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In the Vanguard of Chemical Progress (Jubilee of *Uspekhi Khimii*)

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In 1982 fifty years have elapsed since appearance of the first issue of the periodical *Uspekhi Khimii*.

This journal was founded at the beginning of the 1930s by a decision of the USSR State Education Committee to publish the most important reviews in the field of theoretical and experimental chemistry and chemical technology, as indicated in the first editorial statement[1]. This had serious methodological or generalising value and resulted from constructive critical thought combining the most recent scientific advances into a single elegant whole. It has now become the leading publication of the USSR Academy of Sciences having comprehensive chemical interest, on whose pages are fully reflected all aspects of the development of chemical science in our country and abroad.

For a long period of time now, coinciding with exceptionally vigorous development of chemical science, *Uspekhi Khimii* has performed successfully two important and worthy functions. Firstly, the journal is the most authoritative vehicle for the most recent theoretical and practical achievements of Soviet chemists, regularly acquainting the international chemical community with them. The reviews carry great weight and authority, since they have usually been presented as serious scientific and analytical summaries of the results of many years' experimental or theoretical investigations by whole teams of scientists, which had already been approved either as ordinary papers or at congresses and conferences, and in several cases have been incorporated into current practice. The second function of the journal is to acquaint the Soviet specialist reader with the most important achievements of world chemistry and cognate disciplines, with the best reviews, and with current trends. Since chemical science in our country, while retaining, of course, all its national, organisational, and historic features and traditions, also constitutes an extremely authoritative part of the world chemical community, making its own original contribution to the general development of this science, these two scientific information functions have long been the principal characteristics of the activity of the journal: *Uspekhi Khimii* is now one of the most authoritative vehicles of the international policy of world scientific collaboration, contributing by its work to the comprehensive development of current scientific and technical progress.

Analysing the various aspects of the many sided scientific informational, educational, and also organisational activity of the journal, reflecting the growth in its international authority, it is of interest to recall the creative history of *Uspekhi Khimii*, in order to assess through the prism of its most important scientific papers the contribution that academic chemists have made to the development of Soviet chemical science and industry, to the establishment and elaboration of new branches and trends, also to the organisation and growth of the chemical press and chemical education, and to the training of scientific and technical personnel in our country.

Five main periods of activity of the journal can now be distinguished—an initial stage (from the founding to the beginning of the 1940s), its work during the years of the Great Patriotic War (1941–1945), then the first postwar decade, the 1950s and 1960s, and the present stage—each period characterised by definite scientific and organisational experience, reflecting the efforts by members of its

editorial boards and all its authors and collaborators, which has now served the scientific training of several generations of research chemists.

The initial stage, associated with the names of the founders of the journal (N.P.Gorbunov, A.N.Bakh, A.M. and B.M.Berkengeim, E.V.Britske, S.I.Vol'fkovich, V.V.Potemkin, N.D.Zelinskii, N.S.Kurnakov, and A.N.Frumkin), was distinguished by exceptional fruitfulness. In view of the long absence of a chemical review journal of our own together with a large accumulated scientific potential, due both to many years of work by older generations of chemists and to the influx of fresh scientific and technical personnel, the main value of the journal during those years lay chiefly in its informational and organisational functions both in fundamental science and in the practical application of chemical advances to the national economy.

Founded in the circumstances of the industrial upsurge of the early five-year plans, *Uspekhi Khimii* responded promptly during those years to the most urgent problems of the chemical industry then being established in the USSR. The first issue already containing the full text of the directive by the USSR State Planning Committee and the Committee on Chemicalisation of the National Economy to draw up a plan for scientific research on chemistry and chemical technology[2], in which growth of the chemical industry depended on solving problems of fuel and power (the efficient industrial utilisation of petroleum, coal, lignite, bituminous shales, and peat, and also the liquefaction of solid fuel), working out the most effective technical chemical processes in ferrous, non-ferrous, and electrical metallurgy (development of flotation methods, formulation of novel metal alloys, in particular acid-resistant, heat-resistant, and high-speed steels, protection of metals from corrosion, use of oxygen in metallurgical processes, extraction of light metals—lithium, sodium, beryllium, magnesium, aluminium), chemicalising agriculture and forestry (the search for combined and concentrated organic and inorganic fertilisers, use of new insecticides, development of agricultural chemistry and biochemistry), and finally developing further mineral and organic technology with the aim of obtaining inorganic and organic substances, products, and materials†.

The pages of the journal reflect during those years the problems of combining power–chemical, metallurgical–chemical, and purely chemical processes in single industrial units, aspects of the study of rare and radioactive elements with procedures for their isolation and separation, technological features of the production of ammonia, chlorine, bromine, and iodine, improvements to the cracking of petroleum, the manufacture of synthetic rubber, dyes, artificial fibres, and plastics, medicinals, surface-active agents and perfumes, lubricating oils, and many other products of industrial importance.

The journal paid close attention also to raw-materials problems. The first issue already contained a paper# by A.E.Fersman on "New Problems in the Study of Mineral Resources", devoted to aspects of the utilisation of air, clay, sand, quartzites, and nephelines in large-scale combined production. Together with problems of the technology of natural resources (metals, sodium carbonate, cement, silicates) several papers examined aspects of the widespread industrial use also of agricultural resources (manufacture of alcohol, acetone, acetaldehyde, furaldehyde, acetic acid), the development of biochemical methods for increasing the content of valuable substances in plants (fibres, oils, fats, ethers, esters, starch, glycerol, proteins, vitamins, alkaloids, and tanning agents), and also the production of important organic compounds (hydrocarbons, ethylene, acetylene, butadiene, fatty acids). Effective use of solar energy was regarded as having promise for the future.

Papers in the journal during those years responded also to problems involved in establishing and developing new provincial industrial complexes. Thus aspects of the investigation of natural salt equilibria in terms of physicochemical analysis, developed in N.S.Kurnakov's school, were examined in the paper "The Kara-Bogaz-Gol Problem"; a special paper was also concerned with prospects for industrial organic synthesis associated with construction of the Kuibyshev hydroelectric station and the Second Baku.

Industrial growth in chemical fields of the national economy should be based on an intensification of fundamental scientific research, directed primarily at study of the structure of matter by the latest physical methods, development of the theory of catalysis and chemical kinetics, study of surface phenomena (including adsorption), application of new physicochemical methods to solve problems of organic chemistry, development of new production processes based on novel catalytic reactions, application of the methods of colloid chemistry, and study of solid-phase and photochemical reactions, as well as the chemistry of ultrapure substances.

Among the chief administrative measures taken to secure such investigations were development of a network of general and specialised research institutes and up-to-date works laboratories, and also expansion of the research activity of higher educational institutions with intensified training of personnel for scientific research (in 1939 the journal published the slogan of the Mendeleev All-Union Chemical Society "Youth for Science!").

Thus the historical circumstances of these years themselves promoted in every possible way conversion of the first native academic review journal into a unique and most authoritative forum of science, information and organisation to bring together the combined efforts of all investigators developing new lines of chemical research in the country.

Analysis of the activity of the journal shows that it coped with the task entrusted to it, many of its papers on fundamental science paving the way for current chemical trends. From a methodological point of view, perhaps the most considerable achievement of *Uspekhi Khimii* during the initial period was to develop its own original scientific personality, with an independence and systematic strategy for interpreting current chemical advances. The strategy consisted in particular in orienting the journal towards quantitative features of various aspects of chemistry and elucidating the physical nature of the principles underlying chemical changes.

Although the journal has on the whole preserved its chemical character from its founding till the present time, its editorial board realised even during the initial stage that future progress in all chemical sciences would be determined in considerable measure by advances in contemporary theoretical and experimental physics, including quantum mechanics. In the opinion of I.Langmuir, a paper by whom was published in the journal§, theoretical scientific research is of

†One detail indicating the active organising work of the editorial board of *Uspekhi Khimii* was a special note asking readers to send in their additions to this plan, for consideration by the Chemicalisation Committee in the subsequent planning of scientific research topics.

#Precise references to all the papers discussed subsequently in the survey can be found from keywords in review titles or from the reviewers' names in the appropriate subject and author indexes[3].

§The work of foreign investigators was published in *Uspekhi Khimii* during those years either as Russian translations of contributions to international periodicals or as specially commissioned papers and reviews by leading specialists.

immense value to mankind. However, although theoretical physics underwent an exceptional flowering precisely during those years, the validity of a so-to-say "physical" orientation for a chemical publication was nevertheless far from obvious at that time, and it is only now that, while giving credit to the scientific intuition of the journal, we are able to assess the correctness of the path chosen.

Among purely physical contributions of those years ("Physics of the Nucleus" by P.Debye, "Atomic Structure and Chemistry" by B.F.Ormont, "New Elementary Particles" by E.V.Shpol'skii and later D.D.Ivanenko, "Nuclear Reactions" by S.Z.Roginskii, and "Isomeric States of Atomic Nuclei" by A.A.Grinberg) work on natural and artificial radioactivity and the production of new elements (protactinium, neptunium, technetium, francium) attracted especial attention from the journal. As always, preference was given to original sources, i.e. contributions by the most authoritative workers in these fields (F.Joliot and I.Joliot-Curie's "On the Artificial Production of Radioactive Elements", O.Hahn's "Application of Radioactive Methods to Chemistry" and "Chemical Elements and Natural Forms of Atoms", L.Meitner's "On Artificial Radioactivity" and I. and W.Noddacks' "Current State of Theories of Radioactive Disintegration").

The reader was kept regularly informed of advances in research on nuclear fission (papers by F.Joliot and N.Bohr on "New Work on the Splitting of Uranium and Thorium Nuclei" and "Spontaneous Fission of Uranium"), and briefly acquainted annually with the current literature on nuclear physics, with sessions of the Physics Group of the USSR Academy of Sciences, and also with foreign and All-Union scientific conferences (we may note I.V.Kurchatov's report on the 1940 All-Union Meeting on the Physics of the Atomic Nucleus). As a consequence of such effective operations by the journal every chemistry specialist who regularly examined its contents could be kept informed on the most recent scientific advances in these fields during all those years.

The achievements of nuclear physics and the discovery of new elements aroused great interest at the time in the structure of Mendeleev's Periodic System of the Elements and in the nature of the Periodic Law. The journal satisfied readers' interest in these problems extremely fully, with articles by such authorities as E.Rutherford ("The Periodic Law and its Interpretation"), L.Meitner ("Atomic Weight in Present-day Science"), and V.G.Khlopin ("Transmutation of Elements and the Periodic Law"); that by B.M.Kedrov refined the very concept of "chemical element".

Progress in all these scientific fields would have been inconceivable without the creation of a universal theoretical apparatus to describe microphenomena—quantum mechanics—the current state of which was presented in E.Schrödinger's paper. Among its contents, the journal revealed also the contemporary quantum-chemical treatments of such concepts as "chemical bond" and "valency", by linking analytical papers on this important topic with instructive surveys in the 1940 Section "Aid to the Chemistry Instructor in Higher Education", in which Ya.K.Syrkin, M.E.Dyatkina, and A.A.Zhukhovitskii were active.

Another important feature of the quantum mechanics of those years reflected in the papers of *Uspekhi Khimii*, besides its contribution to pure physics and the study of molecular structure, was its incipient penetration even into chemistry. The development of quantum mechanics at that time acted as a powerful stimulus to that of several classical fields of physical chemistry (e.g. the quantum-mechanical adsorption theory of D.Blokhintsev and S.Shekhter), and to the establishment of a basis for a new and independent branch of science—chemical physics, whose object was to investigate the fundamental physical principles of chemical reactions.

Since many of the fundamental successes of chemical physics in understanding the physical essence of chemical processes occurred precisely in prewar decades, it is remarkable that establishment of the journal *Uspekhi Khimii* (1932) almost coincided in time with foundation of the USSR Academy of Sciences' Institute of Chemical Physics (1931), the first in the world, whose chief scientific interests and achievements (a physical basis for the concepts of valency and chemical affinity, investigation of chemical kinetics and construction of a theory of primary chemical processes in gas and condensed phases, study of the mechanism of energy exchange and transfer in chemical reactions, development of new physical research methods), and also the production of novel substances and materials (e.g. artificial diamonds—O.I.Leipunskii) are reflected in the pages of the journal from the very early years right until the present time.

N.N.Semenov's paper "Chemical Forces and the Theoretical Foundations of Chemical Kinetics" in the first issue already drew attention to the inability of classical physical chemistry—based on thermodynamics, which is concerned with equilibrium states (and therefore, in the author's opinion, would have been more correctly termed *thermostatics*)—to provide a true understanding of the dynamic process of chemical change, i.e. to solve the main problem of chemical physics, which is to calculate absolute rates and activation energies of chemical reactions. This paper suggested that the theoretical principles of chemical kinetics should be based on atomic structural data treated by quantum mechanics; methods for estimating forces of chemical affinity from the analysis of continuous and line spectra and use of these results in chemical dynamics were given for several thermal and photochemical reactions, including various types of dissociation and association stages and energy-exchange processes.

Prewar decades, which coincided with the years during which the scientific activity of the journal was initiated and developed, were characterised by exceptional progress in chemical physics, especially in those branches concerned with formulating a theory of primary chemical processes. *Uspekhi Khimii* showed great efficiency in publicising all these achievements, so that several basic researches in this field, undertaken both in the USSR and abroad, and of fundamental importance for the subsequent development of chemical science, as is now evident, appeared in the journal amost without delay.

Such work included the theory of thermal ignition (N.N.Semenov) and a mathematical formulation for describing thermal flame propagation(D.A.Frank-Kamenetskii), the theory of branched chain reactions, which explains the nature of the lower and upper (pressure) limits of ignition in the oxidation of hydrogen and other elements (N.N.Semenov, C.N.Hinshelwood), and finally direct spectroscopic proof of intermediate formation of the free radical HO· and the determination of its concentration during the oxidation of hydrogen (V.N.Kondrat'ev).

Exceptional progress was made during those years also in formulating theoretical principles of chemical kinetics, with the introduction of such basic concepts as the potential-energy surface and the barrier to reaction. The reader could become acquainted with them from original sources—through review papers by the founders of the theory of rate processes and the transition-state method—H.Eyring, M.Polanyi, E.Wigner, and their successors. Later a special issue appeared in memory of N.A.Shilov, who had elaborated the theory of concerted chemical reactions and made a considerable contribution to the development of several branches of physical chemistry.

Progress in quantum theory, as well as in chemical physics and the kinetics of primary chemical processes, served during those years as a powerful stimulus to elucidation of

the fundamental physical principles underlying chemical changes involving complicated organic compounds. The most significant contributions on this theme were theoretical papers by E.Hückel and by L.Pauling, in which discussion of the structure and the properties of several aromatic and unsaturated organic molecules involved use of molecular orbitals and resonance theory, and also C.K.Ingold's papers ("Principles of the Electronic Theory of Organic Reactions" and "Structure of Benzene"), in which the concept of mesomerism (B.Eistert) was used in posing the same problems. Together with L.Hammett, who published in *Uspekhi Khimii* his review "Some Relations between Reaction Velocities and Equilibrium Constants", which initiated the subsequent widespread use of correlation equations in chemical kinetics (principle of the linear variation of free energy), and in the 1960s introduced the concept of the acidity function H_0 of solutions of strong acids. All the above authors are regarded as founders of the new scientific discipline that was subsequently termed *physical organic chemistry*.

Together with all these trends, research on physical chemistry was also actively pursued during prewar years, and was also exceptionally fully represented on the pages of the journal. This involved physicochemical analysis of salt and colloidal systems, and also of metallic equilibria, the theory of intermolecular forces (G.Briegleb), the theory of melts and solutions (numerous articles on their viscosity and electrical conductivity were provided by V.K.Semenchenko, a collaborator of the journal for many years), the theory of aerosols, adsorption, condensation, evaporation, and vapour pressure. During these and subsequent years the journal reflected in detail the physicochemical interpretation of the photographic process—the theory of the photolysis of silver bromide and formation of the latent image in the emulsion (K.V.Chibisov), optical sensitisation (Kh.S.Bagdasar'yan) and desensitisation, aspects of the mechanism of development, including that of multilayer colour film.

An important direction in which *Uspekhi Khimii* was active in the initial period, which later became traditional, was detailed coverage of the theory and practice of physicochemical methods of investigation and analysis. The journal always appreciated the importance of such contributions, for their conclusions and recommendations were generally promptly used by chemists of the most diverse specialities and have very many practical applications. During the 1930–1940s reviews and papers were published on X-ray structural analysis (W.Bragg), on crystal-optical methods of investigation, dipole moments (N.Sidgwick), the parachor, X-ray diffraction by liquids (H.Stuart), thermotensimetry and calorimetry, ultrasonic methods.

Since many of these methods were at that time relatively novel and not always known to a wide circle of readers, it was important to acquaint specialists with their theoretical basis and practical applications, by publishing papers by their direct originators. This applies to the ultracentrifuge (T.Svedberg), and also to the then recently discovered Raman effect (L.I.Mandel'shtam, G.S.Landsberg), which during those years was used especially widely to establish the structures of organic, inorganic, and polymeric molecules, and also to analyse the hydrocarbons present in liquid fuels. *Uspekhi Khimii* printed also work on molecular spectroscopy (as applied to problems of molecular structure or thermodynamics—Ya.I.Gerasimov), on polarography and chromatography, which subsequently became among the most popular research methods in chemistry and have occupied a prominent place in later issues.

The range of scientific activity of *Uspekhi Khimii* was extremely diverse during those years. The pages reflected organic chemistry (reviews by N.Ya.Dem'yanov and M.Tiffeneau on the novel molecular rearrangements of cyclic hydrocarbon systems with ring expansion and contraction that they discovered), the coordination chemistry of complex compounds (I.I.Chernyaev and A.A.Grinberg's papers), geochemistry (A.P.Vinogradov's papers), the chemistry of hetero-organic compounds—of lithium (G.Wittig), boron and thallium (N.N.Mel'nikov), mercury (A.N.Nesmeyanov), germanium, tin, and lead (K.A.Kocheshkov), and phosphorus (V.M.Plets)—and the chemistry of macromolecular compounds (contributions by H.Staudinger and W.Carothers, its founders), which was especially evident on the pages of the journal during the following decades.

Much of the work published in *Uspekhi Khimii* received high international recognition. Thus physical fields of chemical research or the establishment of novel chemical disciplines were reviewed by winners of the Nobel Prize for chemistry—F.Aston, G.Wittig, O.Hahn, P.Debye, I. and F.Joliot-Curie, W.Lipscomb, I.Langmuir, G.Natta, L.Pauling, W.Prelog, T.Svedberg, N.N.Semenov, G.Seaborg, J.Wilkinson, O.Fischer, G.Hevesy, C.Hinshelwood, H.Staudinger, H.Urey—during various years. Another leading research subject during the 1920–1930s was the chemistry of natural compounds. It is sufficient to state that around ten Nobel Prizes were awarded for work in this field during fifteen prewar years. Most of the winners—A.Windaus (sterols), P.Karrer (carotenoids and flavins, vitamins A and B_2), R.Kuhn (carotenoids and B-group vitamins), A.Butenandt (hormones), L.Ruzicka (polymethylenes and higher terpenes), G.Wieland (cholic acids and oxidative dehydrogenation reactions in Nature)—reviewed their achievements on the pages of this journal. A contributor in 1947 was R.Robinson (research on plant anthocyanins), and later contributors included R.B.Woodward (vitamin B_{12} and development of the chemistry of natural products), A.Todd (nucleotides and coenzymes), D.Crowfoot-Hodgkin (X-ray structural analysis of protein crystals), and quite recently J.Cornforth (biosynthesis of sterols).

The increasing international and All-Union authority of the journal led to the appearance on its pages of papers devoted to several important theoretical studies by major science schools—those of A.N.Frumkin (physicochemical basis of flotation theory and nature of the electrical double layer in electrochemistry), V.M.Goldschmidt (foundations of quantitative geochemistry and principles of the distribution of chemical elements in minerals and rocks), L.Michaelis (semiquinones—intermediate stages in reversible oxidation–reduction involving quinones and hydroquinones), A.Szént-Györgyi (concept of biological oxidation), O.Meyerhof (bioenergetics of muscular contraction), A.N.Bakh (theory of slow oxidation and activation of oxygen in biological systems), and D.Brønsted's theory of acid–base equilibrium.

The great and fruitful editorial experience that had accumulated by the end of the first decade enabled the journal during its subsequent growth to evolve that combination of breadth of coverage of all contemporary chemical literature with depth of insight into physical essence that even in future years will determine the character of much of its contents.

Sometimes the appearance of particular reviews was dictated by contemporary circumstances (e.g. a series of reviews on chemical warfare agents—mustard gas, chloroarsines, lachrymators—and problems of chemical protection), in other cases by the interest taken by the journal in extreme states of matter (chemistry at high temperatures and at high and ultrahigh pressures) and in novel types of action on matter (electric discharge, electric or magnetic fields (E.Müller), ultrasound), or finally simply by day-to-day practical demands, such as reviews on analytical chemistry (radioactive and adsorption indicators (I.M.Kolthoff), organic reagents in inorganic microanalysis (F.Feigl), and

microanalytical advances in studying the composition of minerals and technical products—I.P.Alimarin). During all those years, however, the journal not only followed faithfully the chemical traditions of that time but in several cases was ahead of them or even initiated new ones. By embracing comprehensively almost all the traditional branches of chemistry, many of which, enriched by a physical or physicochemical approach, often evolved into new and independent sciences, the journal served always as a unique methodological clasp permitting the particular scientific interests of chemists of various specialties to be combined into a single whole and conferring on its work a general chemical importance, which it has consistently maintained throughout its half-century history.

Besides its main scientific work *Uspekhi Khimii* paid great attention during all those years to chemical bibliography and the current literature, published many different kinds of information notices and reports (in particular on the activities of science laboratories and institutes of the USSR Academy of Sciences—Institute of General and Inorganic Chemistry, Institute of Organic Chemistry, Bakh Institute of Biochemistry, High-pressure Laboratory—and also on sessions and meetings of the Academy, international scientific congresses, and Mendeleev congresses on general and applied chemistry), and inserted topical notes on various competitions and awards of prizes: i.e. it undertook the great task of informing its readers of the most important events in contemporary chemical science.

Historical and biographical matter also occupied a special place. The journal regularly printed papers and notes on the pioneers of chemical science (M.V.Lomonosov, D.I.Mendeleev, A.P.Borodin, A.B.Bidgeim, M.Berthelot, J.J.Berzelius, J.J.Becher, J.H.van't Hoff, F.Wöhler, J.W.Gibbs, S.Sörensen, H.L.le Châtelier, J.Priestley, J.Thomson, M.Faraday, M.E.Chevreul) and also on eminent contemporary Soviet and foreign academic chemists (A.N.Bakh, A.M.Berkengeim, M.A.Blokh, N.A.Vorontsov, K.K.Gedroits, D.K.Dobroserdov, A.P.Karpinskii, N.S.Kurnakov, A.N.Lebedev, V.V.Longinov, B.N.Menshutkin, V.K.Pershka, N.P.Peskov, L.V.Pisarzhevskii, D.N.Pryanishnikov, A.N.Reformatskii, V.E.Tishchenko, A.E.Favorskii, N.I.Chervyakov, P.P.Shorygin, A.Pictet, J.Ray, M.Sklodowska-Curie, J.Urbain).

The journal published several interesting memoirs (e.g. by P.L.Kapitsa on E.Rutherford, by N.S.Kablukov on the development of chemistry in Moscow University since the 1870s), the historical study by S.S.Nametkin, "Chemistry in Moscow University for 185 Years", and also an analysis of the work of the celebrated International Congress of Chemists at Karlsruhe (1860).

The proportion of articles and reviews of historical and biographical character grew somewhat during the war years, when difficulties in the exchange of world scientific and technical information resulted in a diminished volume of strictly scientific matter, although the journal continued to appear regularly. The editorial board during those years comprised B.M.Berkengeim and V.G.Khlopin (editors-in-chief), A.F.Plate and V.V.Serpinskii (secretaries-in-chief), G.V.Akimov, A.I.Brodskii, A.P.Vinogradov, A.D.Gel'man, B.A.Kazanskii, A.F.Kapustinskii, and A.E.Porai-Koshits. The historical and biographical matter published during the 1940s and 1950s was distinguished by great variety and completeness. Together with biographical information and articles on memorable dates in the history of science, associated with the names of V.F.Alekseev (discovery of the law of the rectilinear diameter), N.N.Beketov, A.P.Borodin, A.M.Butlerov, E.E.Vagner, A.A.Voskresenskii (unknown letter of J.Liebig about him), A.N.Vyshnegradskii and G.G.Gustavson (centenaries of birth), P.D.Dankov, I.A.Dvigubskii (first Russian professor of chemical technology), N.N.Efremov, P.A.Il'enkov (centenary of appearance of *Kurs Khimicheskoi Tekhnologii*), A.A.Colley, D.P.Konovalov, M.G.Kucherov, V.V.Lermantov (author of an early theory of the photographic process), A.A.Letnii (75th anniversary of discovery of the pyrolysis of petroleum), T.E.Lovits, M.V.Lomonosov (bicentenary of his *Slova o Pol'ze Khimii*—"Some Words on Behalf of Chemistry"), V.V.Markovnikov, D.I.Mendeleev, N.A.Menshutkin, N.A.Morozov (scientific forecasts of the well known Schlüsselburger), E.I.Orlov, I.M.Sechenov (chemical work of the Russian physiologist), N.N.Sokolov, L.A.Chugaev, A.El'tekov, and A.A.Yakovskin, as well as A.Werner, B.Clapeyron, A.L.Lavoisier, J.Liebig, the journal continued to print diverse matter also on contemporary scientists (A.E.Arbuzov, G.I.Arbuzov, A.A.Baikov, A.A.Balandin, A.P.Belopol'skii, A.M.Bochvar, E.V.Britske, S.I.Vavilov, V.I.Vernadskii, V.N.Verkhovskii, S.I.Vol'fkovich, N.N.Vorozhtsov, E.N.Gapon, N.Ya.Dem'yanov, A.V.Dumanskii, I.I.Zhukov, Yu.S.Zal'kind, N.D.Zelinskii, S.I.Kanevskaya, V.L.Komarov, V.N.Kondrat'ev, D.P.Konovalov, P.P.Lebedev, S.V.Lebedev, A.I.Loginova, P.G.Melikishvili, Ya.I.Mikhailenko, I.N.Nazarov, S.S.Nametkin, V.A.Nemilov, A.N.Nesmeyanov, B.A.Nititin, B.A.Pavlov, N.P.Peskov, V.M.Petriashvili, L.V.Pisarzhevskii, S.A.Pletenev, A.E.Polesitskii-Yakhnin, A.M.Polyak, A.E.Porai-Koshits, A.V.Rakovskii, P.A.Rebinder, S.Z.Roginskii, V.M.Rodionov, N.N.Semenov, V.K.Semenchenko, M.I.Ushakov, S.N.Ushakov, A.E.Fersman, A.V.Frost, V.G.Khlopin, and I.I.Chernyaev). Furthermore, the journal printed during those years the correspondence of N.N.Zinin, V.V.Markovnikov, A.M.Butlerov, and D.I.Mendeleev (in particular with "supporters" of the Periodic Law—Lecoq de Boisbaudran, Winkler, Nilson, and Brauner), articles on important dates in the history of the discovery of individual chemical elements (argon, ruthenium), on the founder of the nitrogen industry in Russia (I.I.Andreev), and also on the influence of the Kazan chemical school on development of the world chemical industry.

A special issue in 1943 was devoted to the centenary of the discovery of aniline by N.N.Zinin; it included three papers by the eminent Russian chemist and comprehensive biographical material on his life and work. *Uspekhi Khimii* printed other interesting historical studies (e.g. "Some Facts on Chemistry in Armenia from Early Manuscripts"), played an active part in preparations for celebrating the bicentenary of the USSR Academy of Sciences, and, finally, published jubilee reviews on the development in the USSR during the previous 25 years of organic chemistry (A.N.Nesmeyanov), the chemistry of organic dyes and intermediates (A.E.Porai-Koshits), general and inorganic chemistry (A.A.Grinberg), and biochemistry (A.N.Bakh).

Among scientific matter in the journal during the war years were reviews on the chemistry of chlorophyll (by B.N.Stepanenko, who during subsequent years wrote on carbohydrate chemistry in the journal) and on the mechanisms of organic addition, elimination, and substitution (L.M.Smorgonskii), and a fundamental paper on the series rule in analytical chemistry (N.A.Tananaev). During those years the journal followed attentively the achievements of the contemporary X-ray diffractometry and radioscopy of metals, metallic compounds, alloys, and melts; and work on the thermodynamics of solutions at high temperatures, on the application of its achievements to theoretical metallurgy, and on electrokinetic phenomena applied to electrolysis. Other reviews published at that time covered the molecular-spectroscopic analysis of organic compounds, the geochemistry of rare and trace elements in sea-water and the primary migration of radioactive elements in Nature (I.E.Starik),

and also results of and prospects for the coordination theory of A.Werner. Stereochemical matter was not confined to complex compounds (the journal had previously published P.Debye's "Stereochemistry and Physics", H.Hillemann's theory of molecular asymmetry, and M.V.Vol'kenshtein's theory of natural optical activity): interest was extended to internal rotation and rotational isomerism (M.V.Vol'kenshtein). Reviews were published during the war also on the stability of colloidal systems, molecular monolayers on a solid surface, and the role of intermolecular forces of attraction and repulsion in the formation of tactoids, thixotropic gels, and coacervates (I.Langmuir).

The steady interest in such a new subject (at that time) as the chemistry of isotopes requires special mention. As early as the prewar years *Uspekhi Khimii* published a paper by the discoverer of deuterium H.Urey, a fundamental review by F.Aston, who had made several discoveries in this field and had first detected 213 of the 276 then known stable isotopes of chemical elements, and a review by one of the founders of modern radiochemistry G.Hevesy, who had described the first application of radioactive indicators (labelled atoms) to biology. In the 1940s this method had already become one of the main tools of fine chemical research, and the journal helped in all possible ways to disseminate it, having at once published six important reviews, on the use of isotopes of nitrogen, carbon (V.L.Tal'roze, M.B.Neiman), iron (V.I.Gol'danskii, M.B.Neiman), and also deuterium (G.P.Miklukhin) and tritium in chemistry (in the investigation of reaction mechanisms) and in biology. Later, at the end of the 1950s and the beginning of the 1960s, authors providing contributions on radiochemistry were A.N.Murin (thermal diffusion methods for separating isotopes, chemical effects of nuclear reactions in solids), An.N.Nesmeyanov (chemical state of atoms formed in nuclear reactions, hot syntheses of compounds labelled with radiocarbon and tritium, vapour pressure measurements), and V.D.Nefedov (chemical changes in β-disintegration processes, radiochemical methods of obtaining hetero-organic compounds). A major experimental achievement in this field was also the design and accomplishment of a process for isolating more than 100 g of protactinium-231 from residues from the purification of uranium (D.A.Collins et al.).

The stimulation of chemical research, both fundamental and applied, determined the character of the journal in the immediate post-war decade. The extensive series of investigations begun at that time gave rise later to the reviews by A.I.Shatenshtein ("New Work on the Theory of Generalised Lewis Acids and Bases", "Acids and Bases in Liquid Ammonia"), G.A.Razuvaev ("Free-radical Reactions in Tetrachloromethane"), S.I.Vol'kovich ("Progress in Fertiliser Research"), Kh.M.Minachev ("Catalysis in the Hydrogenation of Fuels"), and F.F.Vol'kenshtein ("Electronic Theory of Catalysis on Semiconductors"), all this work being distinguished by the novelty of the theoretical approaches and the up-to-dateness of the experimental methods. The chemistry of natural products was widely represented in the journal at that time in contributions from L.D.Berel'son (steroid hormones, stereochemistry of steroids, chemistry of cortisone), V.M.Berezovskii (vitamins of the B_6 group, pteridines, flavins), N.S.Vul'fson (chemistry of pterins and, later, natural colouring matters), Z.A.Shabarova (structure and synthesis of nucleosides), I.Ya.Postovskii (antibiotics, natural guanidine compounds, antitubercular preparations), and M.M.Shemyakin (vitamins and their inactivators). Other active contributors were A.I.Kiprianov ("Influence of Solvent on Colour of Dyes (Solvatochromism)", "Effect of Steric Hindrance on Properties of Aromatic Amines and Nitro-compounds", "Colour of Dyes and Steric Interference in their Molecules") and A.N.Terenin ("Molecular Compounds and the Intermolecular Electron-transfer Spectrum"), both of whose researches were largely instrumental in converting photonics into an independent branch of science.

A characteristic feature of the work of *Uspekhi Khimii* at that time was unflagging attention to problems of catalysis. Even in its early contents, among which we may note in the first issue an encyclopaedic review by W.Frankenburg and F.Dürr (containing 860 references), it fully appreciated the outstanding value of this branch of science for development of the most diverse fields of chemistry—both its theoretical aspects (physical basis of catalytic reaction mechanisms and theoretical principles underlying the choice of catalysts) and its applied aspects (for the development of up-to-date large-scale catalytic manufactures).

During prewar and postwar years the journal published several important reviews whose authors had shown that the theoretical foundations of the science of catalysis were deeply rooted in the chemical physics and the physical chemistry of heterogeneous and homogeneous reactions (H.S.Taylor's concept of active centres on the surface of a heterogeneous catalyst, K.Weiss's scheme of redox catalysis on transition-metal ions, A.V.Frost's theory of the thermal conversion of hydrocarbons, M.V.Polyakov's idea of hetero-homogeneous reactions, and N.I.Kobozev's theory of active ensembles) and had shed light on the structure and properties of the most important heterogeneous catalysts, problems of the catalytic synthesis of ammonia, and the mechanism of hydrogenation reactions.

Special mention must be made here of the fundamentally important contribution to the work of the journal made by A.A.Balandin, who published in it all his main work—"Catalysis and Change in Form of Molecules", "Catalysis and the Periodic System"—and also a paper on the foundations of his multiplet theory of heterogeneous catalysis on metals, which was most completely formulated in a 1960s two-part paper ("Structural Factors in Catalysis" and "Energetic Factors in Catalysis"). In another contribution to the journal Balandin had raised as early as the 1940s the question of deducing theoretically the complete set of chemical reactions possible for any specified molecular system, and had proposed a special mathematics ("structural algebra") for its solution. This work was one of the first examples of the application, to the analysis of chemical problems, of the logical-heuristic approaches and methods of investigation that are now widely used in organic chemistry, hetero-organic chemistry, and stereochemistry under the general name of *molecular design methods*.

During the 1930s and 1940s contributions in which problems of catalysis were intimately related to those of organic chemistry became especially significant. The general prospects for this approach were outlined in a review by N.D.Zelinskii, A.A.Balandin, and A.M.Rubinshtein, in which catalytic interconversions of saturated, unsaturated, and aromatic hydrocarbons of open-chain and cyclic structure were acknowledged as the main line of investigation.

Hydrocarbon chemistry was very important during those years in connection with the need to solve the problem of obtaining natural and artificial liquid fuel. In *Uspekhi Khimii* these aspects were most widely exposed in a series of reviews by Ya.T.Eidus, who was concerned for a long time with theoretical and applied research on the synthesis of hydrocarbons by the catalytic hydrogenation of carbon monoxide (the Fischer–Tropsch reaction). The journal covered also aspects of the catalytic and contact desulphurisation of petroleum products, regularly acquainted readers with contemporary physicochemical methods of analysis of

hydrocarbon mixtures, and informed them of the most important advances in the processing of petroleum and the production of aviation fuel abroad.

Together with articles summarising the theory and practice of catalytic processes either for particular classes of typical chemical reactions—aromatisation (A.F.Plate), hydrogenation and dehydrogenation (R.Ya.Levina), ring-opening in cyclic hydrocarbons (B.A.Kazanskii)—or for certain types of catalysts (e.g. Raney), the journal regularly included reviews on the chemistry of individual key compounds of enhanced applied value. In the early stages the number of such publications was in general small (e.g. reviews on the use of aluminium chloride in organic chemistry, and also on methanol, pyridine, liquid ammonia, formaldehyde solution, phosphorus, and phosphoric acid). However, such reviews had already become traditional for the journal from the 1940s and 1950s, and covered an increasing variety of compounds.

Articles appeared also on the chemistry of several common large-scale products (gaseous alkanes and alkenes, actylene, butadiene, cyclopentadiene, lower aliphatic alcohols from alkenes, organosilicon monomers, cyanamide, hydrazine, activated carbon) and on new or non-traditional substances and reagents (selenium dioxide, diazomethane, lithium tetrahydroaluminate, new polymerisation initiators, and also boron trifluoride, whose great possibilities as an electrophilic catalyst for alkylation and isomerisation were exhaustively covered in reviews by A.V.Topchiev, Ya.M.Paushkin, and S.V.Zavgorodnii).

We must emphasise also the detailed exposure, typical of the work of the journal at the end of the 1940s and beginning of the 1950s, of progress in the study of several most important organic intermediates and starting materials for fine and special organic syntheses, investigated by the schools of I.N.Nazarov, A.A.Petrov, A.D.Petrov, M.F.Shostakovskii, and V.I.Isagulyants. These were usually unsaturated or difunctional compounds—1,3-dienes and diene esters (and also their halogeno-derivatives), divinyl ketones, pent-1-en-4-yn-3-ols, dienynes, vinyl ethers and sulphides, butadiyne, keten (A.Ya.Yakubovich), 1,3-dichlorobut-1-ene-β-amino-acids (V.M.Rodionov). Several industrially important organic reactions were also given detailed coverage—Kucherov hydration of alkenes (V.N.Belov), formation of oxirans, chlorination of alkenes (studied by N.I.Shuikin's school), alkylation of the aromatic ring (I.P.Tsukervanik), and sulphochlorination of alkanes (A.Ya.Yakubovich), in addition to the nitration of hydrocarbons, the mechanism of which was examined in detail in physicochemical terms by A.I.Titov.

During the postwar period the journal has paid unflagging attention not only to organic synthesis but also to aspects of inorganic and mineral technology. Discussion has covered a wide range of problems in the physical chemistry and technology of glasses, silicates, and spinellides, beginning with contemporary views on their nature (taking into account the contribution to this problem by the I.V.Grebenshchikov school) before examining the kinetics and the mechanism of reactions in solid mixtures (P.P.Budnikov) and specific aspects of glass-making. The journal has paid attention also to problems of thermal reduction methods in metallurgy and of physical phenomena in extrusion and sintering processes in powder metallurgy, and published reviews on the separation of rare-earth elements. Articles by S.I.Vol'fkovich were concerned with the broad task of obtaining compound mineral fertilisers by decomposing phosphates with nitric acid, and also with bringing the teaching of chemical technology up to date.

It must be noted that broadly all reviews on a then important applied subject were characterised by fundamental and diverse coverage of both theoretical and experimental matter, and played an important role in the participation of our chemists in the postwar rehabilitation and development of the chemical industry and the national economy in our land.

The fourth, transitional period in the work of *Uspekhi Khimii* (1950–1960s)¶, which involved preparations for increasing its size (1965), is of great importance for understanding how the present character of the journal has been moulded. It saw further activation of the work of the editorial board, which comprised V.V.Korshak (chief editor), B.M.Berkengeim, S.I.Vol'fkovich, M.M.Dubinin, B.A.Kazanskii, V.V.Mikhailov, B.V.Nekrasov, V.K.Semenchenko, A.M.Sladov (secretary-in-chief), R.P.Lastovskii, Kh.S.Bagdasar'yan, M.I.Kabachnik, and N.M.Emanuel'.

This period was distinguished by considerably intensified development of all chemical sciences. In fundamental research the elaboration and improvement of methods of calculation and computing techniques resulted in great progress in understanding the structure of complicated molecules; such advances as the formulation of theories of perturbations and boundary orbitals, with later discovery of the principle of the conservation of orbital symmetry, paved the way to a deeper insight into the relationship between structure and reactivity. Those years saw the introduction by the experimental chemist of the routine use of such important physical methods of investigation and analysis as nuclear magnetic resonance, mass spectrometry, and also new types of chromatography. The quality of instrumentation also rose considerably during that time. As a consequence of all these factors the traditional sharp division of chemistry into a series of separate classic branches gradually gave way to different, more complicated and significant forms of interrelationship and division between sciences. The major scientific advances and discoveries of those years paved the way for a final shaping of several borderline scientific fields into independent scientific disciplines, among which molecular biology, hetero-organic chemistry, and macromolecular chemistry underwent especially marked development. At the same time stronger demands were made for relevance in scientific research and for a closer relationship with applied, industrial, and technical chemical subjects.

These trends found their organisational expression in the creation of new science research institutes and higher educational institutions, in the founding of new major science centres in several towns. New science schools and lines of chemical research were actively established in those years.

At that time considerable changes were occurring also in the field of chemical information. The total flow of information underwent remarkably strong growth, owing to the inauguration of several new journals and a sharp increase in volume of most chemical publications throughout the world, to an intensification of the issue of monographs, special periodical editions and collections, and to greater activity in the holding of scientific congresses and conferences. In several cases publications exhibited a tendency to narrow specialisation, which might make it difficult to acquaint wide circles of the chemical community with the main trends in contemporary science and prospects for their development.

The profound organisational and structural changes that occurred universally in Soviet and world science during that period posed for the journal the acute problem of working out, under the new conditions, a strategy that would correspond to the greatly increased requirements of specialised chemists for expert and authoritative provision of information. In this situation it was of fundamental importance that the journal should not choose a path of narrow specialisation but,

¶ The silver jubilee of the journal was reported elsewhere[4].

on the contrary, should broaden its interests, by paying attention essentially to the then most promising borderline and contiguous fields of chemical science. As a consequence it is now evident not only that *Uspekhi Khimii* contained the origins of many new sciences initiated in those years but also that its work actively supported their establishment and development.

The most characteristic feature of that time to which the journal responded was the development of hetero-organic chemistry. Just after the war *Uspekhi Khimii* published a paper by A.N.Nesmeyanov on "Hetero-organic Compounds and the Periodic System", which showed results of and the immediate prospects for research on various organic derivatives of metals and non-metals, as well as the important position occupied by this work in the general development of chemical sciences and their interrelationship with various practical requirements and problems. The extremely important role of hetero-organic chemistry in contemporary science was recognised by the creation in 1954 of the Institute of Hetero-organic Compounds of the USSR Academy of Sciences, the first in the world, the work of many of whose personnel on hetero-organic and polymer chemistry, as well as on artificial food, has since been intimately connected with the history of the journal and has appeared in its pages.

These advances were analysed in a 1959 paper by R.Kh.Freidlina, M.I.Kabachnik, and V.V.Korshak included in a special issue celebrating the jubilee of A.N.Nesmeyanov.

The initial growth of this branch of science was due primarily to the development of new methods for obtaining organic derivatives of fluorine, phosphorus, and silicon and was governed by the importance and variety of their fields of practical application. In this connection we may note papers in the journal on methods for introducing fluorine into organic compounds (I.L.Knunyants, O.V.Kil'disheva), on the polymerisation of fluoroalkenes and the addition to them of hydrogen sulphide and thiols, yielding perfluorinated organosulphur compounds (I.L.Knunyants, A.V.Fokin), and also on electrophilic addition to fluoroalkenes (B.L.Dyatkin, I.L.Knunyants), on organofluorine compounds containing functional groups, and on fluorocarbon oils and greases. The chemistry of organic derivatives of silicon was covered by numerous papers by K.A.Andrianov, A.D.Petrov, A.A.Zhdanov, V.F.Mironov, E.A.Chernyshev, and later V.A.Ponomarenko (organofluorosilicon compounds) and also A.B.Topchiev and N.S.Nametkin (organopolysiloxane liquids). The chemistry of organic derivatives of phosphorus appeared during those years in papers by A.E.Arbuzov (organic derivatives of phosphorus acids) and by M.I.Kabachnik (addition of halogen derivatives of phosphorus to organic compounds), and great attention was paid to their biological and insecticidal action (N.N.Mel'nikov).

The journal followed closely the development of the chemistry of organic boron derivatives (U.Lipskii [?W.N.Lipscombe]), regularly publishing for several years reviews on hydroborons (B.V.Nekrasov, Ya.M.Paushkin), diborane, intermediate boranes, borazole (B.M.Mikhailov). It paid attention also the chemistry of new classes of organic derivatives of beryllium, calcium, strontium, barium, and covalent bihetero-organic compounds (N.S.Vyazankin, O.A.Kruglaya), as well as to those of non-metals—the chemistry of cyanuryl chloride, nitrogen-ylides, and phosphorus-ylenes (G.Wittig), cyanohydrocarbons, and compounds containing a nitrogen–fluorine bond (A.V.Fokin).

The vigorous development of the chemistry of σ-bonded organic derivatives of non-metals and non-transition metals (K.Ziegler) was accompanied during those years by great development of a fundamentally new branch—the hetero-organic chemistry of π-complexes of transition metals—which followed on the 1950s discovery of ferrocene and dibenzenechromium. Its successes were covered in the journal by the reviews of F.Cotton and G.Wilkinson (cyclopentadienyl and arene complexes of metals), G.Wilke (cyclo-oligomerisation of butadiene and π-complexes of transition metals), E.Abel (metal carbonyls), G.A.Razuvaev, V.N.Latyaeva (covalent organometallic compounds of transition metals), and M.I.Rybinskaya, L.V.Rybin (reactivity of a double bond coordinated with a metal atom in nucleophilic reactions). All these early investigations on organometallic π- and σ-complexes paved the way for the subsequent development of metal-complex catalysis in organic and polymer chemistry, which was subsequently reflected on the pages of *Uspekhi Khimii*.

The intense development of synthetic and applied aspects of hetero-organic chemistry in the two postwar decades posed acutely the question of the need to organise systematic quantitative research on the structure and reactivity of hetero-organic compounds and their reaction mechanisms.

During those years the journal responded actively to theoretical questions of hetero-organic chemistry. It was found that organic derivatives of metals and non-metals could serve as new models helping to reveal the physical nature of many chemical phenomena. Thus for several functionally substituted organic derivatives of phosphorus it was possible to elucidate the quantitative laws of tautomeric processes, trace their connection with the principles of acid–base catalysis, and discover on this basis new reactions and rearrangements (M.I.Kabachnik). Articles by O.A.Reutov published in *Uspekhi Khimii* at that time showed that many reactions involving σ-bonded organometallic compounds, in which homolytic transformations are observed with formation of free and latent radicals, may be convenient models for the investigation of radical and chain processes in the condensed phase, and can also be used in hetero-organic synthesis. Finally, detailed examination of the kinetics, stereochemistry, and mechanism of many typical electrophilic reactions (proto- and halogeno-demetallation, alkyl exchange, etc.), precisely on organometallic model compounds (including optically active compounds and those labelled with radioactive mercury-203), enabled quantitative laws to be formulated for electrophilic substitution at saturated and unsaturated carbon atoms (O.A.Reutov) and the broad question to be posed whether the principles of stereochemical dynamics (stereochemistry of substitution in the organometallic series) and statics (the asymmetric non-carbon atom—O.A.Reutov, V.I.Sokolov) could be extended to hetero-organic derivatives of metals and non-metals.

It is significant that, just as in the 1930s the journal had reacted keenly to the development of chemical physics and physical organic chemistry, its contents in the 1950s–1960s directed attention to the physical trend then emerging even in hetero-organic chemistry.

The contents of the journal reflected also segregation of coordination chemistry as a separate field of science at the junction between the organic and the inorganic chemistry of complex compounds. An important role in its development was played by research on the kinetics, stereochemistry, and mechanism of various inner- and outer-sphere reactions of coordination compounds in aqueous and non-aqueous media, and also by R.Nyholm's important generalisation (now known as the Gillespie–Nyholm rule) establishing a direct relation between the electronic configuration and the three-dimensional structure of metal complexes.

Together with the evolution of theoretical ideas on reaction mechanisms involving inorganic and organometallic compounds, great importance was attached at that time to research on the mechanism of purely organic reactions. As reflected in

papers in the journal this involved mainly establishing by correlation analysis quantitative relations between the structure and the reactivity of organic compounds (V.A.Palm) and identifying various intermediate species, the most important of which were carbocations and free radicals (in particular in the nitration of hydrocarbons investigated by A.I.Titov). Later the journal paid great attention also to radical-ion states of molecules (both cation- and anion-radicals), and examined in detail the urgent problem of formation of the antecedent intermediate donor–acceptor complexes and of charge-transfer complexes, which play an important part in the mechanism of such reactions as the addition of halogens to alkenes. Three important reviews were devoted to concerted reactions (Ya.K.Syrkin, J.Mathieu), which involve cyclic electron transfer in closed transition states.

Among the reaction mechanisms investigated in the greatest detail were various acid–base processes (A.I.Shatenshtein), kinetic isotope effects (Ya.M.Varshavskii), including the kinetics and thermodynamics of the isotope exchange of hydrogen, reactions of peroxides, diene synthesis, esterification, hydrolysis of esters (Ya.K.Syrkin, I.I.Moiseev), catalytic redistribution of hydrogen in unsaturated cyclic systems (V.M.Gryaznov), various reactions of isocyanates with compounds containing mobile hydrogen (S.G.Entelis), halogenation of alkenes, and Beckmann rearrangement of oximes (I.L.Knunyants). A series of papers was devoted also to the current problem of the dual reactivity of ambidentate systems (V.I.Erashko, S.A.Shevelov, A.A.Fainzil'berg).

To this day many contributions to the journal on several theoretical aspects of physical organic chemistry have not lost their value, among them reviews by R.Pearson, R.Hudson, A.Parker, J.Edwards, K.U.Ingold, and R.Dessy, in which consideration was given to several contemporary approaches (perturbation theory, principle of hard and soft acids and bases) to the theory of reactivity, and the concepts of basicity and nucleophilicity and the influence of solvation (in particular by bipolar aprotic solvents) on rate, equilibrium, and composition of products in homogeneous reactions were discussed. Several articles appeared also on quantum chemistry, covering the nature of σ- and π-bonds in molecules, the theory of electron shells in molecules (N.D.Sokolov), and principles governing the calculation of conjugated unsaturated systems (M.Dewar).

As before, the most prominent position in the journal was occupied by reviews on chemical physics, in conformity with its great scientific importance. During the period that had elapsed since the beginning of the 1930s many problems had been solved, and the results of all this work had found their place on the pages of *Uspekhi Khimii*. This applies especially to research on the mechanism of gas-phase chain reactions, studied in detail by N.N.Semenov, V.V.Voevodskii, and V.N.Kondrat'ev, the theory of ignition and spontaneous combustion, burning and detonation, and also aspects of the energetics of chemical bonds.

Besides this, establishment of the physical characteristics of primary reactions in the condensed phase became during the 1950–1960s an important problem, investigated for the chain decomposition of halogenated alkanes (N.N.Semenov) and in especial detail for liquid-phase oxidation (N.M.Emanuel'). Additions of inhibitors enabled critical phenomena to be studied, and the possibility of catalysis by salts of metals of variable valency was established (N.M.Emanuel', E.T.Denisov). Elucidation of the mechanism of the action of several inhibitors permitted during those and subsequent years the organisation of a scientific search for and the industrial production of new stabilisers for polymers and various antioxidants, which have great practical value.

As the journal showed, several novel opportunities were offered to chemical physics by the use of new and up-to-date experimental methods, e.g.flash spectroscopy for studying fast photoreactions, chemiluminescence for studying kinetics, vibrational spectroscopy for the structure of polyatomic molecules, and also the method of molecular beams (V.B.Leonas) for elementary chemical reactions. In other cases important results were obtained by developing the theory of chemical kinetics (additive calculation of activation energies, derivation of kinetic equations for homolytic reactions and the temperature dependence of their rates, in some complicated cases taking into account topochemistry and chemisorption processes at the interface). It is evident from the journal that advances in chemical physics contributed much to develop a theoretical basis for contemporary chemical technology, especially in the construction of mathematical models and the search for optimum conditions taking into account the peculiarities of heat and mass transfer in complicated heterophase processes (V.V.Kafarov).

A special number of *Uspekhi Khimii*, issued to celebrate the jubilee of N.N.Semenov, was entirely devoted to the latest advances in chemical physics. Topics covered were investigation of the kinetics and mechanism of branded chain reactions in the gas phase (A.B.Nalbandyan), critical phenomena in degenerate branched chain reactions in the liquid phase (N.M.Emanuel'), current state of the theory of thermal explosion (A.G.Merzhanov, F.I.Dubovitskii), free radicals and chemiluminescence (V.Ya.Shlyapintokh), formation of radicals in reactions of valency-saturated molecules (A.E.Shilov, F.E.D'yachkovskii), chain-transfer reactions with rupture in polymerisation and copolymerisation (N.S.Enikolopov), and chemical reactions at around 77 K (G.B.Sergeev).

Work on high-energy chemistry is near in scientific significance to the above topics, and also has been subject to the constant attention of the journal—ionic and electronic processes in the condensed phase under the influence of radiation (E.L.Frankevich), development of a theory of the primary step in "hot" reactions, various theoretical and applied aspects of the radiation chemistry of aqueous (including frozen) and non-aqueous solutions of organic and inorganic compounds (I.V.Vereshchinskii, A.K.Pikaev, A.J.Swallow).

Thus the work of the journal during the 1950s and 1960s showed that the fundamentally physical direction of chemical research, the results and achievements of which were summarised in the papers "Forty Years of Development of Chemical Physics in the USSR" (V.N.Kondrat'ev) and "Fifty Years of Soviet Physical Chemistry" (N.M.Emanuel'), had succeeded and made it possible to solve the most complicated theoretical and experimental problems by investigating the basic principles of structure and reactivity in chemical compounds.

The third largest sphere of activity of the journal in the 1960s, in addition to hetero-organic chemistry and chemical physics, was the chemistry of macromolecular compounds, whose development was largely governed by the needs of industry and the national economy. A set of reviews on polymer topics was selected by the journal with great care, while the scientific range of the problems covered was extremely varied.

For five to seven years in all the journal dealt creatively with almost every conceivable aspect of this science of great world-wide actuality, beginning with synthesis of the most diverse types of macromolecular compounds—heterochain polyamides (V.V.Korshak, T.M.Frunze), polyarylates, polyacetylenes (A.M.Sladov), polyethyleneimines, polymeric carbonyl compounds, fluorinated organic polymers—discussing the polymerisation possibilities of the most diverse classes of monomers—non-conjugated dienes (G.S.Kolesnikov), iso-butene, polyfluorinated linear compounds, difunctional monomers,

α-oxides—and finishing with the use of physical methods to study various physicomechanical and operating characteristics of macromolecular compounds (gel formation and structure in polymer solutions, electrode properties of ion-exchange membranes, self-diffusion and interdiffusion phenomena (S.S.Voyutskii), as well as the plasticisation of polymer systems, molecular relaxation in polymeric dielectrics, and the chemical action of ultrasonic waves on macromolecules). Special reviews were devoted to the most diverse groups of polymeric substances and materials having great practical value (macromolecular dielectrics and semiconductors (B.I.Sazhin), redox and optically active polymers (I.N.Topchieva), ion-exchange and electron-exchange resins, structural plastics (B.A.Kiselev), and also various kinds of telomers and oligomers). Among other problems discussed were ways of enhancing the frost-resistance and the thermal stability of artificial polymeric materials (M.M.Koton) (including the introduction of cyclic fragments into the polymer chain).

Great attention was paid also to extending the ideas of polymer chemistry to macromolecular systems of natural origin, from organic biopolymers to inorganic systems such as cement and silicates. A series of reviews discussed the chemical modification of macromolecular compounds (e.g. of rubber by vulcanisation or of cellulose by phosphorylation) and indicated the technical prospects of cellulosic ion-exchangers, capable in particular of serving as effective supports in the chromatographic separation of proteins (A.Ya.Nikolaev).

Interesting articles during those years were devoted to the interaction of colorants with macromolecular substances, which was of great importance for development of a textile industry of synthetic fibres, and also to the production of new slow-release medicinal preparations by mixing with macromolecular fillers or by grafting to polymer chains.

In several cases the journal has even arranged series of reviews on related topics, if the problem involved deserves that the gap should be urgently filled with consequent stimulation of its development. For inclusion in such series only those reviews are selected, of course, that give independent and expert views without duplicating general information on the subject. An example is the publication over only a few years of about ten reviews covering the most diverse aspects of the main subject "Macromolecular Hetero-organic Compounds", then especially timely. By surveying both purely inorganic systems as a whole (H.J.Emeléus) and also polymers having inorganic main chains (K.A.Andrianov, A.A.Zhdanov), with a discussion of hetero-organic systems, as well as coordination polymers and polymeric chelates, the journal gave within a short period a very complete picture of the state of this branch of science throughout the world in the 1960s.

Examination of the work of the journal on electrochemistry reveals firstly a steady growth in the total number of contributions on this important discipline and secondly an unusual list of review topics in past and present years, reflecting the chief changes in the theoretical and applied content of this extremely broad and diverse branch of science.

Electrochemical matter in *Uspekhi Khimii* during its first two decades was primarily associated with the name of A.N.Frumkin, who as early as 1935 contributed his well known review on the nature of the electrical double layer in electrochemistry (a general analysis of his publications will be found in a 1941 paper by N.A.Bakh). The former followed with his reviews on surface adsorption phenomena in electrochemical oxidation and reduction, on the electrochemistry of protective films (together with G.V.Akimov), and also on electrochemical kinetics, aspects of which were discussed also in contributions by S.Glasstone and by N.I.Zhukov (as applied to electrodialysis).

During subsequent years these questions were further developed on the pages of the journal by the work of Frumkin's students and followers (a special number of *Uspekhi Khimii* was dedicated to him in 1975). This comprised primarily a detailed account of a wide range of topics in the theory of the electrical double layer (B.B.Damaskin) at the boundary between an electrolyte and various electrodes (including those based on bismuth, tin, cadmium, and lead (U.V.Palm, V.E.Past), for all of which the influence of the crystallographic structure of the solid surface was examined, and also that of specific interaction of the surface with the solvent, on the properties of the double layer, the adsorption of ions, and the kinetics of hydrogen evolution in acid and alkaline media). Most of the reviews on this subject gave the most detailed consideration to mercury and platinum electrodes, study of which, in particular, made use of a radioactive tracer method that had been employed also to examine solid electrolytes (S.V.Karpachev, Yu.Ya.Gurevich) and non-aqueous media. The great interest taken by the journal in electrochemical processes in non-aqueous solvents (a special article on this topic as early as 1948 was devoted to the work of L.V.Pisarzhevskii's school) was due to the frequent possibility of controlling in them the progress of the proton-transfer processes accompanying electron transfer, which produces favourable conditions for electrometric analysis—electrochemistry of chelates in non-aqueous media (G.K.Budnikov), polarography in organic solvents (S.I.Zhdanov).

Surface adsorption phenomena, whose study is important both from the general physicochemical viewpoint and for an understanding of the mechanism of ensuing electrode processes and the laws of electrochemical kinetics, were covered in detail by the reviews of B.B.Damaskin (laws of the adsorption of organic compounds) and of O.A.Petrii (adsorption of electrodes of platinum-group metals), which gave a thermodynamic theory of the platinum electrode. Great attention was paid by the journal also to the kinetics and mechanism of electrochemical reactions, as well as the nature of unstable intermediate species. Apart from papers on electrometry and electrosynthesis, which will be named below, this range of problems was considered in relation to the most diverse systems—from metal ions in unusual and unstable states of oxidation (B.G.Ershov) and metal complexes in aqueous electrolyte solutions (V.I.Kravtsov) to molecular oxygen (L.I.Nekrasov) and semiconductors—kinetics of chemical etching, formation of new phases (V.A.Myamlin, Yu.V.Pleskov). Of great value for an understanding of several pressing problems of theoretical electrochemistry were the papers of B.V.Ershler (problem of absolute potential), G.A.Tedoradze and A.B.Ershler (effect of large coverages), and also R.R.Dogonadze, A.M.Kuznetsov, and L.I.Krishtalik, on theories of electronic processes in liquids, barrierless electrode processes, and also the nature of the primary step in electrode reactions.

The journal has always associated theoretical aspects of electrochemistry closely with practical applications, among which the greatest attention is now paid to three vast fields—the development of classic and new methods for the electrometric analysis of inorganic and organic compounds, preparative electrolysis and electrosynthesis of organic and mineral substances, and also problems of the corrosion of metals and alloys.

Uspekhi Khimii has at different times published papers both on equilibrium and on non-equilibrium methods of electrometric analysis (with application of a potential or passage of

a current), the interrelationship between which has been considered in greatest detail in I.M.Kolthoff's well known review "Relation between Potentiometric and Amperometric Titration and Voltammetry". During recent years the journal has given space to especially detailed consideration of the possibilities of the polarographic method of investigation and analysis, both of inorganic systems (e.g. ions of bivalent iron, cobalt, nickel—V.N.Pavlov, V.V.Bondar') and their chemical reactions (e.g. study of equilibrium complex formation—S.I.Zhdanov), with redoximetry for interactions in solutions (V.V.Pal'chevskii), and of various hetero-organic (S.G.Mairanovskii) and organic compounds—cathodic reduction of benzenoid aromatic hydrocarbons (S.I.Zhdanov), coumarins (Yu.E.Orlov), and aminoalkyl esters of αβ-unsaturated acids, and also study of the reactions of carbonyl compounds with ammonia, including their use in polarographic analysis (Ya.I.Tur'yan). The journal has also covered such methods as oscillopolarography and extraction polarography (G.K.Budnikov), inversion amalgam chronopotentiometry (V.I.Bakonov, M.S.Zakharov), and also thin-layer electrochemistry (S.I.Zhdanov). Electrochemical processes produced by alternating currents have also been discussed (impedance method—B.M.Grafov, E.A.Ukshe). Among new electrochemical achievements reported during recent years have been ion-selective electrodes (A.A.Belyustin), opening up several opportunities for investigating complicated enzyme systems involving choline esterases, and also the photoemission of electrons from metals in electrolyte solutions (Yu.V.Pleskov, Z.A.Rotenberg).

Electrochemical methods of investigation, based on a common treatment of acid–base and redox processes under homogeneous and heterogeneous conditions, are now widely used in solving a wide range of problems of physical chemistry and related disciplines. This important trend, whose earlier development was evident in the contributions by V.A.Pleskov (electrode potentials and ionic solvation energies) and by S.S.Voyutskii (electrokinetic potential as measure of aggregate stability of disperse particles), is now represented by the papers of A.Ya.Gokhshtein (elastic method for the study of various surface phenomena), and of R.Sh.Nigmatullin et al. (electrochemical investigation of mass and momentum transfer in solid–liquid systems, electrochemical modelling of heat and mass exchange, and also several hydrodynamic characteristics).

Important practical applications of electrochemical research results are associated in the journal with preparative electrolysis and electrosynthesis. The electrodeposition and electrocrystallisation of metals, surveyed in the 1950s by V.V.Mikhailov and by L.I.Antropov, were subsequently developed in papers on electrolysis at a mercury cathode as a method of isolation of uranium and separation of rare-earth elements (G.M.Kolesov). Several general problems of the electrolysis of molten media (surveyed by A.I.Belov in connection with the 150th anniversary of this method) have been examined in detail for oxide (A.M.Samarin) and hydroxide (O.G.Zarubitskii) melts. Together with inorganic systems (electrochemistry of iodine, selenium, tellurium, as well as metals and their complexes) the journal has always taken great interest in the electrosynthesis of organic compounds, first discussed by N.N.Mel'nikov as early as the 1930s and then by M.Ya.Fioshin in the 1950s. Recent reviews (M.Ya.Fioshin, A.P.Tomilov, L.A.Mirkind, I.N.Rozhkov) show that modern trends in development involve primarily expansion of the range of cathodic and anodic reactions initiated by electrochemical methods. Thus detailed studies are now being made of the oxidation of organic compounds at transition-metal oxide anodes, electrochemical alkoxylation and anodic dimerisation, addition, and substitution, and also cathodic coupling and electrolytic reduction of multiple bonds. A series of papers covered the mechanism of electrosynthetic processes involving organic compounds, the role of free radicals in electrolysis, reactions of these species with the electrode material, and also the cation–radical mechanism of anodic fluorination.

In addition to electrometric analysis, electrolysis, and electrosynthesis an independent and very important field of practical application of electrochemical knowledge is the mechanism and prevention of corrosion. The corrosion of metals as a special problem of colloid electrochemistry was first raised in the journal by V.A.Kistyakovskii as early as 1933 (later, outlines of the achievements of his scientific school were published in *Uspekhi Khimii* in 1945 and 1951). The bulk of the contributions on this theme belong to the 1950–1960s, when the journal published within a short period a whole series on the chemical nature of the corrosion and protection of metals from most diverse external attacks (atmospheric, subterranean, and pitting corrosion, as well as by sea-water at the water-line, or under conditions of limited access of electrolyte). A characteristic feature of this work is the discussion of ways for improving the corrosion resistance of metals and alloys in terms of the electrochemical theory of corrosion (N.D.Tomashov), including the theory of multielectrode systems (G.V.Akimov). The wide and up-to-date coverage of the whole set of most complicated questions associated with corrosion, in whose investigation radioisotope methods were used earlier, and also the influence of anions on the kinetics of dissolution of metals (Ya.M.Kolotyrkin), shows the great value attached by the journal to this important problem of applied science.

While attaching great importance to applied aspects of macromolecular chemistry, all that time the journal never lost sight of fundamental problems of general scientific and theoretical character in this field. Several reviews in those years were devoted to such questions as kinetic features of primary stages in polymerisation and further chemical reactions of the macromolecular compounds, mechanisms of interfacial polycondensation and ionic telomerisation, as well as free-radical, ionic [cationic (L.S.Bresler) or anionic], radiochemical, and cyclic polymerisation and copolymerisation of the most diverse classes of monomers under various experimental conditions, in several cases drawing special attention to novel, unusual, or anomalous types of reactions.

The journal has also extensively published many reviews and papers on general aspects of polymer chemistry—on progress in studying the chief types of processes in polymer formation (e.g. non-equilibrium and equilibrium polycondensation (V.V.Korshak), polymerisation of chemically activated monomers—V.A.Kabanov), on the main lines of research on polymer structure (e.g. the role of structural phenomena in shaping their properties—V.A.Kargin) and study of their reactivity (A.A.Berlin)—indicated future prospects for development in this field of science (reviews by M.Szwarc on "Progress in Polymers" and by H.W.Melville on "Future of Polymer Science"), and acquainted the reader—from original sources, as always—with the story of the major scientific discoveries ("Advances in Stereospecific Polymerisation" by G.Natta). This group can be completed by two articles—"Nomenclature of Linear Polymers based on their Structure" and "Nomenclature of Stereoregular Polymers" (H.Mark)—which have proved extremely useful in bringing the fairly intricate systematisation of complicated three-dimensional polymer structures into harmony with international requirements.

Uspekhi Khimii always reacted so keenly and originally to the conception and establishment of new scientific disciplines, to their differentiation, specialisation, and integration, that its reviews could form the basis of an objective and accurate view both of the origin of most of the most recent branches

of chemistry and of the current trends in their development. It is instructive in this connection to consider e.g. the dynamics of qualitative and quantitative changes in character of reviews in such an important field of applied science as adsorption (M.M.Dubinin), colloid chemistry (B.V.Deryagin), and chromatographic analysis.

With regard to the review activity of the journal on chromatographic analysis, there was a time when practice in this field clearly lagged behind theory. Although in the 1930s great progress was made in understanding the nature of adsorption bonding, heats of adsorption, and the work of adsorption forces (A.V.Kiselev), chromatographic methods of separation and analysis had not yet been properly developed.

At the beginning of the 1940s, however, major scientific developments—A.Martin and R.Synge's improvement of M.S.Tswett's adsorption chromatography and the elaboration of convenient methods of partition chromatography—and also the discovery in the 1950s of methods of column and capillary gas–liquid chromatography led to an immediate intensification of research in this field. The number of reviews on this subject in the journal increased by a factor of several tens, and they themselves came to acquire a differentiated character. Separation of the subject-matter of scientific and applied investigations took place in several directions. Thus paper chromatography (V.V.Rachinskii) became an individual subject, while partition chromatography was so greatly perfected that its application to analytical (N.N.Fuks), inorganic (E.N. and T.B.Gapon), organic, and biological (V.S.Asatiani) chemistry acquired independent significance according to the character of the substances to be separated and analysed.

Subsequently (in the 1960s) a tendency to still more far-reaching and detailed specialisation of individual types of scientific and practical chromatography began to appear, further subdivision of which began at once on three or four planes depending both on the chromatographic method and on the nature of the mixtures of gaseous (A.A.Zhukhovitskii and N.M.Turkel'taub), inorganic, organic, or natural substances to be separated or analysed. Special reviews were now required both on individual types of sorbents (e.g. ion-exchange celluloses, separation of biopolymers on calcium phosphate gels, or asymmetric adsorption as a method of resolving racemates on dissymmetric sorbents—S.V.Rogozhin, B.A.Davankov) and on the types of substrates to be separated (e.g. in the case of organic compounds comprehensive data were accumulated on the chromatographic separation of liquid petroleum hydrocarbons and individually on compounds of the benzene series, and matter on biologically active polymers came to be subdivided into separate reviews on the separation of mixtures of amino-acids (V.M.Belikov), lipids, carbohydrates, nucleic acids and their components, and decomposition products of proteins). Chromatographic methods became increasingly valuable for analysis and separation [?omission, Ed. of Translation] (including as volatile complexes), and also of Groups I–IV organometallic compounds (K.I.Sakodynskii).

In the current stage the coverage of chromatography by *Uspekhi Khimii* is governed by three principal stimuli—firstly further improvements in instrumental chromatographic technique, secondly introduction of several fundamentally novel forms of chromatographic analysis, and thirdly significant expansion of areas of practical use of these methods in the most diverse scientific and applied fields—so that only during recent years has the journal published reviews on the theory of the chromatographic microreactor, the use of packed capillary columns, chromatographic analysis with temperature programming, pulsed and high-temperature chromatography, chromatography in a stream of water vapour, gas chromatography with organic eluants, and also high-pressure gas and liquid chromatography (M.S.Vigdergauz). Newly introduced methods of chromatographic separation and analysis, whose establishment is attentively followed by the journal (peak paper chromatography, ion-exchange, precipitation, reverse, affinity, electrolytic, and gel chromatography), are subject in several cases to a tendency to undergo further differentiation. Thus within the scope of the promising method of reaction chromatography several variants have appeared, e.g. chemispecific covalent chromatography (S.V.Rogozhin) or adsorption–complexing chromatography, in particular involving the formation of charge-transfer complexes.

At the same time a vigorous world-wide search is now being made for new carriers, mobile and stationary phases (in particular surface-film sorbents), and in recent years the journal has drawn attention to the use for this purpose of liquid-crystal systems (gas–liquid-crystal chromatography, and also adsorption–absorption chromatography on Silochromes having films of liquid crystals). Another trend that can be observed in recent issues is the contrary tendency to integrate separate scientific disciplines at new and higher levels, which is evident e.g. in the active penetration of chromatographic methods into adjacent scientific fields for the solution of such problems as the determination of thermodynamic interpretation of the concepts of the polarity and the selectivity of sorbents, for the study of problems in catalysis and polymer chemistry, for investigation of the kinetics of liquid-phase reactions and the state of the multivalent ions in solution, and for the functional analysis of organic compounds (V.G.Berezkin et al.) and of unstable inorganic and heteroorganic species, quite apart from the analysis of trace impurities, atmospheric pollution, etc.

Since reviews on the development of a general-purpose chromatographic method are, very likely, of the greatest interest literally to all experimental specialists in chemistry and chemical technology, the above examples confirm how closely and effectively the journal has followed the most advanced attainments of scientific and technical ideas, and has responded to the continual interchange between the enrichment of various fields of chemical science and practice.

With regard to the modern period in the work of *Uspekhi Khimii* it must be remarked that the present stage in the development of chemical science is indeed characterised by an avalanche of primary information with simultaneous increase in its complexity and saturation. Monographs and textbooks are often unable to react promptly to such developments in various areas, and therefore delay considerably the dissemination of information to chemists in comparison with the periodical literature. This makes the work of chemical review journals especially valuable.

Furthermore, a modern review journal cannot allow itself simply to inform the reader on new scientific achievements: it should serve as a reliable guide in the flux of scientific trends and, by actively directing this process, form a fine structure of contemporary scientific knowledge. By making good the informational deficiency on the most important and urgent scientific questions, while actively moulding the reader's taste and providing a system of contemporary chemical values and priorities, *Uspekhi Khimii* by its practice of strict selection and commission of primary reviews exerts a necessary controlling and organising influence on the very course of the informational process, often foreseeing important tendencies in current and future chemical progress.

The methodological basis of the journal remains as before, as also fifty years ago, to publish contributions on chemical physics, whose importance in modern science is continually increasing. The main prospects for development in

experimental chemical physics, in the opinion of N.N.Semonov expressed in his recent address to an International Symposium on Chemical Physics (Moscow and Erevan, 1981)[5], are governed by a combination of possibilities of the modern theory of primary chemical processes with the use of new experimental physicochemical methods of investigation, among which special value attaches to those that allow appropriate reagents and products to be specified in definite quantum states (electronic, rotational, spin) and thereby the microscopic rate constants of primary reactions and energy-exchange processes to be found.

It is precisely these aspects of chemical physics (both theoretical and experimental) that the journal has been covering during the modern stage. Concerning the theory of primary chemical processes and chemical kinetics (an important part in the establishment of these domains was played by V.N.Kondrat'ev and V.V.Voevodskii, in whose memory special issues were published) the journal has contained during recent years reviews on the current state of the theory of bimolecular reactions, the mechanism of non-adiabatic bimolecular reactions and non-adiabatic energy transfer in gases (E.E.Nikitin), and the nature of the pre-exponential factor in the rate equations of unimolecular gas reactions and hydrogen-abstraction reactions. In addition, the kinetics of molecular reactions, the theory of complicated unimolecular reactions, molecular and kinetic aspects of the chemical physics of the condensed state and reactions in solid polymers (P.Yu.Butyagin), and dynamic primary processes in liquids have been discussed, quantitative appraisals of the mechanism of several reactions of hydrocarbons given, and finally the kinetics of homogeneous reactions in a vessel with ideal mixing (open systems) described (N.M.Emanuel').

Several articles have been devoted to the use of correlation equations in the kinetics of free-radical reactions, and also to questions of the separation of polar, steric, and resonance effects in organic reactions on the principle of the linearity of free energy changes (this same principle has been used also to analyse and summarise extraction data).

Reviews of experimental work continue to pay attention mainly to the kinetics and the mechanism of homolytic processes, having discussed the formation of radicals in the devitrification of matrices, the mutual interaction of atoms and radicals in the liquid phase and their redox reactions with ions in solution, the reactivity of radicals and molecules in various radical reactions (including ternary recombination processes, and also in the solid phase—in connection with the mechanism of the oxidation of carbon-chain polymers), and finally reversible recombination and redox reactions of radicals (I.V.Khudyakov, V.A.Kuz'min).

A number of articles have shown that research on radicals and their reactions now makes use of the great variety of physical methods—electron spin resonance, nuclear magnetic resonance and chemical polarisation of electrons and nuclei (A.L.Buchachenko), chemical lasers (to determine rate constants of reactions of atoms with molecules and the relaxation of vibrationally excited molecules), flash photoexcitation (A.K.Chibisov—to investigate triplet states of organic substances), and finally isotope and mass-spectrometric methods in solution, as well as the method of spin traps (*inter alia* to study radical species containing chlorine or sulphur).

A major achievement here was the discovery of the influence of a magnetic field on radical reactions in solution (R.Z.Sagdeev, K.M.Salikhov, Yu.N.Molin, A.L.Buchachenko).

During the past decades *Uspekhi Khimii* has paid especially close attention to the chemistry of excited states of substances. This subject has been covered by reviews on mechanisms of excitation of chemiluminescence, mechanisms of reactions of electronically excited radicals and quenching of excited states of radicals, primary photoionisation processes and ion–molecule reactions of organic substances (including those induced by β-disintegration of hydrogen-3 in tritiated compounds), photoreactions of free radicals in the solid phase (the nature of the primary photochemical step was examined by K.M.Dyumaev), and proton-transfer reactions in electronically excited aromatic molecules (M.G.Kuz'min).

Research workers have now become very interested in catalytic and photoinduced electron transfer (and also the tunnel transfer of an electron to great distances), photoinitiated reactions of quinones and the photoreduction of aromatic nitro-compounds, radiation-induced electronic processes in solid organic systems, and the investigation in such systems of primary chemical reactions due to the formation of radical-pairs. Understanding of the mechanism of formation of free radicals in the liquid-phase halogenation of alkenes has been facilitated by the concept of intermediate formation in them of corresponding donor–acceptor molecular complexes.

Several papers in the journal have been concerned with fundamental aspects of high-energy chemistry—problem of the solvated electron in polar organic and non-polar molecular liquids (A.V.Vannikov), influence of impurities on radiation-chemical processes in inorganic salt crystals (V.V.Gromov), action of radiation on dissolution, and also the kinetics of chemical reactions initiated by hot atoms and the chemistry of hot (1–3 eV) hydrogen atoms.

The current interest of chemical physics in radical processes is due in particular to their use in the hydroxylation of aromatic compounds and the direct epoxidation of alkenes in the liquid phase (D.I.Metelitsa), as well as in subsequent chemical reactions of epoxy-compounds. However, the main value of such reactions lies in the oxidation of the most diverse classes of organic compounds—benzene (E.T.Denisov, D.I.Metelitsa), alkylaromatic hydrocarbons, alkenes, cycloalkenes, and aldehydes, for which the kinetics and reaction mechanisms have been studied, in particular the role of steric factors and spatial strain of the double bond.

Parallel development is occurring in study of the chemical and chemicophysical properties of oxidants—molecular oxygen and its radical-anion O_2^- oxygen activated by transition-metal complexes, singlet oxygen (its formation, quenching, chemical properties, and value in biological systems), and also the reactivity of the oxygen-containing radicals $HO^\cdot$, $O^\cdot$, $HO_2^\cdot$, and atomic oxygen (V.Ya.Shlapintokh, I.B.Afanas'ev, V.B.Aleskovskii) (results of and prospects for study of $HO_2^\cdot$ have been covered in the greatest detail in view of the contributions by V.V.Voevodskii).

Theoretical work of the preceding years (much of which also has been published in *Uspekhi Khimii*) has shown that a fundamentally important stage in the mechanism of many liquid-phase oxidations is degenerate chain branching, in which molecular products of the primary chain reaction (in the autoxidation of hydrocarbons these are hydroperoxides) can in turn act as initiators of further chain reactions. Subsequent development of this branch of chemical physics has involved detailed investigation of individual stages in liquid-phase oxidations, mostly by modelling them in specially selected reaction systems (E.T.Denisov, D.B.Pobedimskii). Thus intensive research has been undertaken on the primary reactions of oxidation inhibitors, whose role is either chain termination by reaction with alkyl radicals (nitroxyl and quinone inhibitors) or peroxy-radicals (amine and phenolic inhibitors) or non-radical decomposition of the accumulating hydroperoxides (I.V.Khudyakov, V.A.Kuz'min). Reviews in the journal have shown that these two types of reactions are modelled e.g. by the interaction of known hydroperoxides (as well as $PO^\cdot$, $PS^\cdot$, $PO_2^\cdot$ radicals) with sulphides, phosphines, and aromatic amines (D.G.Pobedimskii) and by the oxidation of sterically hindered phenols and amines. The kinetics

and the mechanism of the breakdown of hydroperoxides in the presence of transition-metal compounds and the metal-catalysed oxidation of organic compounds by hydroperoxides are also being investigated (G.A.Tolstikov, V.P.Yur'ev, U.M.Dzhemilov). Association in alcohols and phenols has been studied by nuclear magnetic resonance (V.D.Pokhodenko). All these current lines of research, represented in detail in the journal, are important for an understanding of the main features of the mechanism of inhibited oxidation, for a scientifically based search for new inhibitors and antioxidants, and for the study of synergism in their action in composite materials. An important part has been played by posing in the journal the question whether selectivity in chemical reactions is not a kinetic problem (N.M.Emanuel').

All work on the chemical physics of oxidation, among which an important position is occupied by investigations of the aging and the stabilisation of polymers, and also the kinetics of their degradation (*inter alia* in aggressive liquid media), is directly related to the most important practical problem of the protection from oxidation of several artificial and natural materials—fuels, lubricants, oils and fats [the problem of studying physicochemical mechanisms of damage to DNA is raised in the work—by means of various types of synthetic oxidation inhibitors and bioantioxidants (which include chemical geroprotectors)]. The great interest taken by the journal in such questions is indicated by its gathering together in one issue reviews on allied topics, in which the task of predicting changes in the properties of polymer materials on prolonged storage and service (including polyalkenes on photo-oxidation), and also measuring their durability and service life, was treated as a general physicochemical problem, whose solution could be facilitated by the construction of appropriate kinetic models. By using such interrelated series of publications to direct the attention of the reader to matters of great scientific and applied importance, *Uspekhi Khimii* is in some measure following the practice of another of our review publications—*Zhurnal Vsesoyuznogo Khimicheskogo Obshchestva im. D.I.Mendeleeva* [Journal of the Mendeleev All-Union Chemical Society] (published since 1956), every number of which is devoted to the subject-matter of a single major problem.

During recent years *Uspekhi Khimii* has published, besides reviews on the above scientific trends, several contributions on the chemistry of the positron, the muon, and mesoatoms (V.I.Gol'danskii, V.G.Firsov), the physics and chemistry involved being studied even in complicated polymer systems. The positron method enables the effective charge on anions in ionic media to be determined, and also new results on the structure of materials to be interpreted in the light of the Periodic Law (V.I.Gol'danskii). Several studies have appeared on novel physical actions on matter—processes occurring in solids under the influence of shock waves (A.N.Dremin), changes in condensed substances on shock-wave compression under controlled thermodynamic conditions (V.I.Gol'danskii), and epitaxial production of diamond in the metastable region (B.V.Deryagin, D.V.Fedoseev). Consideration has been given also to the formation of organic surface films by an electron beam, ultraviolet radiation, and a glow discharge, as well as the production of high-temperature materials by direct high-frequency melting in a cold container.

The classic problems of chemical physics—the theory of ignition, combustion, and explosion—first covered by the journal as early as 1930s, are now undergoing development. The present interests of research workers lie in using mass spectrometry to study flame structure and burning processes, in studying the thermal decomposition of aliphatic *C*- and *N*-nitro-compounds, and in the possibilities of practical application of the results to chemical technology and metallurgy (F.I.Dubovitskii, A.G.Merzhanov). The completeness of coverage of modern scientific trends in study of the physical foundations of chemical science is shown also by articles on the chemistry of low and extremely low temperatures associated with the phenomenon of a low-temperature quantum limit to the rate of chemical reactions (V.I.Gol'danskii), on solid-state chemistry (V.V.Boldyrev, P.Yu.Butyagin) (kinetics and nature of mechanochemical reactions, mechanism and kinetics of the dehydration of crystal hydrates), and on the classic thermodynamics of isotope exchange (N.M.Zhavoronkov).

The activity in publicising the fundamental physical foundations of chemical processes is especially important at the present stage in the work of the journal also because it is knowledge of the physical principles underlying the structure and the reactivity of various classes of compounds that is of the greatest interest to the majority of readers. Despite the organisation and publication during recent years of a multitude of sectional and interdepartmental review symposia, and also the active participation of many specialised chemical journals in review work, *Uspekhi Khimii* continues to play its part of general chemical review publication, reflecting not only the specialisation and differentiation occurring in chemical sciences but also the considerably more complicated contrary processes of mutual integration with the formation of new major fields of science.

Especially significant in this respect is the great attention paid to enzyme chemistry, a fundamentally new and important trend in the activity of the journal during the past decade. On this subject *Uspekhi Khimii* by no means publishes work on the structure of individual enzymes (which is the concern of specialist journals) but focuses its attention on reviews of general character, of interest to wide circles of specialists. At the present time it appears from the contents (I.V.Berezin, K.Martinek) that the main interest lies in the problem of enzymatic catalysis, for whose solution the methods of chemical kinetics and thermodynamics are widely used (in particular in study of the nature of intermediate compounds). Apart from its theoretical significance this type of catalysis has recently acquired immense applied importance, and now the chief problem is to stabilise enzymes, a key factor in the introduction of biocatalysis both into industrial practice and into organic synthesis. This many-sided research is directed mainly at immobilising enzymes, especially by the use of polymeric carriers. In sum, all this work draws attention to a new and independent branch of science, development of which will stimulate growth in all related theoretical and applied disciplines and promises major advances in the near future.

At present the most promising direction in the search for new catalysts—chemical bionics—involves chemical modelling of the action of enzymes (primarily lysozyme, which effects biocatalytic hydrolysis (V.I.Maksimov), as well as cytochromes, oxygenases and nitrogenases, responsible respectively for the anobolism of atmospheric oxygen and nitrogen *in vivo*). A convincing advance in this field is the discovery of new nitrogen-fixing systems based on vanadium in a low state of oxidation, which operate in aqueous solutions at ordinary temperatures and pressures (A.E.Shilov). Another modern line of research (bioinorganic chemistry), at the boundary between biochemistry and the coordination chemistry of physiologically active oxygen-, nitrogen-, and sulphur-centred ligands, is also represented in reviews, on chlorophyll, its synthetic analogues, metal porphyrins, and also the interaction of metals with nucleic acids (E.E.Kriss, K.B.Yatsimirskii) and proteins (V.A.Sergeev, M.G.Bezrukov). Yet another direction of advance (bioheteroorganic

chemistry) is apparent in papers on establishing the nature of hydrophobic sites on the active surface of choline esterases and of the mechanism of their inhibition by organophosphorus compounds (M.I.Kabachnik, N.N.Godovikov, M.Ya.Mikhel'son, A.P.Brestkin, Vi.I.Rozengart, et al.).

The journal has always paid great attention to the three-dimensional structure of complicated molecular systems, both by publishing special reviews on stereochemistry and conformational analysis (anomeric effect, stereospecific synthesis and catalysis, asymmetric synthesis of α-amino-acids, planar chirality of metallocenes, stereochemistry of hydroxymercuration, transannular effects in macrorings and *p*-cyclophanes) and by discussing various types of steric and spatial effects in a considerable number of the most diverse studies. As early as the 1960s the journal opportunely discerned the permeation of classic stereochemistry by several novel and fertile trends ("Algebraic Aspect of Chirality" by E.Ruh, "Problems of Chemical Topology" by W.Prelog, "Topological Ideas in Stereochemistry" by V.I.Sokolov) promoting an understanding of spatial relations in the molecular world. During recent years a close interest has been taken in framework and polyhedral structures—adamantanes and their hetero-analogues, the problem of tetrahedrane (N.S.Zefirov), carboranes and their rearrangements (L.I.Zakharkin, V.N.Kalinin, V.I.Stanko, V.I.Bregadze)—and a clearly structural approach characterises matter on the theory of cyclisation–recyclisation processes and also on structural aspects of several solid-phase reactions and rearrangements (right up to polymerisation processes).

Modern in both content and form is a recent review by V.I.Minkin and R.A.Minyaev on "Polyhedral Organic Molecules and Ions—Structural Analogues of Organometallic Clusters", which uses current orbital ideas and R.Hoffman's principle of isolobality to show the possibility of a single approach to understanding the fundamental interrelations between organic and hetero-organic compounds. A feature of this work is a general and fruitful analogy revealing interrelations between different branches of chemistry, unexpected at first glance but capable of serving as a guide to further experimental and theoretical investigations.

New stereochemical ideas are finding application also in practical chemistry. For example, several reviews in the journal explain catalysis on zeolites by the enclosure of reactant molecules in cavities bounded by the aluminosilicate framework (Kh.M.Minachev), and the molecules of inorganic heteropoly-acids have a different but also very complicated three-dimensional structure (V.I.Spitsyn); catalysis by cyclodextrins is attributed also to the presence in their spiralled molecules of a special kind of cylindrical cavity surrounded by polysaccharide chains. In the molecules of macrocyclic crown polyethers, which now play a very important part in the most diverse branches of chemistry (K.D.Pedersen), the appearance of coordination vacancies for particles of suitable size (e.g. metal ions) is also due to a peculiarity of the spatial structure of the cyclic multidentate ligand. Complexes formed by them find application as polymerisation catalysts (V.A.Kargin, S.L.Davydova).

Uspekhi Khimii exhibits two main approaches to publishing matter on catalysis—firstly towards a deeper insight into the mechanism of several traditional catalytic processes, and secondly to acquaint the reader with new types of catalysis arising during recent years in borderline and related sciences.

Together with the classic problems of acid–base catalysis (a special form of which is difunctional catalysis—L.M.Litvinenko) the journal gives detailed consideration to all aspects of traditional heterogeneous catalysis (kinetics, thermodynamics, problems of adsorption and chemisorption). The current scientific trend in this field is to use quantum-chemical calculations and physical methods of investigation—electron spectroscopy (V.B.Kazanskii), Mössbauer spectroscopy (V.I.Gol'danskii), ferromagnetic resonance (A.A.Slinkin), internal reflectance spectroscopy, paramagnetic probes, and isotope methods (G.K.Boreskov)—to study the surfaces of catalysts and to determine the nature of the intermediate surface compounds formed. The interest long taken by the journal in the catalytic hydrogenation of carbon monoxide to the hydrocarbons of synthetic liquid fuel (the Fischer–Tropsch reaction) has also been freshly stimulated by progress in understanding that this process involves intermediate formation of carbonyl and carbonyl–hydride complexes of transition metals.

During recent years the discovery of fundamentally new types of compounds to serve as heterogeneous catalysts (e.g. lamellar compounds of graphite—M.E.Vol'pin, Yu.N.Novikov) has been accompanied by the development of homogeneous metal-complex catalysis, which plays an important part in exploiting new opportunities for the industrial organic synthesis of several most important products—monomers for polymerisation and polycondensation, alcohols, aldehydes, ketones, carboxylic acids and esters, amines, alkyl halides—from a comparatively accessible unsaturated starting material (alkenes and alkynes). Reviews in the journal suggest that homogeneous catalysis is now a borderline discipline, whose theoretical basis comprises recent advances in organometallic, organic, coordination, and quantum chemistry and which has applications to chemical industry and technology. Theoretical research in this field is currently directed at establishing the nature of the catalytically active centres in stereospecific coordination and coordination–ionic polymerisation (B.A.Dolgoplosk) and studying the detailed mechanism of the catalytic reactions of organic compounds. In some approaches (M.L.Khidekel') coordination of reactive unsaturated ligands with coordinatively unsaturated metal atoms may be a factor removing orbital prohibitions on subsequent chemical reactions by concerted mechanisms.

The journal covers also new types of catalysis—hetero-homogeneous combining the ideas of heterogeneous and homogeneous catalysis, micellar due to special factors at the interface between colloidal micelles and the external medium, and finally phase-transfer catalysis in which the transport of active reactant species to the interface is effected by additions of special surface-active agents (M.Mankosha).

In organometallic chemistry, which now plays a key role in the development of related sciences, the journal publishes matter surveying the results of many years of systematic research and opens up new prospects for organometallic synthesis and the investigation of reaction mechanisms. It comprises reviews on the discovery of carbene complexes of transition metals (E.O.Fisher), the preparation of new types of organometallic compounds, analogues of alkenes and ketones having a multiple bond linking a carbon atom with a Group IV metal (L.E.Gusel'nikov, V.M.Vdovin, N.S.Nametkin), a review by the authors of the Taylor–McKillop reaction, which has enabled thallium(I) compounds to be introduced into the everyday practice of organic synthesis, and finally papers on the preparation and properties of silatranes (M.G.Voronkov) and polymetallic chains (M.G.Bochkarev). Consideration has been given also to organometallic peroxy-compounds (G.A.Razuvaev) and their rearrangements, dinuclear complexes of transition metals containing nitrogen bridging ligands (M.I.Rybinskaya, L.V.Rybin), oxidation of organometallic compounds by transition-metal salts (I.P.Beletskaya, A.N.Kashin), possibilities of using carbonyl chloride in the chemistry of functionally substituted silicon

derivatives (V.F.Mironov, V.D.Sheludyakov), preparation and properties of ethynyl derivatives of Group IV elements, and the chemistry and practical applications of silver and copper acetylides (A.M.Sladkov).

Recent advances in the chemistry of organophosphorus compounds are illustrated by new derivatives of quinquevalent phosphorus (G.Wittig), compounds containing phosphorus–phosphorus (I.F.Lutsenko, M.V.Proskurnina) and phosphorus–hydrogen (E.E.Nifant'ev) bonds, and optically active thiophosphates. Ever new physical phenomena are now being discovered for organophosphorus compounds—e.g. diastereoisomeric intermolecular interactions, studied in detail by nuclear magnetic resonance (M.I.Kabachnik et al.), synthetic possibilities such as the capacity for involvement in 1,3-cycloaddition (A.N.Pudovik), and also new practical applications as insecticides (N.N.Mel'nikov) and, in the case of alkylenediphosphine dioxides, as complexones (M.I.Kabachnik).

Uspekhi Khimii has widely illumined during recent years the introduction into modern hetero-organic chemistry of physical methods of investigation—thermochemistry, nuclear magnetic and quadrupole resonance, infrared spectroscopy (N.A.Chumaevskii), the vibrational spectroscopy of hydrogen-bonded and charge-transfer complexes, and polarography (S.P.Gubin, L.I.Denisovich)—which in several cases have provided new structural information on organometallic compounds and have broadened current views on their reactivity. Among theoretical concepts that have evolved in hetero-organic chemistry during the 1960–1970s are the important role of solvation and intramolecular coordination (O.Yu.Oxlobystin, A.K.Prokof'ev), the organometallic α-effect (M.G.Voronkov, V.P.Feshin), the nature of the siloxane bond (M.G.Voronkov, Yu.A.Yuzhelevskii), the role of non-bonding electron-pairs of the phosphorus atom in organophosphorus chemistry (M.I.Kabachnik, E.N.Tsvetkov), and the use of $\alpha\pi$- and $d_\pi p_\pi$-conjugation effects to explain the properties of carbon–metal and heteroelement–metal bonds. On the fairly controversial topic of the role of *d*-orbitals in hetero-organic chemistry (H.Jaffé published his review in 1957) the journal has even published several articles in which it has provided a forum for both supporters (A.N.Egorochkin) and critics (N.P.Gambaryan, L.M.Epshtein, D.A.Bochvar) of this concept.

A new interest of the journal during recent years has been work on hetero-organic medicinals—biological activity of silicon compounds (M.G.Voronkov, E.Ya.Lukevits), antitumour action of certain platinum complexes—and also on industrially convenient methods of obtaining organometallic compounds from atomic metals in the gas phase (G.A.Domrachev) and their practical application to the production of films, coatings (G.A.Domrachev, O.N.Suvorova) and ultrapure substances (B.G.Gribov).

In 1967 *Uspekhi Khimii* published an article by N.S.Zefirov on "Soviet Organic Chemistry after Fifty Years" (containing more than 600 references). Since that period elapsed many new and interesting advances have been made in this field, several evident on the pages of the journal. Although contributions on this subject have generally been exhaustive in character, with a considerable breadth of coverage of both experimental and theoretical work, a few overlapping fields have been treated in depth, and in the review activity of the journal on organic chemistry five main trends can now be distinguished, giving in total a very complete view of the current state of this scientific discipline.

Firstly, systematic publication is continuing of reviews on general aspects of the chemistry of a number of important classes or organic compounds, including thi-irans (A.V.Fokin, A.F.Kolomiets), carbon suboxide, small carbon rings (E.Vogel), tropylium and cyclopropenylium cations, organic peroxides (V.Karnozhitskii), triptycenes (V.R.Skvarchenko), sterically hindered phenols and cyclohexadienones (V.V.Ershov, G.A.Nikiforov, A.A.Volod'kin), and cyclododeca-1,5,9-triene (L.I.Zakharkin). The chemistry of saturated and unsaturated functionally substituted open-chain and cyclic systems containing oxygen, sulphur, and especially nitrogen atoms in various states of oxidation is also undergoing development. Such systems exhibit considerable chemical activity and offer various structural opportunities for organic synthesis, as the journal has shown for pernitriles (N.S.Zefirov, D.I.Makhon'kov), tetracyanoquinodimethane (B.P.Bespalov, V.V.Titov), chloro-derivatives of nitriles (E.M.Movsum-zade), hydrazones (Yu.P.Kitaev, B.I.Buzykin), nitro- and diazo-derivatives, nitramines and nitrosamines (S.S.Novikov, A.L.Fridman, S.L.Ioffe, V.A.Tartakovskii), as well as systems containing a nitrogen–nitrogen bond (B.V.Gidaspov) and *N*-fluoroimines (A.V.Fokin).

A definite tradition of the journal has been to pay special attention to the chemistry of heterocycles, which has always been represented very broadly, with detailed examination of three–seven-membered systems containing one or more heteroatoms, including aromatic derivatives and their benzoanalogues. Together with oxygen heterocycles—2-pyrones, enolic δ-lactones (R.Ya.Levina, N.P.Shusherina, E.A.Luk'yanets), 1,3-dioxans, $\Delta^{\alpha\beta}$-butenolides, pyrylium salts—and the still fairly exotic derivatives of selenium (2,1,3-thia- and selena-diazoles—V.G.Lesin), tellurium (tellurans—V.I.Minkin), and phosphorus (1,3,2-dihetero-phospholans and -phosphorinans—R.A.Cherkasov, M.A.Pudovik, A.N.Pudovik; E.E.Nifant'ev—and oxaphosphorinans—B.A.Arbuzov), the bulk of the material relates to nitrogen heterocycles—benzoisoquinolines, azafluorenes, indolizines, γ-piperidones (N.S.Prostakov), azaindoles, quinuclidines (L.N.Yakhontov), perimidines (A.F.Pozharskii), indoles and indolines (M.N.Preobrazhenskaya), aziridines (A.P.Sineokov, V.S.Etlis), 1,4-benzodiazepines (A.V.Bogatskii), quinolizidines, indolizidines, pyrrolizidines (I.M.Skvortsov), purines, oxapurines (E.S.Golovchinskaya), pyridine bases (M.Ya.Karpeiskii), sydnones (V.G.Yashunskii), quinolinium salts (B.M.Gutsulyak), *N*-acylated pyridines (A.K.Sheinkman, S.I.Suminov, A.N.Kost)—and many other compounds. In all these papers detailed consideration is given to methods of preparation of the systems, their structure (an important part in whose determination is played by various physical methods) and reactivity, and also many practical applications (in particular as analytical reagents—V.M.Ivanov). Reviews by R.A.Khmel'nitskii, P.B.Terent'ev, and N.S.Vul'fson, V.G.Zankin (coumarins, quinolizidine alkaloids) have discussed the mass-spectral behaviour of heterocycles. The journal pays close attention also to the theoretical problems of heterocyclic chemistry—prototropic tautomerism (A.R.Katritzky), application of the principle of hard and soft acids and bases to the coordination chemistry of azoles (V.N.Sheinker, A.D.Garnovskii, O.A.Osipov), mechanisms of recyclisation (O.P.Shvaika, V.N.Artemov), of condensation with elimination of ammonia (B.A.Geller), and of electrophilic substitution in 3-hydroxypyridines (K.M.Dyumaev, L.D.Smirnov) and other heterocycles and arenes (L.D.Smirnov) and other heterocycles and arenes (L.I.Belen'kii), and also the Fischer reaction and its analogues (I.I.Grandberg).

The special value of many classes of organic compounds (including some containing heterocyclic structural fragments) is largely due to their natural origin or their role in metabolic processes (including genetic aspects). The steady attention paid by the journal to structural and synthetic aspects of the chemistry of natural products and bio-organic chemistry is now responsible for a major independent line

in its work. Thus during recent years it has covered questions of the structure, biosynthesis, and properties of several important biopolymers of animal origin—chitin (E.A.Plisko, S.N.Danilov)—and vegetable origin—e.g. cellulose, its biologically active derivatives, and dextrans (A.D.Virnik), lignin (O.P.Grushnikov)—and also progress in and problems of solid-phase peptide synthesis (Yu.P.Shvachkin), the chemistry of glycero- and inosito-phosphatides and myoinositol (V.I.Shvets, B.A.Klyashitskii), phosphamides, laws of the three-dimensional structure of nucleosides, nucleotides, and oligonucleotides (N.N.Preobrazhenskaya, Z.A.Shabarova), and chemical methods of synthesis of their amino-acid and peptide derivatives (B.P.Gottikh). The journal continues actively to inform readers also on current directions in the search for natural and synthetic medicinals, which in several cases is able to reveal quantitative relations between chemical structure and biological activity (S.V.Nizhnii, N.E.Epshtein). Thus special reviews have been devoted to aminoglycosidic antibiotics, antimycotics, and glycosamidines, analogues of vitamin D_3, derivatives of γ-aminobutyric acid, as well as heterocyclic analogues of prostaglandins and steroids (A.A.Akhrem, Yu.A.Titov and G.N.Dorofeenko, G.I.Zhungietu), barbiturates (E.A.Cherkasova), anaesthetics (S.V.Bogatkov), chemical searchlight radar (V.G.Yashunskii), and bis-2-chloroethyl derivatives of amino-acids and peptides possessing antitumour activity (L.P.Rasteikene, M.I.Dagene, I.L.Knunyants).

The third trend in the output of the journal on organic chemistry is the provision of information on recent research on reactions involving organic compounds. Reactions or rearrangements having the most general significance are selected for review, many of which have become during recent years independent synthetic methods. Such are ionic hydrogenation and catalytic ionic hydrogenation (D.N.Kursanov, Z.N.Parnes), 1,5-sigmatropic migration in dienyl systems (V.A.Mironov, A.A.Akhrem), degenerate rearrangements of *O*-metallated *o*-semiquinolate radicals (M.I.Kabachnik, A.I.Prokof'ev), heterocyclisations involving acetylene (B.A.Trofimov), acyl migrations in unsaturated compounds (V.I.Minkin, L.P.Olekhnovich, Yu.A.Zhdanov), and also β-ketovinylation (M.I.Rybinskaya, A.N.Nesmeyanov, N.K.Kochetkov), aromatic nucleophilic substitution (O.N.Chupakhin), dimerisation of alkenes (V.Sh.Fel'dblyum), the Wurtz reaction, oxidative decarboxylation of carboxylic acids, and oxidation of alkylaromatic compounds (I.P.Beletskaya, D.I.Makhon'kov, Yu.A.Serguchev).

The fourth, vast area of reviews on organic chemistry, concerned with the mechanism of organic reactions, is represented by matter on the kinetics and the stereochemistry of such important processes as cleavage of the epoxide ring, hydroxymercuration, substitution, elimination, and incorporation. As before, *Uspekhi Khimii* is paying close and systematic attention to all the advances in research on the various kinds of unstable intermediate species that can be found in organic reactions. The number of such species has increased considerably in comparison with earlier periods of the journal. For example, perfluorinated carbanions and arenonium ions, dehydroarenes (arynes) arising from *o*-halogenated organometallic aryl systems (O.M.Nefedov, A.I.D'yachenko, A.K.Prokof'ev), and carbenes, in particular, which may be formed by α-elimination (G.Köbrich), have become very important. Long ago the journal forecast, as it were, the blossoming of this field of chemistry, publishing in 1934 its first review on the carbene theme (containing, incidentally, only eight references to the literature).

Apart from the classic carbocations (carbonium and carbenium ions) appearing in electrophilic reactions (G.Olah) and the free radicals generated in various homolytic processes, importance is now attached to radical-ion species (O.Yu.Okhlobystin, A.S.Morkovnik), of interest with respect to stereochemical features (Z.V.Todres). Material in the journal shows that cationic and anionic radical species can be formed in chemical reactions both in consequence of one-electron transfer as the primary step in the chemical process (K.A.Bilevich, O.Yu.Okhlobystin) and in a special type of hetero-homolytic mechanism such as radical–nucleophilic substitution (I.P.Beletskaya, V.N.Drozd). It is fundamentally significant that many of these modern radical-ion processes often take place by chain mechanisms, the importance of which in chemistry was realised in the very first years of *Uspekhi Khimii* and which it has covered in detail at all later stages. The chemistry of homolytic species is in general the longest established theme in the journal. Since the times of A.E.Arbuzov, who published his review on the chemistry of organic free radicals as early as the first volume, the structural variety and the range of thermodynamic and kinetic stability of these species have greatly expanded—from stable radicals (including nitroxyl, phenoxyl, and organometallic) to extremely unstable reactive intermediates capable of taking part in new molecular rearrangements (R.Kh.Freidlina, A.B.Terent'ev, G.I.Nikitin, A.D.Stepukhovich).

Ion-pairs constitute another type of intermediate to which the journal has paid close attention, especially during recent years. They have an important role, firstly in practice, since their formation enables the true mechanism of several reactions to be understood and the latter to be controlled (e.g. the anodic polymerisation of alkenes—M.Szwarc); and secondly in general theoretical terms, for it has emerged that taking into account the intermediate formation of ion-pair species is important for a fuller understanding of the state both of classic carbocations and of carbanions in solution. According to modern theoretical ideas discussed in the journal, ion-pairs play an important part in the mechanism of electrophilic and nucleophilic substitution at a saturated carbon atom (I.P.Beletskaya, A.A.Solov'yanov).

Finally, the fifth direction in which the journal covers organic chemistry is the development of modern theoretical principles and concepts of physical organic chemistry, on which are now based both planned organic synthesis and the study of mechanisms of chemical processes involving organic compounds. Such coverage includes theoretical aspects of the equilibrium acidity of carbon–hydrogen bonds (O.A.Reutov, I.P.Beletskaya, K.P.Butin), progress concerning the nature of the dual reactivity of ambident ions (O.A.Reutov, A.L.Kurts), the nature of differences in the acidity of organic and hetero-organic compounds on passing from condensed to gas phases (M.I.Kabachnik), role of hydrogen bonding in nucleophilic substitution, prototropy of triad nitrogen-containing systems, metallotropy, and transmission and nature of substituent effects in organic and hetero-organic molecules (D.N.Krasvtsov). Modern theoretical organic chemistry appears in the journal as such a varied scientific field that it finds room even for fertile qualitative concepts of intuitive character, such as e.g. the well known ideas on strained double bonds (L.I.Belen'kii, V.I.Sokolov, N.S.Zefirov), used successfully to explain peculiarities in the oxidation of strained cycloalkenes (V.V.Voronenkov) and for strictly quantitative approaches based on an orbital (L.Salem) or a kinetic–thermodynamic analysis of the theory of chemical reactivity (R.Zahradnik) and, as already mentioned, the principles of selectivity in chemical processes (N.M.Emanuel'). Further development of this area of investigation may arise also from advances in quantum-chemical calculations on complicated molecules, covered in reviews by C.Coulson, V.G.Dashevskii (conformational energies of organic compounds), A.A.Ovchinnikov, I.A.Misurkin (conjugated π-electron systems).

As before, *Uspekhi Khimii* has actively covered during recent years new physical methods for the investigation of organic and inorganic compounds, striving to keep the reader informed about the latest advances—infrared photochemistry (Yu.A.Molin), resonance Raman effect (P.P.Shorygin), mass spectrometry with chemical ionisation (O.S.Chizhov), dynamic nuclear magnetic resonance (N.M.Sergeev), and X-ray structural analysis—the last of which has created a revolutionary situation in crystallography (W.C.Hamilton). The n.m.r. method now permits the study of heterophase solvation (G.S.Bystrov), and the electron spin resonance method for investigating complicated molecular systems containing special spin labels has found several important applications in chemistry and biology. Useful tabular and reference data with exhaustive analyses have been given in reviews on the thermochemistry of organometallic compounds (I.B.Rabinovich) and the search for molecules possessing enhanced electron affinity (L.N.Sidorov). Among physicochemical matter special mention must be made of several contributions especially useful with respect to experimental method—reviews by E.N.Gur'yanova on "Mathematical Treatment of Results of Physicochemical Research on Complex Compounds" and by A.N.Korol' on "Reproducibility of Retention and Identification Data in Gas–Liquid Chromatography", as well as a few early journal papers that are still of interest—International System of Retention Factors in Gas Chromatography (for results obtained by this method see review by R.V.Golovnya), "Nomographic Methods in Physical Chemistry", and "Errors in and Accuracy of Measurements" (1947).

In concluding this survey we shall examine the character of the most recent material on the chemistry of macromolecular compounds, which at the present time, perhaps, is absorbing in the highest measure all the latest advances both in related fundamental scientific disciplines and in the instrumental technique of modern scientific research. The journal reflects all the chief lines of development, among which a few main trends in scientific research can be noted.

Firstly, new systems are constantly used in the formation of polymers, the main tendency being that, apart from purely organic monomers—acetylenes and diynes, dialkenylaromatic (B.A.Krentsel') and alkyl systems, adamantane derivatives, and mono- and bis-α-diketones (E.S.Krongauz)—enhanced importance is being attached to macromolecular derivatives of the most diverse elements—nitrogen (polyimides based on nitrogen heterocycles, polycyclotrimerisation of aromatic nitriles and acetylenes (V.A.Sergeev, V.K.Shitikov, V.A.Pankratov), polyisocyanates (S.G.Entelis), polytriazines, polyazaporphyrins (A.A.Berlin) and polyquinoxamines, and also thermostable polymers from tetramines and aromatic tetracarboxylic dianhydrides), fluorine (fluorination of polyethers and polythioethers, polyfluorovinyl), sulphur (polymers based on alkene sulphides and αβ-unsaturated sulphur-containing compounds—E.N.Prilezbaeva), phosphorus (and also polyphosphazens and oligomers of organo-oxaphosphazens—E.F.Chernyshev), and silicon (including organosiloxazans and oligodialkylsiloxanes—V.V.Korshak, A.A.Zhdanov). Broad investigations have been made also on polymers based on carboranes (V.V.Korshak) and ferrocene, various inorganic and metal-containing macromolecules (V.A.Kargin), and also coordination polymers.

Secondly, an intense search is being made for ever new promoters, initiators, and catalysts of the formation of macromolecular compounds, and detailed investigation of their mechanism is being based on the latest advances in physical organic, organometallic, coordination, and quantum chemistry. Methods are being elaborated for the polymerisation of chemically activated monomers, and redox reactions are acquiring great value in polymerisation processes—e.g. initiation by one-electron oxidation or reduction (including electrochemical) with formation of active intermediate radical-ions (N.G.Gaylord) or oxidative polymerisation of vinyl monomers and reductive polyheterocyclisation—a new method of synthesis of polyheteroarylenes. In several cases initiating systems based on readily oxidisable organic derivatives of non-transition metals (E.B.Milovskaya) cause radical polymerisation of polar monomers; derivatives of magnesium (B.L.Erusalimskii) and alkaline-earth metals (A.A.Arest-Yakubovich) initiate anionic polymerisation. The main laws governing the capacity of lactams for anionic polymerisation as a function of their structure are being established, and new activators for this process investigated (T.M.Frunze, V.V.Kurashev). Study continues of the mechanism of, and the nature of active centres for, stereospecific polymerisation of alkenes under conditions of metal-complex catalysis by transition metals (B.A.Dolgoplosk), while linking the ideas of anionic and coordination forms of catalysis has led to the discovery of anionic–coordination polymerisation (S.S.Medvedev). Finally, detailed research on the mechanism of polymerisation continues by the application of quantum-chemical and spectroscopic methods: the kinetics (and in the case of emulsion polymerisation also the topochemistry) of individual stages and the influence of the solvent are being studied, rates of growth and termination measured, and quantitative theories formulated to explain polycondensation processes and also (with the application of topological principles—S.Ya.Frenkel') random and heterophase copolymerisation.

Advances in the synthetic chemistry of macromolecular compounds (the title of a recent review by V.V.Korshak) involve at the present time the formation of many classes of polymeric molecules, which is apparently the third major line of development. Only in recent years have syntheses been accomplished of block copolymers of polycondensation type (P.M.Valetskii), semi-rigid chain molecules, ladder polyheteroarylenes (A.L.Rusanov), skeleton and network polymers (Ya.S.Vygodskii, S.V.Vinogradova—interpenetrating networks), polymers having a stellar or comb-like structure, ion-exchange membranes (B.N.Laskorin), oligo- and polyphenylenes with functional groups, and finally poly(arylene sulphides) (V.A.Sergeev, V.K.Shitikov, Ya.N.Nedel'kin).

The most diverse synthetic methods, several using novel types of catalysts (including stereospecific for optically active polymers—E.L.Klabunovskii), are now employed to obtain the bulk of such varied classes of compounds. Since many of these methods often acquire independent scientific and practical value, their exploitation represents a fourth line of research in polymer chemistry during recent years. This has been closely followed in the journal by the inclusion of reviews on polycondensation methods, of value for the synthesis of thermostable polymers, which have been covered also by special reviews (V.V.Korshak, S.V.Vinogradova, A.A.Berlin), on copolymerisation of cyclic compounds (T.M.Frunze, V.V.Kurashev), and on hydro-dehydropolymerisation and isomerisation polymerisation of unsaturated hydrocarbons (B.A.Krentsel'). Detailed discussions have appeared also on non-equilibrium copolycondensation in homogeneous systems, solid-phase polymerisation(V.E.Shklover, Yu.T.Struchkov), and heterophase radical polymerisation, as well as on polycyclisation, polycyclotrimerisation, trimerisation polycondensation (M.M.Teplyakov), and acceptor–catalytic polyesterification (V.A.Vasnev).

Many of the macromolecular compounds obtained during these years possess most interesting properties of practical value, such as the ability to catalyse chemical reactions and stabilise polymers (N.A.Plate) and to form macromolecular

charge-transfer complexes. Several of these polymers show great technical promise—e.g. electrical, photoelectric, and photochromic—as well as photoconduction and electrophotographic phenomena in linear polymers containing saturated and conjugated bonds. Semiconducting pyropolymers, conjugated inorganic polymers based on carbon (M.I.Cherkashin), and vitreous carbon (M.Ya.Fioshin) have also been obtained. Progress in the structural study of polymeric carbon has been surveyed by A.M.Sladkov.

Many of these properties are also of great theoretical interest (thus a quantum-chemical interpretation of the electronic structure and properties of polymers containing conjugated bonds has been given in a paper by A.A.Ovchinnikov, I.A.Misurkin), while others are of interest in biochemistry (use of polymers as matrices for peptide synthesis, formation of biologically active cellulose derivatives, use of polyethylene glycol in biochemistry, the grafting of biologically active compounds to the surface of optical materials, and the preparation of polymeric biological chemotherapeutic agents having carcinolytic activity), as well as for other purposes (e.g. use of ion-exchange resins in photometry, development of thermostable antifriction plastics (I.A.Gribova, S.V.Vinogradova), and formation of coatings by anodic electrodeposition of water-thinned paint systems based on water-soluble oligomers).

In view of the extraordinary value of polymeric substances for the most varied branches of practical science and technology, all this work probably indicates yet another, fifth line of research in modern polymer chemistry—the synthesis of macromolecular substances and materials having specified properties—for which those properties that are directly related to the service characteristics of macromolecular compounds are, naturally, of especial interest. In this connection the journal has continually published during recent years matter on the mechanism of stabilisation and the thermal stability of polymers and its dependence on their chemical structure (V.V.Korshak, S.V.Vinogradova), including cation- and anion-exchange resins, frost-resistance of polymers, their plasticisation, improving the water resistance of fibreglass plastics by additions of water-repellent adhesives, and finally problems of the photodegradation (M.B.Neiman), photostabilisation, and photostability of polymers (including coloured materials).

Finally, the sixth trend in macromolecular chemistry now evident in the journal is the physical chemistry and the physicochemical mechanics of polymer substances and materials, whose development also is regarded as very important. General contributions on this subject cover a wide range of problems—molecular-mass distribution in the production of homopolymers (N.S.Enikolopov), chemical defects in heterounit polymer molecules (V.V.Korshak), composition inhomogeneity of polymers (S.Ya.Frenkel'), and finally the nature of supermolecular structures in rubbers (V.A.Kargin). Great attention has been paid to the structure and properties of heat-resistant polymers (A.A.Askadskii, G.L.Slonimskii), block polymers and their solutions (L.Z.Rogovina, G.L.Slonimskii), and amorphous polymers, as well as to mechanisms of the diffusion of electrolytes (G.E.Zaikov) and the sorption of certain polymers in relation to their porous structure.

The most diverse physical methods are now used in solving physicochemical problems of macromolecular chemistry—sedimentation of polydisperse polymers, n.m.r. study of systems comprising a polymer with a substance of low molecular mass, electrochromism (for the study of slow movements in macromolecules), and also study of surface electrical characteristics of polymer-containing disperse systems—low-temperature methods being covered in a special review by A.G.Merzhanov). In combination with progress in developing new approaches to a theoretical interpretation of the experimental results this work has yielded in recent years very important quantitative data for several individual polymers, their mixtures, and solutions. Examples are studies of ion exchange and the swelling of exchangers, of structural features of homo- and co-polyurethanes and of networks based on heat-resistant polymers, of dilatancy of colloid structures and polymer solutions, of conformational and thermodynamic properties of macromolecules in ternary polymer systems, and of the polymeric structure of selenium also photoelectric phenomena. Furthermore, the influence of hydrogen bonding and ionic interactions has been established on several carboxyl-containing copolymers and ionomers based on them, and also that of a solid surface on relaxation and structure formation in polymer boundary layers (a theory of the "isofree" volume and the glass transition was constructed for amorphous polymers).

The value of such research is that the results can be used in the exploitation of macromolecular substances and materials. This applies in particular to investigations on the nature of gel formation, the structure and properties of polymer gels, also changes in rheological properties accompanying the formation and transformation of polymers, and those of thermosetting resins. Furthermore, the importance of modern research on the physics of polymers, to which the journal has recently paid such close attention, lies in the theoretical possibility of using the resulting quantitative characteristics to predict important practical properties of new synthetic macromolecular compounds. A recent review was devoted to methods for calculating physical parameters of high polymers (A.A.Askadskii, G.L.Slonimskii).

A survey of the contents of *Uspekhi Khimii* in the modern period must take note of two additional tendencies. The first is a definite increase in the number of contributions in which purely scientific interest in a research field is combined with great applied significance. Examples are a detailed examination of the ozonolysis of alkenes (an important method for obtaining dibasic carboxylic acids and other carbonyl compounds—G.A.Tolstikov), a long-term comprehensive study of radical reactions of 1,3-dioxans—an important class of saturated heterocycles—which are extremely promising compounds in organic synthesis (D.L.Rakhmankulov, S.S.Zlotskii, R.A.Karakhanov, U.B.Imashev, V.V.Zorin), and finally an analysis of current prospects for the use of organosulphur compounds present in crude petroleum and the determination of trace elements (Yu.A.Zolotov).

A second clear trend is for the journal to establish new headings. Examples are provided by new interrelations found between chemical and biological kinetics (N.M.Emanuel'), enabling the quantitative laws of many most complicated biological processes to be investigated and the effectiveness of several medicinal (including antitumour) preparations to be assessed and optimum régimes determined, the regular appearance of matter on synthetic food products—"Ways of using Amino-acids in Industry", "Plasteins in Nutrition", and "Chemistry of Odour and Flavour" (V.M.Belikov, S.V.Rogozhin, B.V.Tolstoguzov, R.V.Golovnya)—the discovery of new chemical possibilities in recording and storing information (A.V.Vannikov), including the use of photosensitive enzyme systems (I.V.Berezin, K.Martinek), papers on problems of silverfree photography, high-temperature exciton conduction, and photocatalytic conversion of solar energy (K.I.Zamaraev), and papers on enzyme electrodes. The contents have covered also aspects of the prebiological evolution of organic substances, and quite recently ecological questions, at present causing great interest throughout the world in connection with global problems of the protection of the environment. The great work of the journal is now actively crystallising the views of wide circles of its readers and

guiding them in the saturation flow of world chemical information has required that it should make its own appraisals of the relevance of reviews in various fields of chemical science.

Activity in scientific information during recent years was summarised at a 1977 All-Union conference on "Problems in the Improvement of Review Information on Chemistry", at which the chief editor of *Uspekhi Khimii*, Academician N.M.Emanuel', gave a lecture on "Criteria of the Quality of Reviews in the Field of Chemistry"†. He showed that, since it is chemical science that now produces the greatest amount of experimental material (especially on organic chemistry), while being actively involved in forming new fields of science and creating interdisciplinary networks, chemical literature has constituted during recent years an especially weighty portion of the total flow of world scientific and technical information#. Since for ordinary chemical journals (not only original but also abstracts) it is now difficult to ensure effective identification of scientific papers and facilitate their retrieval, the most efficient route for disseminating information, incorporating it, and bringing it to the attention of chemists is the review literature, with its inherent ability to condense primary scientific information, as well as its critical analysis and skilled generalisation.

The journal now considers that an immediate task, as was mentioned later, is to examine the possibility of condensing primary information by publishing analytical surveys. Numerical data in several leading science and science-assessing papers have shown that such analytical review activity enhances considerably the efficiency of scientific work and in several cases may lead to economies in the material resources consumed in scientific research.

To assess the quality of review literature the lecture proposed the use of a special "condensation factor", equal to the ratio of the volume of the primary information to that of the scientific review and representing the saving in the time of the specialist reader. A yearly analysis in the lecture showed that for *Uspekhi Khimii* the factor has more than doubled (its value at ten-year intervals from 1936 to 1976 was 20, 26, 36, 50, and 50), and has now apparently reached an optimum value (in the opinion of specialists further increase would heighten the risk of distorting the primary scientific information).

Later in the lecture it was stated that the most objective quantitative criterion of the scientific value of review papers may be their citation index, which depends exponentially on two factors—topicality, i.e. timeliness of a particular item, and timeless scientific importance—and as a rule (although these are exceptions) diminishes with the time that has elapsed since publication. According to statistics given in the lecture the number of highly quoted papers (>4–5 references in 3 years) in *Uspekhi Khimii* for the period 1961–1969 was ~7% of the total number of publications, more than double the index for ordinary (non-review) academic scientific journals on chemistry.

In the concluding part of the lecture it was shown that reviews published in *Uspekhi Khimii* are usually cited regularly by all the major journals published in various countries. For all years the maximum numbers of citations are found in the *Journal of the American Chemical Society* (1240 references), *Journal of Organic Chemistry* (360), and *Journal of Chemical Physics* (310). Each of the other major science journals examined contains on the average 240 citations, which over all the journals amounts to >12000 references to items in *Uspekhi Khimii* (of which >1000 in 1972)[7]§.

All these statistics confirm that our leading review journal fulfills successfully its scientific information function, and is up to the standard of modern demands on world analytical review literature.

The journal has also played an important scientific educational role in the training of science personnel. Throughout its many years *Uspekhi Khimii*, whose editorial board has contained at various times many most eminent representatives of chemical science, has educated its active expert staff and writers. Matter published in it has enabled many scientific workers to improve thei qualifications and prepare to solve complicated scientific problems, and workers in applied fields of chemistry, engineers, and works laboratory technicians to find on its pages valuable practical tips for everyday work. Reviews in the journal have always been widely used to raise the level of instruction in chemistry and chemical technology in higher education, and its contents have always been useful to students for their undergraduate and degree work. It is now difficult to imagine modern candidate or doctoral theses, monographs, handbooks, or textbooks without references to *Uspekhi Khimii*.

The geographical range of the journal's activity is constantly expanding. Among its authors have been chemists in Moscow and Leningrad, Riga, Vilnius and Tallinn, Kiev and Minsk, Kharkov, Donetsk, Rostov-on-Don, Ufa and Kazan, Gorky and Sverdlovsk, Irkutsk and Novosibirsk, Erevan, Baku, Tashkent and Dushanbe—i.e. all those towns in which new science and information centres have grown and developed, and important and interesting results have been obtained in various modern fields of chemistry. The journal regularly contains also contributions from leading research workers in the USA, Japan, the Federal Republic of Germany, France, England, Czechoslovakia, Poland, Bulgaria, Italy, Switzerland, and many other countries.

Results obtained from a questionnaire on improving review information in the country recently issued to our chemical community¶ are objective and significant for a general appraisal of the work of the journal. Many of the specialists questioned (10000 questionnaires were distributed among workers in academic and specialised scientific organisations, as well as higher educational institutions) named *Uspekhi Khimii* as their principal source of general chemical information, and expressed satisfaction with its work.

We can be confident that *Uspekhi Khimii* will continue to fulfill its important function of review journal, shedding light on prospects of development for current chemical trends.

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†The conference was held in Moscow on the initiative of the Moscow administration of the Mendeleev All-Union Chemical Society, the editorial board of the society's journal, the local organisation of the Nesmeyanov Institute of Heteroorganic Compounds of the USSR Academy of Sciences, and the Chemistry Section of the Moscow Scientists Club. A précis of the lecture was published[6].

#Estimates by several experts indicate that its proportion increased between 1968 and 1976 from 18.7% to 23% of the total number of published items.

§The citation index of *Uspekhi Khimii* rose sharply in the 1960s, from the first issue of a complete ("cover-to-cover") English translation (published under the title Russian Chemical Reviews from January 1960 by the Royal Society of Chemistry, Burlington House, London, in collaboration with the British Library).

¶The enquiry was conducted in 1981 by the Section on Review Information on Chemistry and Chemical Technology of the Central Administration of the Mendeleev All-Union Chemical Society together with the Chemistry Division of the All-Union Institute of Scientific and Technical Information of the USSR Academy of Sciences.

All readers heartily congratulate their journal on its fine jubilee and wish it further achievements in its efficient contribution to the progress of world chemical science.

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