (To the problems of plans and the structure of behavior I: On the principles of the mathematical expressing of a plan), Studijní materiály k otázkám vztahů mezi matematikou a zkoumáním psychických procesů č. 15, 1974, pp. 141.
[p] *Abstraktní struktury a modelování psychických procesů* (Abstract structures and modelling of psychic processes), Part 1, 1973, pp. 203.
[q] (with P. Jedlička) *Modelování některých aspektů roztroušené sklerózy* (Modelling of some aspects of multiple sclerosis), 1977, pp. 88.
[r] (with P. Jedlička, I. Vrkoč) *A model of the course of multiple sclerosis based on the concepts of the catastrofe theory*, 1979, pp. 45.
[s] *Matematické modelování v psychologii — základní pojmy* (Mathematical modelling in psychology—elementary notions), Matematické metody v psychologii — Vybrané kapitoly I, 1979, 2. ed. 1982, pp. 25.
[t] *Některé základní pojmy teorie pravděpodobnosti* (Some basic notions of the probability theory), Notes to the course 1978/1979, pp. 12.
[u] *Základy modelování rozvrhově regulovaného chování* (Basics of the modelling of disposedly regulated behavior), 1982, pp. 16.
[v] *Některé matematické pojmy používané v populační genetice* (Some mathematical notions used in population genetics), Notes to the course 1984/1985, pp. 17.