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NEWS AND NOTICES

AN ANNIVERSARY

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Professor Jindřich Nečas, Doctor of Science, an outstanding Czech mathematician, has reached sixty years of age on December 14, 1989. For almost fourty years he has been enriching the Czechoslovak and the world mathematics by new ideas, by the force of his natural authority promoting new directions of research, and by all his

activities integrating in a natural way two aspects of mathematics, by many people considered contradictory: namely, pure and applied mathematics.

Born in Prague on December 14, 1929, J. Nečas spent his youth in the nearby town of Mělník. He studied mathematics at Faculty of Science, Charles University in Prague, 1948–1952. After a short period at Faculty of Mechanical Engineering of Czech Technical University he joined the Mathematical Institute of the Czecho-

slovak Academy of Sciences. Thus he started the first important period of his scientific career, which ended only in 1977 when he came to the Faculty of Mathematics and Physics of Charles University. Of course, his cooperation with the Faculty had started much earlier – for example, he was external head of Department of Mathematical Analysis in 1965–1971. He has been member of staff of the Faculty until now; since 1987 he has been head of Department of Mathematical Modelling of the Mathematical Institute of Charles University.

Let us go back to Nečas' first steps in mathematical research. He was first a research student (aspirant) of Prof. I. Babuška whom he still recalls with gratitude. As one of his first serious tasks he cooperated on the preparation of the pioneering monograph *Mathematical Methods of the Theory of Plane Elasticity* by Babuška, Rektorys and Vyčichlo. This task considerably influenced him in forming his scientific interests: it was mechanics (of course, from a mathematician's view-point), which naturally directed him to applications of mathematics. Let us note that he resumed research in this field in the seventies – naturally on an essentially higher level given by the progress of mathematics as well as of his own.

This period ends in 1957 by defending the dissertation *Solution of the biharmonic problem for convex polygons* on the basis of which J. Nečas received his Candidate of Science degree. His interest gradually shifted to the so-called modern (functional-analytical) methods of solution of partial differential equations. It was again I. Babuška who oriented him in this direction, introduced him to S. L. Sobolev and arranged his trip to Italy. His visits to Italy and France where he got acquainted with the renowned schools of M. Picone, G. Fichera, E. Magenes and J.-L. Lions deeply influenced the second period of Nečas' career, and marked the beginning of the fruitful cooperation of Czech and Italian mathematicians in the theory of partial differential equations which has lasted till today. Here we can find the fundaments of Nečas' contribution to the linear theory: Rellich's identities and inequalities (now frequently called Rellich-Nečas) made it possible to prove solvability of a wide class of boundary value problems for generalized data, and they are important also for the application of the finite element method. This represents the first significant contribution of J. Nečas to Czechoslovak and world mathematics. As for the "local" contribution, it consists primarily in his unceasing promotion of modern methods, his university lectures, his first students and research students. Without exaggeration we can consider him the founder of the Czechoslovak school of modern methods of investigation of both boundary and initial value problems. It is essential for this period that J. Nečas becomes "independent" from the organizational view-point: in 1960 he is appointed head of the new department of the Institute, Department of the Theory of Partial Differential Equations. As for the "global" contribution, it assumed its tangible form in Nečas' monograph *Les méthodes directes en théorie des équations elliptiques* [A1]. It became a standard reference book and found its way into the golden funds of world mathematical literature. We have only to regret that it has never been translated into English

or Russian. Its originality and richness of ideas was more than sufficient for J. Nečas to receive the Doctor of Science degree in 1966.

It takes some time for a book to be published, and therefore, while giving his monograph the final touch, J. Nečas already worked on another important research project, which can be characterized by the adjective "nonlinear". It was then that he met the pioneers and founders of the nonlinear theory S. Agmon, F. Browder, J. Leray and others. With his usual enthusiasm J. Nečas studies and promotes the methods of solution of nonlinear problems, helps numerous young Czechoslovak mathematicians to start their career in this domain, organizes a number of international events and – last but not least – achieves many important results himself.

Nonlinear differential equations naturally lead to the study of nonlinear functional analysis. This is why the monograph *Spectral Analysis of Nonlinear Operators* [A2] appears in 1973. The book represents a milestone even in the history of world mathematics. Among many outstanding results let us mention the infinite dimensional version of Sard's theorem for analytical functionals which makes it possible to prove denumerability of the spectrum of the nonlinear operator. Theorems of the type of Fredholm's alternative represent another leading topic. The choice of the subject was extremely well-timed, which is confirmed by the fact that analogous problems were at the same time considered by a prominent Moscow mathematician S. I. Pokhozhayev, and that many successors were appearing soon after the book had been published. This interest has not ceased till now and has resulted in very deep and exact conditions of solvability of even very anomalous nonlinear boundary value problems. Svatopluk Fučík, who appears as one of the co-authors of the monograph, was – together with Jan Kadlec, who worked primarily in problems characteristic for the previous period – one of the most talented and promising Nečas' pupils. It is to be deeply regretted that the premature death of both of them prevented them from gaining the world fame of their teacher.

The period of nonlinearities, describing stationary phenomena, reached its summit probably in the monograph *Introduction to the Theory of Nonlinear Elliptic Equations* [A6]. At the moment when the book was published, J. Nečas already concentrated on another group of problems. However, before giving account of this period, we must not omit one direction which is typical for all periods of Nečas' scientific career, namely, the problem of regularity of solutions of partial differential equations. If there is a leitmotif that can be heard through all Nečas' research work then it is exactly this problem, closely connected with the solution of Hilbert's 19th problem.

In 1967 Nečas publishes his crucial work [B33] in this field, solving the problem of regularity of generalized solutions of elliptic equations of arbitrarily high order with nonlinear growths in a plane domain. Let us remark that in their generality these results have not yet been surpassed. In 1968 E. De Giorgi, E. Giusti and M. Miranda published counterexamples convincingly demonstrating that in spaces of dimensions higher than two analogous theorems on regularity fail to hold. The series

of Nečas' papers devoted to regularity in more-dimensional domains can be divided into two groups. One of them can be characterized by the effort to find conditions guaranteeing regularity of weak solutions. Here an important result is an equivalent characterization of elliptic systems whose weak solutions are regular. This characterization is based on certain theorems of Liouville's type. The fact that Nečas' method can be applied to the study of regularity of solutions of both elliptic and parabolic systems demonstrates its general character. During this period Nečas collaborated also with a prominent Italian mathematician M. Giaquinta. The other group of papers consists of those which aim at a deeper study of singularities of solutions of elliptic systems. J. Nečas is the author of numerous examples which have the importance of milestones in this, not yet well mapped, field.

In the next period Nečas resumes his study of mechanics, more precisely mechanics of continuum. Again we can distinguish two fundamental groups. The former concerns the mechanics of elasto-plastic bodies. J. Nečas is the co-author of monographs and papers with results of world-wide reputation. Among them let us mention the theory of elasto-plastic bodies admitting plastic flow and reinforcement, as well as the not yet surpassed theory of contact problems with friction. The latter group consists of papers devoted to the transonic flow where Nečas achieved remarkable results by using the method of entropic compactification and the methods of viscosity. These methods raised lively interest of the mathematical community: Nečas together with Ciarlet published the monograph [A7], and the methods or viscosity became the central methods of the study of problems of flows at a number of world's best research institutions. The (at least temporary) summit of this period of Nečas' activity is the theory of multipolar liquids with a natural and logical construction of fundamental laws and with deep existence results.

The above survey of Nečas' activities is naturally far from exhausting. Nečas had and has many new ideas and new plans. Not all his projects were equally successful, not in all branches of mathematics which he developed and for which he enlisted his students and colleagues did he affect Czechoslovak mathematics to such a degree as in those mentioned above. Nonetheless, we can declare that J. Nečas has a nose for good, effective problems, which are never far from technical practice but on the contrary have a sound physical or technical interpretation. This conviction is corroborated by the interest of people from engineering sciences – let us mention only Nečas' long-lasting cooperation with the state enterprise Škoda Plzeň.

J. Nečas tirelessly organizes seminars, lectures at them, assesses them, deeply contemplates the possibilities of developing the ideas presented, generalizing the known facts, applying the results obtained. His frequent statement that this or that problem "contains topics for a number of diploma papers or dissertations" characterizes him both as a man and as a scientist.

Nečas is not able to keep a reserved standpoint. He is always active, involved, contributing by remarks and ideas in every domain of mathematical (and not only mathematical) life. He flings himself into attempts of reforms of education, of

improvement of the pedagogical process. This is naturally a domain much more difficult and "dangerous" than mathematical research. Therefore it is not so easy to trace distinctly such successful contributions as in research. Nonetheless, even here Nečas' influence is non-negligible. This is demonstrated among other by concrete results of his pedagogical efforts, by the modern content of his lectures and seminars attracting numerous attendance, and last but not least by the crowds of graduate and doctoral students looking for him in their hope that he will guide them in a fruitful and bearing direction. Nečas' last "adventure" in reforming mathematical education is the foundation of an interdisciplinary specialization "Mathematical and computer modelling in physics".

It is difficult and maybe impossible to squeeze such a "multidimensional" personality as J. Nečas is onto a (twodimensional) surface of paper sheets. Whatever the result of our efforts may be like, we have enjoyed writing about Jindřich, and in the conclusion we wish (rather untraditionally) to ourselves and to the whole mathematical community that Jindřich's eagerness to develop mathematics and to win more and more people for this activity may not cease for many years to come.

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