

The History and Perspectives of the Development of Applied Geometry in Russia¹

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Abstract. Here the development of Descriptive Geometry as a scientific discipline in Russia and its transition to Applied Geometry is presented. It includes the main authors and the directions of research as well as the tasks of the organization plan and the methodical plan for the nearest future.

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1. The development of Descriptive Geometry

The coming into being and the development of Applied Geometry is indissolubly connected with its main basis — *Descriptive Geometry*. The concentration on Descriptive Geometry in Russia began in the thirties and forties of the 20th century with contributions of N.A. GLAGOLEV, O.A. VOLBERG and N.F. CHETVERUHIN. As they all had passed a mathematical education and worked at schools and universities, they began to consider Descriptive Geometry as a part of mathematics. The deviation from the narrow view on Descriptive Geometry only as a sketching grammar and the creative assimilation of achievements of the classical German geometry school laid the foundation and planned the ways for its development.

In those years the scientific view on “image theory” was formed. The relationship between different sorts of mappings and different geometries (projective, affine and Euclidean) were studied and they were brought into the concepts of projectively, affinely and metrically complete images (O.A. VOLBERG, N.F. CHETVERUHIN). From Algebraic Geometry the methods of modifying surfaces by transformations were drawn to Descriptive Geometry (N.A. GLAGOLEV and his pupils).

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After that a natural stratification of the ways of research occurred. The main part of research was directed to the development of multidimensional geometry, non-Euclidean geometry and non-pointed spaces (N.M. BESKIN, B.A. ROZENFELD, Z.A. SKOPETS, I.M. YAGLOM and others). After N.F. CHETVERUHIN's came to MAI² and organized the *Moscow City Seminar on Descriptive Geometry*, the scientific research in the various departments improved greatly. The regular work of the seminar, the publication of its papers and the organization of respectable conferences in Riga, Tashkent, Tbilisi, Kazan and other cities in the fifties and sixties was essential for the appearance of a lot of talented specialists

- in Moscow (M.Y. GROMOV, I.I. KOTOV, V.N. PERVIKOVA, N.N. RIZHOV, A.M. TEVLIN, S.A. FROLOV, A.V. BUBENNIKOV and others),
- in Kiev (S.M. KOLOTOV, A.V. PAVLOV, V.E. MIHAILENKO, A.L. PODGORNIY, V.S. OBUHOVA and others),
- in Tbilisi (G.A. VACHNADZE, E.A. MCHEDLISHVILI, I.S. DZHAPARIDZE and others),
- in Leningrad (G.D. ANANOV, K.I. VALKOV, P.V. FILIPPOV), and
- in other cities: L.N. LIKHACHEV (Riga), A.N. PODKORITOV (Omsk), G.K. NIKOLAEVSKY (Harkov), M.M. YUDITSKY (Militopol) and others.

As a result of it, rather strong scientific schools appeared which were led by high-educated specialists. The main achievements in that period in Russia were made in the development of methods of *image theory*. They were: combined images (I.I. KOTOV), nonlinear cyclography (Z.A. SKOPETS), the generalizations to multidimensional and non-Euclidean spaces (V.N. PERVIKOVA, P.V. FILLIPOV, N.V. NAUMOVITCH and others), the theory and practice of the construction of linear perspectives (K.I. VALKOV, N.A. KUZNETSOV); the generation, the images and the research of properties of surfaces, curves and composite lines (M.Y. GROMOV, A.V. BUBENNIKOV, I.I. KOTOV, N.N. RIZHOV, A.M. TEVLIN and a lot of others).

2. The transition to Applied Geometry

A lot of researches began to exceed the limits of Descriptive Geometry. The questions of images of compound forms began to be combined with the problem of their automatic construction, research and application. Methods of adjacent parts of mathematics and engineering disciplines were introduced on the base of a wide introduction of electronic-calculating technics to science and technique. So, a scientifically technical process assisted the transition of research from the field of Descriptive Geometry to the wider field of Applied Geometry.

The new requirements of the head examination board (VAK) in the USSR appeared in the connection with its reconstruction in the midst of the seventies and they assisted the afore-mentioned transition, too.

In these years a new wave of members of scientific staff appeared both from the departments of engineering graphics and from industry, mainly from aviation industry. They laid special stress on the research of applied type, directed towards the solution of tasks of *automated construction* and *technologic preparation* for the industry — in the interest of forward branches of industry, building and architecture. These researches were executed under the guide of I.I. KOTOV, his pupils and followers: V.A. OSIPOV, V.A. BUSIGIN, K.M. NADZHAROV, V.S. POLOZOV, A.D. TUZOV, V.I. YAKUNIN and others. For solving the tasks of projection of compound technical forms *non-linear Descriptive Geometry* was developed under inclusion of algebraic geometry methods (G.S. IVANOV, N.V. NAUMOVICH,

²Editor's note: Moscow State Aviation Institute.

V.A. PEKLICH, U.P. SUHAREV). The solution of tasks of physical-chemical analysis and the studies on the dependence “structure – quality” required the development of methods of *multidimensional and non-Euclidean geometries* (V.Y. VOLKOV, N.V. NAUMOVICH). Also the works executed for the solution of applied tasks by methods of nomography should be mentioned (G.S. HOVANSKY, S.N. BORISOV).

It should be mentioned that the united work of the leading specialists assisted the high scientific level of the dissertations for the Doctor degree. The contributions of V.E. MIHAILENKO and A.K. PODGORNYY (Kiev) and V.Y. VOLKOV (Omsk) to the Moscow specialized union and the work of G.S. IVANOV (Moscow), V.S. POLOZOV (Nizhny Novgorov), and P.V. FILIPPOV (Leningrad) for the Kiev union affected essentially an increase of the scientific level and the applicability of the defended dissertations. To the achievements of those years we should attribute the preparation of qualified specialists for various union republics: E.A. STARODEKO (Byelorussia), B.N. NURMAHANOV (Kazakhstan), K.A. SOGOMONYAN (Armenia) etc.

3. Future perspectives of Applied Geometry

The collapse of the USSR deteriorated the conditions for a close collaboration, which existed between the specialists of Russia and the Ukraine in the field of Applied Geometry. None the less, the high scientific potential grown in the years of close cooperation let prepare a wide circle of high-qualified specialists in both republics. In Russia we should attribute to U.I. DENISKIN, V.A. KALININ, V.G. LI, V.V. MARTINOV, V.V. NAYHANOV, S.I. ROTKOV, V.U. URKOV. We also point out dissertations for Doctor degree, defended by specialists of our departments of the history of science (B.F. TARASOV) and of pedagogy (I.N. AKIMOVA, L.A. NAYNISH, V.I. NILOVA, L.G. NARTOVA).

Though the list of the new doctors of studies is rather spacious, their scientific interests don't comprehend all the directions of Applied Geometry. The scientific level of the dissertations on pedagogy isn't high. It is aggravating that the scientific forces are separated into three doctor's unions (Moscow, Nizhny Novgorod, Omsk). This will lead undoubtedly to the competition of these unions in the struggle for competitors, and, consequently, to the decrease of levels for the requirements of dissertations.

The amount of hours, devoted to the courses of Descriptive Geometry and Engineering Graphics is decreasing undeviatingly. This is caused by bad work of the scientific-methodical council on the development of the structure and content of the teaching courses: they obviously don't correspond to the requirements of the present. For instance, why should a modern engineer know the method of constructing the curve of intersection between two surfaces?

It is obvious that for overcoming these difficulties a number of essential problems of organization, of scientific and methodical type should be solved in the nearest future:

It seems that in the *organization plan* it is necessary

- to combine the efforts and the scientific potential of all the specialists in Russia in the field of Applied Geometry (the foundation of an All-Russian specialized magazine or a collection of publications, the constitution of one (or maximally two) councils for the defense of dissertations);
- to revive the former connections with the specialists in Ukraine and other countries of SNG in the way of organizing joint conferences and the joint approbation of doctor's dissertations;
- to establish closer connection with ISGG.

In the *scientific plan* the presidium of the scientific-methodical council jointly with the representatives of the specialized councils should formulate the actual directions of research for the solution of problems of modern science and technique, such as elaboration of geometrical problems for the solution of optimization tasks in technique, technologies, and economy, the construction of models of spaces of different dimensions, structures, etc.

In the *methodical plan* there has brewed the necessity of the revision of structure and content of the studying courses in view of modern requirements. In particular, the questions destined only to the development of spatial conception of the students should be deleted from the courses on Descriptive Geometry. It is necessary to lay special stress on parallel studies of constructive and analytical methods for the solution of tasks with the accented attention to universal algorithms working in multidimensional spaces. It is necessary to display the connections between the methods of Descriptive Geometry and those of special disciplines together with that of general education.

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