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USSR Report

LIFE SCIENCES

BIOMEDICAL AND BEHAVIORAL SCIENCES

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20 May 1985

USSR REPORT

LIFE SCIENCES

BIOMEDICAL AND BEHAVIORAL SCIENCES

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PROTEIN AND LYSINE LEVELS IN DIFFERENT STRAINS, LINES AND HYBRIDS OF CORN

Tbilisi SOOBASHCHENIYA AKADEMII NAUK GRUZINSKOY SSR in Russian Vol 114, No 3, Jun 84 (manuscript received 18 Mar 83) pp 601-604

LIPARTELIANI, O. G., CHIGVINADZE, T. D. and CHAKHIDZE, O. T., Institute of Plant Biochemistry, Georgian SSR Academy of Sciences; Institute of Soil Science imeni Yu. M. Lomouri, GSSR Ministry of Agriculture

[Abstract] Tabular data are presented on protein and lysine concentrations in corn kernels of 22 different varieties, 19 lines, and 12 hybrids of corn. The breeding of corn with high protein and lysine levels became possible after the isolation of the Opaque-2 and Floury-2 mutants, noted for their high lysine levels. In the case of the tabulated hybrids the protein concentration ranges from 9.0 to 11.9%, free lysine from 0.78 to 2.18 mg/100 g of grain, and protein lysine from 2.4 to 3.8 g/100 g protein. The corresponding values for the varieties were 8.9-12.0%, 0.67-2.00 mg/100 g grain, and 2.0-3.8 g/100 g protein, and for the various lines 9.7-12.6%, 0.68-1.60 mg/100 g grain, and 2.0-3.1 g/100 g protein. References 10: 6 Russian, 4 Western.
[247-12172]

UDC 631.524:633.2.001.12

INTRODUCTION OF FODDER PLANTS SELECTED FROM NATURAL FLORA: PRINCIPLES AND RESEARCH METHODOLOGY

Leningrad RASTITEL'NYE RESURSY in Russian No 1, Jan 85
(manuscript received 15 Aug 83) pp 3-14

SIN'KOVSKIY, L. P., All-Union Scientific Research Fodder Institute imeni V. R. Vil'yams, Lugovaya, Moscow Oblast

[Abstract] The demands for increased meat production in the USSR make it necessary to increase significantly the fodder base, and in that respect the USSR is unique among the countries of the world in the wealth of its agricultural plant resources. As a result of this situation, increasing efforts are being expended on research and practical utilization of these resources as fodder for domestic animals. These studies include improvements in the natural flora and its introduction into new regions once it has been identified as useful in agriculture for the purposes intended. From the administrative viewpoint, it appears that even more efficient research can be conducted by

creating a special section within the All-Union Academy of Agricultural Sciences to deal with fodder cultures. The practical applications of such research would then be considerably facilitated. In addition, an added benefit of a centralized research effort would be a unified and highly controlled approach to such studies, again making for more efficient utilization of available resources. References 62 (Russian).
[1040-12172]

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PLASMODESMS--INTERCELLULAR CONNECTORS IN PLANTS

Moscow FIZIOLOGIYA RASTENIY in Russian Vol 32, No 1, Jan-Feb 85
(manuscript received 14 Apr 84) pp 176-190

GAMALEY, Yu. V., Botanical Institute imeni V. L. Komarov, USSR Academy of Sciences, Leningrad

[Abstract] This is a review paper. Studies of cytoplasmic connections between plant cells go back far into history. The term "plasmodesms" was proposed back in 1901 by Strasburger. The second "rediscovery of plasmodesms took place in the 60's when the use of electron microscopy made it possible to refine their structure and to observe them in a variety of cells and taxonomic plant groups. In 1975 the results of electron microscopic studies were reviewed at an international symposium in Canberra. In the present article a review of published results is being reported covering the post 1975 period. Data on the structure and functions of plasmodesms are reported along with their formation, development and distribution in higher plant tissues, general organization and taxonomic variations in their structure as well as the possible functions they may have (transport, transmission of signals, etc.). Further progress in studies of intercellular connectors will require new developments in methodologies because, in spite of the great interest and intensified activity in this area, little of significance comes out of all these attempts. Figures 8, references 76: 9 Russian, 67 Western.
[1043-7813]

UDC 581(134.4+192.7):582.542.1

EFFECT OF NATURAL AND SYNTHETIC GROWTH REGULATORS ON PROTEIN CONTENT IN WHEAT GRAIN

Moscow FIZIOLOGIYA RASTENIY in Russian Vol 32, No 1, Jan-Feb 85
(manuscript received 27 Feb 84) pp 196-198

SOBOLEV, A. M. and DUBKO, L. A., Institute of Plant Physiology imeni K. A. Timiryazev, USSR Academy of Sciences, Moscow

[Abstract] It was of interest to determine the possibility of using natural and synthetic growth regulators to increase protein content in grain. Because

of the fact that growth is inversely related to accumulation of food reserves, growth inhibitors were studied: abscisic acid (ABA), sodium salt of maleic acid hydrazide (MAH) and simazin [2-chloro-4,6-bis(ethylamino)-symm-triazine] using Moscovskaya 35 and Belorusskaya 80 spring wheat in hot house and in field experiments respectively. The results showed a significant increase in protein content without any alterations in the harvest yield or in total weight of 1,000 grains. Only late treatment with ABA showed increased weight of grains. The results obtained in hot house experiments and in the field studies were analogous. Hence it was shown that treatment with natural and synthetic growth inhibitors leads to increased content of protein in grain without lowering the productivity of the culture. References 10: 8 Russian, 2 Western.
[1043-7813]

UDC 575.113:633.111

COMBINATIONAL ABILITY AND GENE EFFECTS IN SOFT WINTER WHEAT FROST RESISTANCE

Moscow GENETIKA in Russian Vol 20, No 12, Dec 84
(manuscript received 28 Jun 83; in final form 29 Feb 84) pp 2031-2034

MUSICH, V. N. and GERASIMENKO, V. F., All-Union Breeding and Genetics Institute, Odessa

[Abstract] An analysis of gene effects was conducted in terms of frost resistance in soft winter wheat, using full diallelic crossings in five varieties of wheat: Erythrospermum 121/47 (1), Odessa 16 (2), Priboy (3), Bezostaya 1 (4), and Erythrospermum 127 (5). Combination ability was determined by the method of Griffing using the F_1 and F_2 generations, as well as true dominance (h_{rs}) and epistatic deviation (y_{rs}) by the Hayman method. A positive correlation (0.726) prevailed between the specific combinational ability and h_{rs} , but not between the combinational ability and y_{rs} , the latter indicating that the Hayman approach does not determine the direction of y_{rs} . Consequently, determination of epistatic deviation should be analyzed in terms of comparison of the specific combinational ability with h_{rs} and y_{rs} . The crossings 1 x 2, 3 x 4, 2 x 5, and 1 x 3 appear promising for frost resistance since they possess additive genes for this trait and a positive epistatic deviation, which can be fixed by self-pollination. Figures 1; references 10 (Russian).
[238-12172]

EXPECTED AND ACTUAL SELECTION INDEX EFFICIENCY FOR SOFT SPRING WHEAT GRAIN QUALITY

Moscow GENETIKA in Russian Vol 20, No 11, Nov 84
(manuscript received 5 Jul 83; in final form 10 Dec 83) pp 1864-1870

BEBYAKIN, V. M. and MARTYNOV, S. P., Scientific Research Institute of
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[Abstract] Selection indices were studied for various grain characteristics for 26 lines of $F_4[F_1(\text{Atlas } 66 \times \text{Diamond}) \times \text{Saratov } 38]$ hybrids. Analysis of the expected and actual indices showed that phenotypic correlation between an index for the F_4 families and flour quality in F_5 progeny was relatively low ($r = 0.38$). In addition, the relationship between flour quality of these two generations was even lower ($r = 0.24$). These observations indicate that a selection index does not guarantee identification of high-quality genotypes, although, in comparison with direct breeding for a trait, they increase the probability of such identification. References 8: 4 Russian, 4 Western.
[242-12172]

UDC 631.523.1.11.4

GENETIC CONTROL OF GROWTH HABIT IN SOFT SPRING WHEAT MILTURUM 553

Moscow GENETIKA in Russian Vol 20, No 11, Nov 84 (manuscript received 23 Sep 83)
pp 1881-1886

ZHARKOV, N. A., Siberian Scientific Research Institute of Agriculture, Omsk

[Abstract] The genetic control of growth habit in soft spring wheat was investigated by conducting monosomic genetic analysis on F_2 hybrids obtained by crossing the monosomic variety Chinese spring with Milturum 553 (a Western Siberian ecotype). Reciprocal monosomic study of the F_2 hybrids representing three monosomic lines (chromosomes 2B, 5B and 7B), resulted in a segregation ratio in disomic and most monosomic populations of 63 spring growth plants to one winter growth plant. Evidently, there were different control factors involved in the expression of the independently inherited Vrn genes which are responsible for spring growth habit. Apparently, spring growth of milturum 553 is determined by two dominant Vrn genes located on chromosomes 2B and 5B. Based on a four-loci control system, Milturum 553 can be represented as having the genotype $vrn1\ vrn1Vrn2Vrn2-vrn3vrn3Vrn4Vrn4$. A gene(s) responsible for the duration of growth has been localized to chromosome 7B. Figures 1; references 14: 6 Russian, 8 Western.
[242-12172]

BREEDING FOR DROUGHT RESISTANCE

Moscow GENETIKA in Russian Vol 20, No 11, Nov 84
(manuscript received 21 Nov 83; in final form 3 May 84) pp 1887-1893

IL'INA, L. G., Scientific Research Institute of Agriculture of the Southeast,
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[Abstract] Historical and current cultivation practices are presented for Saratov 42 spring wheat, which was derived by crossing Saratov 38 with Albidum 1616. The technique utilized is commonly referred to as the "compound stepwise hybridization", the essential feature of which consists of gradual accumulation of desired genes from an increasing number of local, well established, wheat varieties. Saratov 42 is extensively cultivated in regions with arid climates, in some oblasts accounting for 54 to 91% of all the spring wheat plantings. The hardness of Saratov 42 is due to the fact that it combines genes from four wheat varieties (Beloturka, Poltavka, Rusak, Khivinka) regarded as aboriginal in the Southeast. Figures 3; references 31: 30 Russian, 1 Western.
[242-12172]

UDC 633.11"324":581.08.132

PHOTOSYNTHETIC INDICATORS OF WINTER WHEAT VARIETIES IN RELATION TO EAR PRODUCTIVITY

Moscow DOKLADY VSESOYUZHNOY ORDENA LENINA I ORDENA TRUDOVOGO KRASNOGO
ZNAME NI AKADEMII SEL'SKOKHOZYAYSTVENNYKH NAUK IMENI V. I. LENINA in Russian
No 10, Oct 84 (manuscript received 18 May 84) pp 3-5

VARENITSA, Ye. T., corresponding member, All-Union Academy of Agricultural
Sciences, GINS, V. K., RYBAKOVA, M. I. and CHAPLYA, S. A., Scientific Research
Institute of Agriculture of the Central Nonchernozem Zone

[Abstract] The grain productivity of some 30 varieties of winter wheat were analyzed in terms of flag leaf photosynthetic potential, taking into consideration leaf area, chlorophyll concentration, photochemical activity of chloroplasts, and ribulosediphosphate carboxylase (RDPC) activity. Considerable variation was obtained in the correlation parameter between grain weight per ear and the individual indicators of photosynthetic potential among the different varieties. In most cases high grain yield was correlated with a large leaf area high RDPC activity, and intense chloroplast activity. However, optimum photosynthetic indicators obviously depend on the agroclimatic conditions, and as such standard varieties of wheat should be utilized for each climatic region to provide a baseline for comparison and assessment of potential productivity. References 9: 7 Russian, 2 Western.
[1039-12172]

GENERALIZATION OF PHOTOSYNTHETIC THEORY OF AGROECOSYSTEM PRODUCTIVITY

Moscow DOKLADY VSESOYUZNOY ORDENA LENINA I ORDENA TRUDOVOGO KRASNOGO ZNAMENI AKADEMII SEL'SKOKHOZYAYSTVENNYKH NAUK IMENI V. I. LENINA in Russian No 10, Oct 84 (manuscript received 18 May 84) pp 5-8

SIROTENKO, O. D., All-Union Scientific Institute of Agricultural Meteorology

[Abstract] A summary review is presented of a novel approach to analysis of agroecosystem productivity, which relies on generalization of the photosynthetic theory underlying productivity. This approach involves both physical and mathematical modeling of energy mass exchange relating a hydrodynamic system with a biodynamic system. The unique feature of this approach is a combined evaluation of the effects of the environment on plants both via effects on photosynthesis and respiration, growth and development. Independent description of each phytomere leads to the creation of models that are both flexible and adaptable, incorporating as they do principles of internal feedback. Figures 2; references 11: 9 Russian, 2 Western.
[1039-12172]

UDC 631+338

BIOENERGETIC ASSESSMENT OF GRAIN CROPS

Moscow DOKLADY VSESOYUZNOY ORDENA LENINA I ORDENA TRUDOVOGO KRASNOGO ZNAMENI AKADEMII SEL'SKOKHOZYAYSTVENNYKH NAUK IMENI V. I. LENINA in Russian No 10, Oct 84 (manuscript received 24 May 84) pp 9-11

NOVIKOV, Yu. F., corresponding member, All-Union Academy of Agricultural Sciences and BAKAY, S. S., Central Scientific Research and Planning Technologic Institute of Mechanization and Electrification of Animal Husbandry of the Southern Zone of the RSFSR; All-Union Order of the Red Banner of Labor Corn Scientific Research Institute

[Abstract] A bioenergetic assessment of grain crops is proposed, using the conditions prevailing in the Zaporozh'ye Oblast of the Ukraine in the cultivation of winter wheat. The basic indicator of crop value and potential consists of an energy efficiency coefficient, which reflects the ratio of energy accumulated in a harvest to the energy expended in producing the harvest. Energy expended per hectare is calculated from standard tables. On the basis of comparative data for several varieties of winter wheat, Odessa-51 appears best suited to the Zaporozh'ye Oblast with energy efficiency coefficients of 1.90-2.41, followed by semi-dwarf variety 49. References 1 (Russian).
[1039-12172]

FLAG LEAF ENZYMATIC ACTIVITY AS SPECIES CHARACTERISTIC IN WHEAT

Moscow DOKLADY VSESOYUZHNOY ORDENA LENINA I ORDENA TRUDOVOGO KRASNOGO ZNAMENI
 AKADEMII SEL'SKOKHOZYAYSTVENNYKH NAUK IMENI V. I. LENINA in Russian No 10,
 Oct 84 (manuscript received 21 May 84) pp 11-13

CHERNYSHEVA, N. F. and DEKHTYAREV, P. Yu., Institute of Biology, Buryat Branch,
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[Abstract] Flag leaf enzymatic activities were determined for several varieties of wheat (*Triticum* sp.) in relation to their genome and ploidy, to determine the effects of evolutionary factors in their responsiveness to nitrogen and phosphorus nutrients. Analysis of the activities of nitrate reductase, adenosine triphosphatase and acid phosphatase showed clear-cut species differentiation. In terms of enzymatic activity the genomic groups ranked in order of decreasing activity as follows: AB > ABD > AG. Species with A and AG genomes responded better to nitrogen nutrients, AB species to phosphorus fertilizers, and ABD species responded equally well to both types of fertilizers. Figures 1; references 9: 8 Russian, 1 Western.
 [1039-12172]

IDENTIFICATION OF INSECT THIOL PROTEINASE INHIBITORS IN WHEAT AND OTHER GRAIN CROPS

Moscow DOKLADY VSESOYUZHNOY ORDENA LENINA I ORDENA TRUDOVOGO KRASNOGO ZNAMENI
 AKADEMII SEL'SKOKHOZYAYSTVENNYKH NAUK IMENI V. I. LENINA in Russian No 10,
 Oct 84 (manuscript received 18 May 84) pp 13-15

KONAREV, Al. V. All-Union Order of the Red Banner of Labor Scientific Research
 Institute of Plant Protection

[Abstract] Studies were conducted on protein inhibitors of thiol proteinases in wheat grain and other grain crops to determine the scope of their activity vis-a-vis proteinase of *Tribolium confusum*, grain endosperm proteinases, and trypsin and papain. Isoelectric focusing in polyacrylamide gel demonstrated that the identical proteins were responsible for the entire spectrum of inhibitory activity, i.e., against endogenous and exogenous proteinases. The fact that endogenous enzymes are inhibited is indicative of a regulatory function of these proteins in grain metabolism. In addition, since insect proteinases are also inhibited the possibility remains open that these proteins may exert a protective effect against insect pests. In the Chinese Spring soft wheat the inhibitors are under the control of chromosomes 2B and 2D-beta. Figures 1; references 7: 5 Russian, 2 Western.
 [1039-12172]

EFFECTIVENESS OF WHEAT INOCULATION WITH AZOSPIRILLA IN NONCHERNOZEM ZONE

Moscow DOKLADY VSESOYUZHNOY ORDENA LENINA I ORDENA TRUDOVOGO KRASNOGO ZNAMENI AKADEMII SEL'SKOKHOZYAYSTVENNYKH NAUK IMENI V. I. LENINA in Russian No 10, Oct 84 (manuscript received 18 May 84) pp 15-16

CHEREMISOV, B. M. and RED'KINA, T. V., Moscow Department of the All-Union Scientific Research Institute of Plant Culture imeni N. I. Vavilov; Institute of Microbiology, USSR Academy of Sciences

[Abstract] In March 1981 azospirilla were isolated from experimental plots in the Moscow Oblast used for the cultivation of Mironovskaya 808 winter wheat, as well as from the roots and grain of this plant. Subsequently, a suspension of pure culture of azospirilla was used for inoculation of Mironovskaya 808 and Zarya wheat, which were then planted under controlled conditions at the Institute of Plant Culture. In the case of Mironovskaya 808 wheat the increase in harvest was 10-11% as a result of treatment with the nitrogen-fixing micro-organism, while Zarya wheat showed no benefit. It appears that azospirilla can be effective in improving the yields of certain varieties of winter wheat in the nonchernozem zone, if compatible plant-microbe combinations are selected. References 7: 4 Russian, 3 Western.

[1039-12172]

EFFECTS OF NATURAL HEAVY RADIONUCLIDES IN FERTILIZER AND SOIL IMPROVEMENT AGENTS ON CYTOGENETIC EFFECTS IN PLANTS

Sverdlovsk EKOLOGIYA in Russian No 5, Sep-Oct 84 (manuscript received 19 Jan 84) pp 38-42

ARKHIPOV, N. P., KAL'CHENKO, V. A., SHEVCHENKO, V. A., FEVRALEVA, L. T., BOBRIKOVA, Ye. T. and BAZYLEV, V. V.

[Abstract] Field studies were conducted on low-humus leached soil to determine the effects of natural heavy radionuclides in fertilizers and soil conditioning agents on chromosomal abnormalities in plants. Studies conducted with wheat, barley and corn showed that the use of ammophos and nitrophos, as well as phosphogypsum, in levels sufficient to increase the baseline soil concentration of U-238 5-fold, Th-232 2-fold, Ra-226 60-fold, and Pb-210 and Po-210 40-fold, resulted in a 1.5- to 5-fold increase in the number of cells with chromosomal abnormalities in the meiotic phase. Considerable variability was shown by the individual crops, with corn being most susceptible to the effects of U-238 and Th-232, for example. More extensive studies will have to be conducted with a greater variety of crops and various other fertilizers to fully assess the problem that may be posed by using fertilizers derived from mining products. Figures 1; references 6: 1 Hungarian, 5 Russian.

[1696-12172]

INVISIBLE AGRICULTURAL WORKERS: NITROGEN-FIXING BACTERIA

Moscow SEL'SKAYA ZHIZN' in Russian 2 Mar 85 p 2

BERESTETSKIY, O., director, All-Union Scientific Research Institute of Agricultural Microbiology, corresponding member, All-Union Academy of Agricultural Sciences imeni Lenin, Leningrad

[Abstract] Recent research at the All-Union Scientific Research Institute of Agricultural Microbiology has resulted in significant advances in crop improvement through the isolation and culture of highly efficient nitrogen-fixing bacteria. Treatment of legumes with such new strains has shown a pronounced increase in crop yields. For example, trials with soybeans at the Druzhba Narodov collective farm in the Crimean Oblast of Ukraine showed that the yield of crops treated with such new bacteria (designated rizotorfin) increased from 14 to 22 centners per hectare. Of even greater interest may be developments in the so-called associative nitrogen fixation, in which nitrogen-fixing bacteria reside on the root surface of nonleguminous plants, such as corn, wheat, rye, rice, oats, and so forth. Here again, harvests have been markedly improved. To systematize and coordinate such important research efforts, the All-Union Academy of Agricultural Sciences has developed an all-encompassing research program entitled "Biological Nitrogen". Already, more than forty various research establishments, associations, and institutes are engaged in working within that program.

[1764-12172]

UDC 577.153.211:547.953.04

PREPARATION OF AFFINITY SORBENTS FOR PHOSPHOLIPASE A₂ ISOLATION

Moscow BIOORGANICHESKAYA KHIMIYA in Russian Vol 10, No 12, Dec 84
(manuscript received 26 Jun 84) pp 1639-1644

OSTAPENKO, O. V., YEVSTRATOVA, N. G., SREBRENNIKOVA, G. A. and YEVSTIGNEYEVA, R. P., Moscow Institute of Fine Chemical Technology imeni M. V. Lomonosov

[Abstract] Several biospecific sorbents were devised to serve in affinity columns for the isolation of phospholipase A₂ (PLA). The sorbents consist of organosilicon supports with different concentrations of covalently coupled sn-glycero-3-phosphocholine (GPC) and its derivatives. A column yielding optimum results, (purification factor of 9.3) was obtained by using a trimethylsilyl derivative of GPC. The sorbents were successfully used in the isolation of PLA from the venoms of Agkistrodon halys blomhoffii and Naja naja oxiana; however, they were ineffective in the isolation of PLA from porcine pancreas. References 19: 4 Russian, 15 Western.
[1691-12172]

UDC (541.49+546.73):546.284

SILICA-IMMOBILIZED HEMATOPORPHYRIN-COBALT COMPLEXES

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 280, No 6, Feb 85
(manuscript received 24 Apr 84) pp 1382-1385

YATSIMIRSKIY, K. B., academician, Ukrainian SSR Academy of Sciences, YAKUBOVICH, T. N., BRATUSHKO, Yu. I., KOTLYAR, S. S., YANISHPOL'SKIY, V. V. and TERTYKH, V. A., Institute of Physical Chemistry imeni L. V. Pisarzhevskiy, Ukrainian SSR Academy of Sciences, Kiev

[Abstract] Technical details are presented on the formation of silica-immobilized hematoporphyrin, its subsequent complexing with cobalt, and assessment of the effectiveness of the complex in activation of molecular oxygen. Hematoporphyrin immobilization was conducted in dimethylformamide, with a formation of peptide bonds between the porphyrin and aminoorganoaerosil via dicyclohexylcarbodiimide. The final concentration of hematoporphyrin on the carrier was 0.42 $\mu\text{moles}/\text{m}^2$. The hematoporphyrin-cobalt complexes were formed by heating (60-80°C for 1 h) a suspension of the immobilized porphyrin with

cobalt acetate in glacial acetic acid. Absorption measurements demonstrated the presence of cobalt in the Co(III) oxidation state, also confirmed by the absence of a ESR signal at -185°C . The final complex catalyzed hydrazine oxidation by molecular oxygen with an initial rate constant of 3.69×10^{-5} moles/liter.min. Figures 3; references 10: 5 Russian, 5 Western.
[260-12172]

ENERGETICAL EFFICIENCY OF FLIGHT AND SWIMMING

Moscow ZHURNAL OBSHCHEY BIOLOGII in Russian Vol 45, No 6, Nov-Dec 84, pp779-795

[Article by V. G. Gorshkov, Leningrad Institute of Atomic Physics imeni B. P. Konstantinov: "Energy Efficiency of Flight and Swimming"]

[Text] The efficiency α of movement at high speeds u coincides with the ratio of mechanical power (Tu) to metabolic (Q). The thrust $T = D(\vartheta) + mg \sin \vartheta$, where ϑ is the lift angle and $D(\vartheta)$ is the resistance. The measurement of Q and speed u with movement on treadbans and in wind tunnels with varying incline angles ϑ does not allow the determination of efficiency α , since $D(\vartheta) \neq D(0)$. The calculation of α in the assumption $D(\vartheta) = D(0)$ leads to excessively high values of α , up to the nonsense value $\alpha > 1$.

At high flight speeds of animals, the induced drag is small and the resistance coefficient c is close to a constant value. With $c = c^M$, where c^M is the known value for non-live models, the flight effectiveness α for different animals was determined according to measured values of body weight, metabolic capacity and flight speed. The correlation of α with weight has the appearance of $\lg(\alpha/\alpha_{\max}) = \alpha_1 \lg(m/m_{kp})$, $\alpha_{\max} = 0.25$, where $\alpha_1 = 0.29 \pm 0.042$, $m_{kp} = 3.2$ kg in flight and $\alpha_1 = 0.30 \pm 0.021$, $m_{kp} = 260$ kg during walking-running. Incline α_1 does not depend on value c^M . The weight m_{kp} depends on the selection of value c^M . This weight is universal, and does not depend on the mode of movement with the condition that $c_r/c \geq 5$, where c_r and c are the true coefficients of wind resistance for living animals during running and in flight, respectively. The empirical data for swimming also do not contradict the universal dependence of α on m .

In horizontal flight and swimming with a constant speed (u), the mechanical power of movement is expended for compensation of dissipation (thermal dispersion) of energy outside the organism with contact of the body surface with molecules of the surrounding environment (air and water). A considerable portion of the energy is transmitted to the environment in the form of deformation waves and turbulent flows, which are subject to dissipation already after

passing the moving body. The dissipation of the mechanical power inside the organism generated by the muscles cannot be separated from the dissipation of the entire metabolic power. Therefore, it is not included into the mechanical power of movement. The dissipation of energy outside the organism is equal to the derivation of energy flow density $\rho_c \frac{u^2}{2} \cdot u$ (ρ_c -- density of the environment) to the effective surface of body resistance with environment cs . Since the resistance coefficient c is determined experimentally, it is convenient to select surface s by the universal method (Pennycuick, 1969) in the form of¹

$$s \equiv l^2, \quad l \equiv (m/\rho)^{1/3}, \quad (1)$$

where m and ρ are the mass and density of the animal. The resistance coefficient c differs by a factor on the order of one, which is easily computed and does not depend on l , from the coefficient of frontal resistance C for standard bodies, for which C is determined with s equal to the greatest cross section, as well as for aerodynamic bodies, for which C is determined with s equal to the full body surface (Pennycuick, 1969; Aleksander, 1970; Aleyev, 1976).

Effectiveness of movement. The metabolic power $(Q(u))$ of an animal moving at speed u will be written in the form (Gorshkov, 1983):

$$Q(u) \equiv (A+1)q, \quad A \equiv a+b, \quad (2)$$

$$b \equiv Q(u \rightarrow 0)/q - 1,$$

where q is the standard metabolic power (BMR), A is the full activity, a is the pure activity of movement, or activity, and b is the pure readiness for movement, or readiness. Readiness b includes all the static forms of activity which are not accompanied by the transmission of impulse to the environment from the animal's body. Activity a includes all the dynamic forms of activity accompanied by the transmission of impulse to the environment, including immobile hovering in the air, where the speed of the body relative to macroscopic air volumes is not equal to zero. The activity $a \geq 0$. In all types of activity, as a rule, $b \geq 0$. The working metabolic power aq is translated to mechanical αaq with efficiency α . The law of conservation of energy, which expresses the equality of mechanical and dissipating power with uniform horizontal movement has the appearance of:

$$\alpha aq = \frac{c}{2} \rho_c u^3 l^2 \equiv Tu = -Du, \quad T = |D| \equiv \frac{c}{2} \rho_c u^2 l^2, \quad (3)$$

where T is the drag force, and D is the force of resistance (both forces represent projections of full forces of the body's interaction with the environment to direction of movement).

Equation (3) is conveniently rewritten in the form of:

$$u = a^{1/3} \left(\frac{\alpha \rho}{c \rho_c} \right)^{1/3} w, \quad w \equiv (2q/\rho l^2)^{1/3}, \quad (4)$$

where the metabolic rate w , which has a dimensionality of m/sec and is singularly computed by value of basic metabolism and weight of the animal (Gorshkov, 1982a, b), determines the value of movement speed (Table 1).

The efficiency $\alpha > 0$, since the mechanical power may develop with expenditure of metabolic power. The efficiency α cannot exceed the efficiency of the work

of muscles $\alpha_{\max}$, since part of the power developed by the muscles is subject to dissipation inside the organism. The effectiveness of aerobic work of the muscles is $\alpha_{\max} \approx 0.25$. Therefore, we may consider that α satisfies the condition

$$0 < \alpha < \alpha_{\max} \approx 0.25. \quad (5)$$

With known resistance coefficient c (3), which includes all types of resistance (induced, parasitic, profile, which for animals are principally immeasurable individually) and with the condition that $a \gg b$, the measurement of the metabolic power and the speed of flight and swimming singularly determines the efficiency α (3). On the contrary, independent measurement of the efficiency α determines the coefficient of resistance c if the values a and u are known. Measurement of efficiency α is possible by means of measuring the growth in level of activity a with addition of the known dissipation of energy to the right side of (3) (Brody, 1945; Gorshkov, 1983). (This may be achieved by means of attaching to the animal a thin elastic band with a lightweight object on the end which possesses a certain sailing capacity. The additional force of resistance may be measured by the value of extension of the band during flight and swimming.)

Thus, horizontal flight and swimming are characterized by seven independent variables: b , a , q , c , α , u , and l , of which the last six are associated with the condition of energy conservation (3), while q is correlated with l (Table 1).

If the resistance coefficient c is unknown, then the measurement of metabolic power and speed of movement may be used to determine only the relation of coefficients c/α or the pure energy value of movement of a unit of weight associated with this ratio:

$$\varepsilon \equiv \frac{aq}{mgu} = \frac{\gamma}{\alpha},$$

$$\gamma \equiv \frac{|D|}{mg} \equiv \frac{c}{2} \frac{\rho_c}{\rho} \frac{u^2}{gl}, \quad (6)$$

where g is the acceleration of the force of gravity, γ is the dissipation coefficient (ratio of absolute value of force of resistance to body weight).

In movement with acceleration G with incline θ to the horizon, the following member is added to the drag force in (3):

$$mG + mg \sin \theta.$$

With $G=0$, the activity and drag and resistance forces depend on the angle and the equations (3) and (6) take on the appearance of:

$$\begin{aligned} \alpha q a(\theta) &= T(\theta) u, \quad T(\theta) = -D(\theta) + mg \sin \theta, \\ -D(\theta) &\equiv \frac{c(\theta)}{2} \rho_c u^2 l^2 \equiv -\gamma(\theta) mg \neq -D(0), \\ \varepsilon(\theta) &\equiv \frac{a(\theta) q}{mgu} = \frac{\gamma(\theta) + \sin \theta}{\alpha}. \end{aligned} \quad (7)$$

Table 1. Observed dependences on size of animals for standard metabolic power per unit of weight (λ), section (j) and metabolic rate (w)

Taxonomic group	λ , m/sec	λ'	$j/W/m^2$	j'	w_0 , m/c	$w'=j'/3$	Source
Aves Passerines	4,3	-0,83	420	0,17	1,1	0,057	1,2,3
Aves Nonpasserines	2,5	-0,83	250	0,17	0,89	0,057	1,2,3,4
Mammalia	2,2	-0,80	220	0,20	0,85	0,067	3,4
Insecta (20° C)	0,37	-0,54	36	0,46	0,47	0,15	3
Reptilia (20° C)	0,20	-0,65	20	0,35	0,38	0,12	3
Pisces (20° C)	0,17	-0,57	17	0,43	0,37	0,14	3,5

Notes. $z = z_0(1/l_0)^{z'} \equiv z_0(m/m_0)^{z'/3}$, $l_0 = 1\text{cm}$, $m_0 = 1\text{g}$, $z \equiv j, \lambda$ or w ; $j \equiv q/l^2 \equiv pw^{3/2}$, $\lambda \equiv q/mg \equiv j/pgl$, $w \equiv (2j/p)^{1/3}$; q , W and $m \equiv pl^3$, g -- standard metabolism and mass of organism, $g = 9.8\text{m/sec}^2$, $p = 1\text{g/cm}^3$. Source: 1 - Lasiewski, Dawson, 1967; 2 - Kendeigh et al., 1977; 3 - Dol'nik, 1978; 4 - Brody, 1945 (Kleiber (1961) for mammalia gives $\lambda_0 = 1.8\text{ m/sec}$, $\lambda' = -0.73$); 5 - Vinberg, 1976. In addition to the standard resident period of time $\tau \equiv mq^{-1}K$, $K = 1\text{ kcal/g}$, the calorie count of living organics, rates λ and w determine two characteristic periods of time: gravitational $\tau_\lambda \equiv l/\lambda \equiv m^{1/2} q^{-1/2} (g\rho^{-1/2})$ and energetic $\tau_w \equiv l/w \equiv m^{1/2} q^{-1/2} (2^{1/2} \rho^{-1/2})$.

Generally speaking, the force of resistance during movement with acceleration G at an angle θ does not coincide with the force of resistance during horizontal movement, which definitely takes place in land movement.

The efficiency α with small dissipative losses within the organism in comparison with full dissipation of energy may depend only on the value of activity a , regardless of the method of movement. The dependence of α on a may differ in different types of locomotion only with internal and external dissipative losses which are comparable in value and which change proportionately to each other with the coefficient of proportionality, depending on the type of locomotion. It has been empirically determined that with movement on land, in the oxygen balance with $a \lesssim 30$, the efficiency α is a constant, i.e., it does not depend on a (Gorshkov, 1983). Therefore, it is natural to consider α a constant value up to $a \lesssim 30$ both for flight and for swimming.

Considering value α to be independent of $a(\theta)$ and, consequently, also independent of angle θ , from (7) we have:

$$\alpha = \frac{\Delta T(\theta)u}{\Delta aq}, \quad \Delta T(\theta) = -\Delta D(\theta) + mg \cos \theta \Delta \theta. \quad (8)$$

Formula (8) is correct if $d\alpha/da \ll \alpha/a$. Otherwise, a series of measurements at different values of θ and u are required. For movement on land (Cohen et al., 1978) and for flight (Tucker, 1968, 1972; Bernstein et al., 1973; Pennycuik, 1975), the efficiency of movement α has been determined from the results of a measurement of metabolic power in movement with various incline

angles and given speed. In this case, (7) posits that $\Delta D(\theta) = 0$. In reality, member $\Delta D(\theta)$ is of the same order value as the second member in $\Delta T(\theta)$. Specifically, $D(\theta) \neq D(0)$. This was simply demonstrated in tests with movement on land at an incline where the values α obtained in supposition $\Delta D(\theta) = 0$ turned out to be greatly exaggerated and did not satisfy condition (5). They even exceeded one, which indicates a disruption in the law of energy conservation (see overview by Cohen et al., 1978). In flight and in swimming there is also no basis to posit $\Delta D(\theta) = 0$. Below it is demonstrated for flight that the results of measurements treated in supposition $\Delta D(\theta) = 0$ give overly high values of α , as with movement on land.

In order to determine the value of $\Delta D(\theta)$, it is necessary, as with horizontal locomotion, to conduct additional experiments with the addition of a known drag force attained through some type of harness. Such experiments are technically quite feasible in modern aero- and hydrodynamic tunnels used for measuring animals. However, up to the present time such experiments have not been performed either for flight or for swimming. Therefore, there are no reliable measured values of efficiency α for these types of locomotion.

Flight

In horizontal flight, the body weight mg is equalized by the lift force L , which analogous to the force of resistance (3) we may write in the form of:

$$L \equiv \frac{c_{\perp}}{2} \rho_c u^2 l^2 = mg, \quad \text{or} \quad c_{\perp} = \frac{2\rho}{\rho_c} \frac{gl}{u^2}. \quad (9)$$

The lift coefficient $c_{\perp}$ is fixed by equation (9) and is not an independent variable. The wingspan of all aerobionts is proportional to l , while the wing area is proportional to l^2 (Greenewalt, 1962, 1975). Therefore, the generally used coefficient of lift force C_L , which is computed for wing area, differs from $c_{\perp}$, which does not depend on l , by the multiplier. We will note that the coefficients c and $c_{\perp}$ are computed for the same surface l^2 , which is singularly tied with the body mass (1). Both coefficients may be directly obtained by measurements of mass, speed and energetics of flight without any complex measurements of surfaces creating frontal resistance and lift force.

By means of dividing both parts of equation (3) into weight mg , equation (3) may be represented with the aid of (9) in a form which coincides with the corresponding equation for movement on land (Gorshkov, 1982,a,b, 1983):

$$\begin{aligned} \alpha u \lambda &= \gamma u, \quad u = k \sqrt{gl} \quad \text{или} \quad a = k \frac{\sqrt{gl}}{u_p}, \\ \varepsilon &\equiv \frac{\lambda}{u_p} = \frac{\gamma}{\alpha}, \quad u_p \equiv \frac{u}{a} = \frac{\alpha \lambda}{\gamma}, \end{aligned} \quad (10)$$

$$\lambda \equiv \frac{q}{mg}, \quad \gamma \equiv \frac{|D|}{mg} = \frac{|D|}{L} = \frac{c}{c_{\perp}}, \quad k^2 \equiv \frac{2\rho\gamma}{\rho_c c},$$

where λ is the main metabolic power per unit of weight and which has, like w , dimensionality of speed (Table 1); the coefficient of dissipation γ (6) in horizontal flight is equal to the relation of coefficients $c/c_{\perp}$ (γ coincides with the ratio L/D which is usually employed, and which is also called the aerodynamic quality); u_p is the speed of flight which the animal possesses; ε is the energetic cost of moving a unit of weight for a unit of distance (Fig. 1); k^2 is the Frude value for flight speed u .

Attainable flight speed. The attainable flight speed u_p introduced into (10) in practice corresponds to the average daily speed of movement of all aerobionts. We will designate as $\mathcal{L} \equiv ut$, $\bar{u}$, t , b and a the average daily length, speed, time, readiness and activity of flight; through $\mathcal{L}_1 \equiv u_1 t_1$, u_1 , t_1 , b_1 and a_1 we will designate the same average daily values for all other types of activity and rest, and through $\bar{\mathcal{L}} = \bar{u}T$, $\bar{u}$, $T=1$ day, $\bar{b}$ and $\bar{a}$ we will designate the same average daily values for all observable types of activity and rest. $\bar{A} \equiv \bar{a} + \bar{b} \equiv (\text{DEB-BMR})/\text{BMR}$, DEB will represent the average daily budget of energy. From the laws of addition of energy, path and time we obtain:

$$\bar{A}T = At + A_1 t_1, \quad \bar{u}T = ut + u_1 t_1, \quad T = t + t_1;$$

$$A \equiv a + b, \quad A_1 \equiv a_1 + b_1.$$

From here we have $\bar{u}$ as a function of the five independent variables $\bar{A}$, A , u , A_1 and u_1 :

$$\bar{u} = (u - u_1)x + u_1, \quad x \equiv \frac{t}{T} = \frac{\bar{A} - A_1}{A - A_1}. \quad (11)$$

Considering the fact that in flight the speed and activity is always much greater than for other types of locomotion, from equations (11) we obtain $\bar{u}$ as a function of the four variables $\bar{A}$, A_1 , u_1 and U_p :

$$\bar{u} = (\bar{A} - A_1)U_p + u_1, \quad U_p \equiv \frac{u}{A}; \quad A \gg A_1, \quad u \gg u_1. \quad (12)$$

An animal may be considered an aerobiont if the main portion of its average daily movement is determined by flight, i.e., if $\mathcal{L} \gg \mathcal{L}_1$ or $ut \gg u_1 t_1$, which in considering (11) is equivalent to inequality: $\bar{u} \gg u_1$. This frees (12) from value $u_1 \equiv \mathcal{L}_1/t_1$, which is difficult to measure:

$$\bar{u} = (\bar{A} - A_1)U_p, \quad \mathcal{L} \gg \mathcal{L}_1, \quad \text{or} \quad \bar{u} \gg u_1. \quad (13)$$

If, as for example for swallows and martlets, the main portion of the average daily energy expenditures is defined by flight, i.e., $At \gg A_1 t_1$, which when considering (11) is equivalent to inequality $\bar{A} \gg A_1$, then (13) is simplified to the expression

$$\bar{u} = \bar{A}U_p \equiv \bar{A}u/A, \quad At \gg A_1 t_1, \quad \text{or} \quad \bar{A} \gg A_1. \quad (14)$$

Values A and A_1 are directly observed. For most birds, $\bar{A} + 1 \approx 2.5$; $A_1 + 1 \approx 1.5$ (Dol'nik, 1982), so that in (13) $\bar{A} - A_1 \approx 1$ and consequently $U_p \approx \bar{u}$. In flight, the condition $a \gg b$ is evidently always fulfilled, and therefore we have $\bar{u} \approx U_p \approx u_p$.

Coefficient of resistance in flight. By means of changing the orientation of the animal's body relative to the flight direction, the degree of wind spreading, the amplitude of wing flapping, etc., the values of lift force L and lift coefficient c_L may vary, which makes it possible for the animal to fly at any speed from $u=0$ (hovering) to a certain $u_{\max}$. The value of maximal flight speed is determined by the maximally attainable level of activity a and the minimally possible values of the resistance coefficient c (3).

The lift force (9) is equal to the descending flow of the impulse transmitted by the body to the air masses:

$$mg = C_L \rho c L^2 u_1^2 / 2, \quad \text{or} \quad u_1 = k_L \sqrt{gl}, \quad k_L^2 \equiv \frac{2\rho}{C_L \rho c}.$$

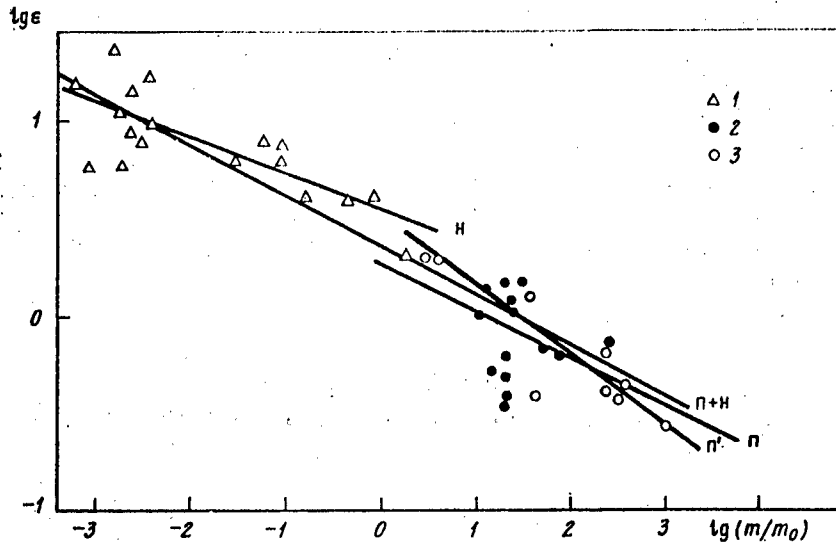


Figure 1. Energetic cost of flight. 1 - insects, 2 - passerine and 3 - non-passerine birds. Lines indicate: description of observed correlation by degree functions $\epsilon = \epsilon_0 (m/m_0)^{\epsilon'/3}$, $m_0 = 1g$, whose parameters are found by the method of the smallest squares; $n+H$ --birds and insects together: $\epsilon'/3 = -0.27 \pm 0.016$, $\epsilon_0 = 2.3 \pm 0.17$, $N = 41$, $r^2 = 0.87$; $n \equiv p+n$ -- all birds; $\epsilon'/3 = -0.24 \pm 0.062$, $\epsilon_0 = 1.9 \pm 0.48$; $N = 23$, $r^2 = 0.40$; H -insects: $\epsilon'/3 = -0.18 \pm 0.038$, $\epsilon_0 = 3.8 \pm 0.68$, $N = 18$, $r^2 = 0.55$; errors are equal to root-mean-square deviations, r^2 everywhere are computed for logarithms of values, data are taken from Table 2; n' -birds, except for swallows, martlets and birds noted with an asterisk in Table 2.

where $u_{\perp}$ is the vertical speed of these air masses, $k_{\perp}^2$ is the Frude number for $u_{\perp}$. With maximal wing spread, $C_{\perp}$ reaches its maximal value $C_{\perp \max}$, while the speed $u_{\perp}$ reaches its minimal value $u_{\perp \min} = k_{\perp \min} \sqrt{gl}$. Value $u_{\perp \min}$ is the speed of the descending air flow during hovering or, and this is the same thing, the minimal speed of uniform fall of an inactive animal.³

In the sphere of movement speeds $u > u_{\perp \min}$, speed $u_{\perp} \propto u$, while the coefficients $C_{\perp} \propto c_{\perp} \propto (u/u_{\perp \min})^{-2}$ (more precisely, $u = (C_{\perp}/c_{\perp})^{1/2} u_{\perp}$). Here the input of induced resistance associated with generation of lift force into c (3) is small, and the resistance coefficient c reaches its minimal value, which is determined by parasitic resistance of the most aerodynamic placement of the animal, which practically does not depend on the speed (see below). In this

sphere of activity a increases $\propto (u/u_{\perp \min})^3$ (see (3)), while the dissipation coefficient $\gamma = c/c_{\perp}$ increases $\propto (u/u_{\perp \max})^2$.

In the sphere of partial hovering $u < u_{\perp \min}$, speed $u_{\perp} = u_{\perp \min}$, $C_{\perp} = C_{\perp \max}$, while $c_{\perp} = C_{\perp \max} (u_{\perp \min}/u)^2$. In this case the main portion of the animal's $\gamma_{\perp \max}$ is expended for creating lift force, while the resistance coefficient c is wholly determined by the induced resistance and changes sharply with speed. Theoretical predictions (Tucker, 1974; Greenewalt, 1975; Pennycuick, 1975) for the dependence of induced resistance on speed do not correspond with the measurements (Tucker, 1968; Bernstein et al., 1973; Tucker, 1972; Torre-Bueno, Larochelle, 1978). These measurements show that the dependence of the resistance coefficient c on speed is an aspectual characteristic of flight which may only be determined empirically. We will consider that a does not depend on u under aerobic conditions. With the observed activity a , which does not depend on speed (Bernstein et al., 1973; Tucker, 1972; Torre-Bueno, Larochelle, 1978) we have from (3) and (10): $c \propto (u/u_{\perp \min})^{-3}$, $\gamma \propto (u/u_{\perp \min})^{-1}$. For the ridged parrot (Tucker, 1968), the activity decreases with increased speed: $a \propto (u/u_{\perp \min})^{-1}$, which yields $c/\alpha \propto (u/u_{\perp \min})^{-4}$, $\gamma/\alpha \propto (u/u_{\perp \min})^{-2}$. In all the observed cases, the energetic cost $\epsilon = \gamma/a$ decreases with increased speed $\propto (u/u_{\perp \min})^{-2}$ or $\propto (u/u_{\perp \min})^{-1}$ with $u < u_{\perp \min}$, and increases $\propto (u/u_{\perp \min})^2$ (6), (10) with $u > u_{\perp \min}$, passing through a minimum $\epsilon_{\min} = \gamma_{\min}/a$ near $u \sim u_{\perp \min}$. This minimum is observed for the ridged parrot (Tucker, 1968) and is evidently at the margin of measured speeds for the starling (Torre-Bueno, Larochelle, 1978), the gull (Tucker, 1972) and the crow (Bernstein et al., 1973). Subsequently, the sphere of optimal speeds $u > u_{\perp \min}$ is examined, and the symbol c is understood to stand for only the minimal value of this coefficient.

Based on aerodynamic considerations and considering the few measurements made for birds (Pennycuick, 1975), we may assume that for most flying animals the resistance coefficient c is approximately equal. Therefore we will take:

$$c = c^M = \begin{cases} 0.3, & \text{Re} > 600 \text{ (Pennycuick, 1969, 1975),} \\ 0.6 c_M(\text{Re}), & 6 < \text{Re} < 600, \\ 20/\text{Re}, & \text{Re} < 6 \text{ (Stokes law)} \end{cases} \quad (15)$$

where $\text{Re} = lu/\nu$, $\nu_{\text{bird}} = 0.15 \text{ cm}^2/\text{sec}$, $c_M(\text{re})$ —the empirical curve for a globe with volume 1^3 (Landau, Lifshits, 1954; Aleksander, 1970). The coefficient of proportionality in the intermediate sphere is determined from the condition of merging with asymptotic values. The index "M" indicates that the coefficient is a model coefficient and may differ from actual values for living organisms in flight. Below all the values computed with $c = c^M$ (15) are marked with the index "M".

Flight of different size animals. With fixed readiness for flight b and a known resistance coefficient c in equation (10), we obtain the possibility of determining the dissipation coefficient γ —the relation of force of resistance to the weight and efficiency a by speed u and metabolic power of flight Q . The readiness for flight b (2) cannot be obtained by extrapolation to zero speeds, as for locomotion on land, since flight with fixed γ and c takes place at a fixed speed.⁴ Since $b \lesssim 1$, then the absence of information on b with known Q and q (2) introduces a significant indeterminacy into the activity value a only with $a \sim 1$, which rarely occurs in flight.

Table 2 presents the meanings of all values computed according to empirical data for Q , q and u with $c = 0.3$ and $m > 0.4g$ and with $c = c(Re)$ and $m < 0.4g$. The readiness b was not measured. Therefore, Table 2 presents the full values A , E , a_{tot} , U which have meaning for any b . However, everywhere below we will consider that the condition $a \gg b$ has been fulfilled and the following equalities are therefore in effect:

$$A=a, E=\varepsilon, \alpha_{tot}=\alpha, U_p=u_p, a \gg b.$$

The margins of changes in k and γ in conjunction with the allowable margins of change in effectiveness α and activity a in the oxygen balance are as follows

$$13 \leq k \leq 31 (Re > 10^3); 1 \leq a \leq 30; 0 < \alpha \leq 0.25;$$

$$\gamma_{min} \leq \gamma \leq \gamma_{max}, \text{ при } c = c^M: \gamma_{min}^M = 0.02, \gamma_{max}^M = 0.2.$$

The marginal line of allowable speeds with fixed marginal values of derivation a are determined by equation (3). In Figure 2 this (almost horizontal) boundary for speeds and sizes is represented by a solid line A_2B_2 with $a = 5$ ($a = 0.25$; $a = 20$). Greater speeds may be attained by birds in oxygen deficiency. We will note that the corresponding boundary for insects (see Table 1) with $a = 7.5$ ($a = 0.25$; $a = 30$) lies close to the boundary for birds, i.e., flying insects may attain a large size. The maximal masses of actively flying animals obtained from equation (3) according to the data in Table 1 for λ and with the given ultimate values of a , are as follows: non-passerine birds and mammals $m \leq 120$ kg (Wilkie, 1959), $a \leq 5$; insects $m \leq 70$ kg, $a \leq 7.5$; reptiles $m \leq 1.4$ kg, $a \leq 7.5$. From this it follows that fossil pangolins with wingspan of up to 7m were either gliders, or had metabolic characteristics which differed from present-day reptiles.

The activities $a \sim 100$ in insects (*Lucilia*, *Apis*) are characteristic for locomotion in oxygen deficiency, under which prolonged flights are impossible. Evidently, in the flight of these insects there is an increase in the body temperature to $\sim 40^\circ C$, i.e., $20^\circ C$ higher than the standard temperature of the surrounding environment. At $Q_{10} \sim 2.5$ the value of the basic metabolic power q increases by $Q_{10}^2 \sim 6$ times, and the activity a (computed in Table 2 at $20^\circ C$) is reduced accordingly to $1/6$ the value (see (2), (3)) and becomes on the order of 15. It is possible that numerous values of activities for insects in Table 2 are exaggerated for the same reason. Values ε , γ and α do not depend on the body temperature in flight.

The flight of mosquitos (*Aedes*, Table 2, source 12) takes place reliably under conditions of partial hovering with speeds of $u \ll u_{limin}$. This is indicated by the anomalously low values of γ and α which are placed in parentheses, and computed in Table 2 with resistance coefficient $c \sim 1$. The true values of γ and α are evidently 10 times greater and correspond to $c \sim 10$, which is wholly determined by induced resistance.

Flight speeds of birds are measured simultaneously with metabolic power in wind tunnels for *Melopsittacus undulatus*, *Sturnus vulgaris*, *Corvus ossifragus* and *Larus atricilla*. (For other birds the flight speeds are taken from other data and may not fully correspond to the developed flight power. In most cases the errors in the value of speeds evidently do not exceed 10-20%). For the listed types of birds the measurements were performed with varying angles of incline of the wind tunnels (Tucker, 1968, 1972; Bernstein et al., 1973)

Table 2. Speed, energetic cost and efficiency of animal flight

a-	b-	c- m, g	d- u, m/sec	A	E	γ^M	$\alpha_{tot}^M \cdot 10^2$	e- U_p , m/sec	$\alpha_{tot}^{M \cdot \lambda} \cdot 10^2$	g-
Alaptus	i	$2 \cdot 10^{-4}$	0,05	1,0	80	0,05	0,08	0,05	0,33	1
Aphis	i	$7 \cdot 10^{-4}$	0,45	4,0	17	0,02	0,1	0,13	0,14	2
Drosophila	i	$9 \cdot 10^{-4}$	1,3	5,0	5,9	0,08	2	0,26	1,3	3
Aedes	i	$1,7 \cdot 10^{-3}$	0,17	3,3	24	(0,002)	(0,008)	0,05	—	12
Drosophila	i	$2 \cdot 10^{-3}$	2,1	10	6,0	0,1	2	0,21	1,9	3
Simulium	i	$2,1 \cdot 10^{-3}$	2,4	24	11	0,13	1	0,10	1,3	3
Simulium	i	$2,5 \cdot 10^{-3}$	1,2	7,0	7,3	0,03	0,4	0,17	0,4	3
Aedes	i	$2,5 \cdot 10^{-3}$	0,25	3,5	15	(0,002)	(0,04)	0,07	—	12
Aedes	i	$3,2 \cdot 10^{-3}$	0,69	4,7	8,1	0,02	0,2	0,15	0,2	3
Aedes	i	$3,9 \cdot 10^{-3}$	0,40	4,0	10	(0,003)	(0,03)	0,10	—	12
Aedes	i	$8,2 \cdot 10^{-3}$	0,89	14	17	0,01	0,06	0,064	0,05	3
Lucilia	i	0,030	8,3	75*	6,4	0,40	6*	0,11	4,5	3
Tabanus	i	0,062	2,5	33	8,3	0,03	0,4	0,076	0,2	3
Apis	i	0,10	8,3	95*	6,4	0,27	4*	0,087	2,4	3
Apis	i	0,16	2,2	29	7,7	0,02	0,3	0,076	0,2	3
Tabanus	i	0,46	3,0	15	4,1	0,01	0,2	0,13	0,1	3
Vespa	i	0,89	3,0	30	4,0	0,02	0,5	0,11	0,22	2
Aeschna	i	2,1	3,5	20	2,2	0,02	0,8	0,13	0,26	2,3
Schistocerca	i	3,0	11	13	2,0	0,16	8	0,85	14	4
Calypto costae	n	3,7	11	10	2,0	0,14	8	1,1	15	4
Archibochus collaris	n									
Vermivora peregrina	p	11	19*	8,0	1,0	0,3	30*	2,4	70*	2
Spinus spinus	p	13	15	12	1,4	0,17	12	1,3	22	4
Dendroica striata	p	15	11	7,1	0,53	0,09	10	1,6	14	4
Hirundo rustica	p	18	6,4(9)	2,8	0,61	0,03	4,6	2,3	6,5	6,13,14
Delichon urbica	p	20	7,1(13)	1,7	0,34	0,03	10	4,2	14	6,13,14
Dendroica striata	p	21	11*	2,0	0,35	0,08	23*	5,5	44*	2
Fringilla coelebs	p	22	15	15	1,5	0,14	9	1,0	14	4
Fringilla coelebs	p	23	14	11	1,1	0,13	12	1,3	17	2
Fringilla monticola	p	23	16	14	1,2	0,17	12	1,1	20	4
Pyrrhula pyrrhula	p	30	14	14	1,5	0,11	8	1,0	11	4
Melospittacus undulatus	n	35	10	11	1,3	0,05	4	0,8	4,0	2
Apus apus	n	41	9,0(16)	4,0	0,38	0,03	7,4	2,3	6,4	4,11,14
Prong subis	p	51	10	4,7	0,69	0,05	7	2,1	10	6,10
Sturnus vulgaris	p	73	17	8,6	0,65	0,12	18	2,0	23	7
Columba livia	n	254	13	18	0,71	0,05	7	0,7	3,5	2
Corvus ossifragus	p	275	11	5,4	0,80	0,03	4	2,0	3,6	8
Larus atricilla	n	277	12	4,7	0,60	0,04	7	2,6	3,6	9
Larus atricilla	n	350	13	10	0,38	0,04	11	1,3	5,6	6,10
Columba livia	n	384	16	14	0,40	0,06	15	1,1	7,0	4
Larus delawarensis	n	410	10	10	0,47	0,02	5,4	1,0	2,4	6,10
Anas platyrhynchos	n	1000	20	13	0,28	0,07	25	1,5	10	4
Anser anser	n	3000	19	13	0,20	0,05	25	1,5	7,5	1,10
Cygnus cygnus	n	10000	19	12	0,12	0,03	25	1,6	4,8	1,10
Tratopsis macraria	n	25000	18	9,5	0,08	0,02	25	1,9	3,8	1,4

Key: a - Object; b - Taxonomic group; c - m, g; d - u, m/sec; e - U_p , m/sec; f - m/sec; g - Source.

Note. Indices: i - insecta, p - aves passerines, n - aves nonpasserines.

Values: m - body weight (g), u - flight speed (m/sec); $A \equiv (Q-q)/q$ - full activity, where Q and q are metabolic powers in flight and at rest (for insects q is presented for temperature of surrounding environment observed

during flight); $E \equiv Aq/mgu$ - full energetic cost of moving a unit of weight; $g = 9.8 \text{ m/sec}^2$, $\lambda = q/mg$ - basic metabolic power of unit of weight, in case of absence of direct measurements of q , value λ is computed by Table 1; $U_p \equiv u/A$ is the attainable flight speed $\gamma \equiv c \frac{2p_c}{p} \cdot \frac{u^2}{gl} \equiv \gamma^M c/c^M$ - coefficient of dissipation, where $l \equiv (m/p)^{1/2}$, $p = 1 \text{ g/cm}^2$, c and c^M - true and model (15) coefficients of aerodynamic resistance; $\alpha_{tot} \equiv \gamma/E \equiv \alpha_{tot}^M c/c^M$ - full effectiveness of flight. Since $A \equiv a+b$, at $a \gg b$: $A \approx a$, $E \approx \epsilon$, $U_p \approx u_p$, $\alpha_{tot} \approx \alpha$, cf (10). For the flight of mosquitos (source 12) under conditions of partial hovering, the values γ^M and α^M obtained at $c^M = 0.6 c_m$ ($Re \sim 1$), are presented in parentheses. The true values γ and α evidently are 10 times greater and correspond to $c \sim 10$. In the graph, u in parentheses give maximal speeds of prolonged flight of swallows and martlets. * - extremal values discussed in the text. Source: 1 - computations by the author with given values in italics for flying animals with known extremal masses, 2 - Kokshayskiy, 1970; 3 - Tucker, 1970; 4 - Dol'nik, 1969, 1975; 5 - Tucker, 1968; 6 - Hails, 1979; 7 - Torre-Bueno, Larochele, 1978; 8 - Bernstein et al., 9 - Tucker, 1972; 10 - Greenewalt, 1975; 11 - Oehme, 1968; 12 - Nays, Van Handel, 1971; 13 - Lyuleva, 1971; 14 - Tsvelikh, 1982.

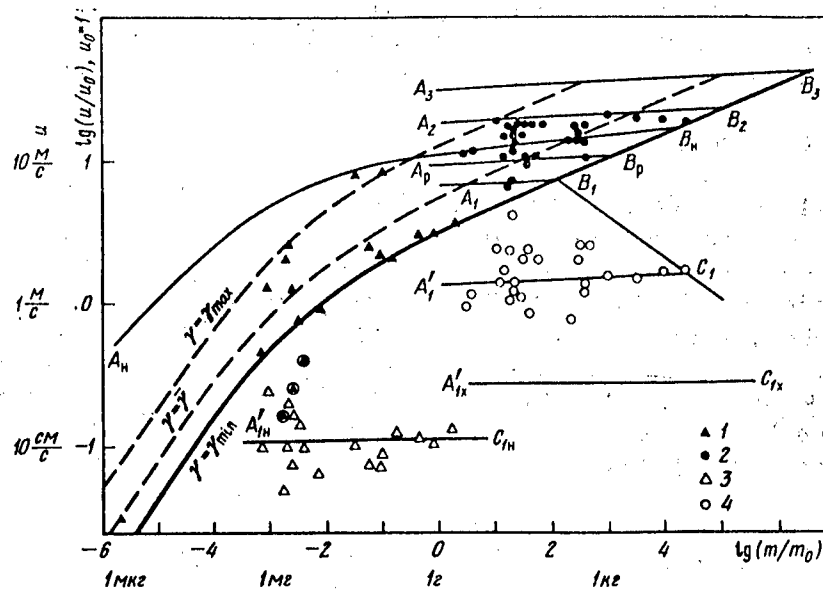


Figure 2. Flight speeds of various size animals. Observed flight speeds u : 1 - insects, 2 - birds; attainable average daily flight speeds $u_p \equiv u/a$, $a = (Q-q)/q$, Q, q - metabolic powers of flight and rest; 3 - insects, 4 - birds. Thick line - line of constant dissipation coefficient $\gamma = \gamma_{min}$; dotted line - $\gamma = \bar{\gamma}$ and γ_{max} . The bends in all curves are associated with dependence c on the Reynolds value Re . Other lines: $A_1B_1C_1$ - maximally possible attainable speed of birds $u_p = a\lambda/\gamma$ at $\alpha = \alpha_{max}$ (A_1C_1 at $\gamma \geq \gamma_{min}$, B_1C_1 at $\gamma = \gamma_{min}$);

$A_1' C_1$ - observed attainable flight speed of birds $u_p = \lambda/\varepsilon = u_{p0}(m/m_0)u_p'/3$, $m_0 = 1$, $g: u_{p0} = (1.7 \pm 0.48)$ m/sec, $u_p'/3 = 0.020 \pm 0.069$, $N = 23$, $r^2 = 0.0036$;
 $A_1' C_{1x}$ -- same for flight of insects: $u_{p0} = (0.096 \pm 0.020)$ m/sec, $u_p'/3 = -0.029 \pm 0.039$, $N = 18$, $r^2 = 0.029$. Lines $A_2 B_2$ - limit of speed of prolonged flight by birds (3) ($\alpha a = 5$, $\alpha = 0.25$, $a = 20$), B_2 - limit of speed and mass for prolonged flight of homiothermals; $A_3 B_3$ - absolute limit of speed for horizontal flight of birds ($\alpha a = 25$, $\alpha = 0.25$, $a = 100$), B_3 - limit of soaring speed and mass of gliders; $A_p B_p$ and $A_H B_H$ - limit of speed for prolonged flight of reptilians and insects respectively ($\alpha a = 7.5$, $\alpha = 0.25$, $a = 30$). On lines $A_i B_i$, where $i = 1, 2, 3, p, H$, the dissipation coefficients γ vary with the indicators $v' = (2\lambda' - 1)/3$ (10). The speeds located below line $\gamma = \gamma_{\min}$ correspond to flight with partial hovering: $u < u_{1 \min}$. These speeds are observed for mosquitos (circled). Data are taken from Table 2.

This made it possible to measure value μ , cf. (7), (10):

$$\mu^{-1} = \frac{\varepsilon(\theta) - \varepsilon(0)}{\sin \theta} = \alpha^{-1} \left\{ 1 + \frac{\gamma(\theta) - \gamma(0)}{\sin \theta} \right\}. \quad (16)$$

The measured values μ turned out to be within the margins of 20-50 percent for $\theta > 0$ as well as for $\theta < 0$, which exceeds value α by 5-10 times for these birds as presented in Table 2 and computed at $c = 0.3$. This means that

$$\gamma(\theta) < \gamma(0) \quad \text{at} \quad \theta > 0, \quad \gamma(\theta) > \gamma(0) \quad \text{at} \quad \theta < 0.$$

According to definition (7), $\gamma(\theta) \geq 0$. From this, at $\theta > 0$ the lower limit may be obtained for the true value of effectiveness α : $\gamma(\theta) = \alpha \varepsilon(\theta) - \sin \theta > 0$, $\alpha \geq \sin \theta / \varepsilon(\theta)$. At $\theta < 0$ we have only the condition $\gamma(\theta) \geq \gamma(0) > 0$ and it is impossible to obtain a limitation on α . At $\theta > 0$ the measurements were performed only for parrots (Tucker, 1968), which yields $\alpha \geq 4\%$; from this we have: $\gamma = \alpha \varepsilon \geq 0.05$, $c = \gamma c^* / \gamma^* \geq 0.3$, $\gamma = \gamma(0)$, $\varepsilon = \varepsilon(0)$. These values correlate with the values in Table 2 under the condition that $\gamma(\theta) \ll \gamma(0)$. In assumption $\gamma(\theta) = \gamma(0)$, as was done in all the works, we have $\alpha > 0.2$, $\gamma > 0.3$ and, consequently, $c > 1.8$. This contradicts direct aerodynamic measurements even for static models (Pennicuck, 1969, 1975).

The anomalously high efficiency α in birds *Vermivora peregrina* and *Dendroica striata* indicate that either the flight speeds of these birds have been exaggerated or the flight takes place with utilization of energy of air currents. An analogous phenomenon arises for swallows and martlets, if for the average flight speeds of these birds we use the values $\sim (45-60)$ km/hr, which were taken earlier (Oehme, 1968; Dol'nik, 1969; Lyuleyeva, 1971; these speeds are presented in parentheses in Table 2).

The attainable flight speed u_p for swallows and martlets, which spend all day in the air, and for whom a $\approx \bar{a}$, should not differ significantly from the real flight speed (see (14)). This actually is the case for swallows, but it is disrupted for martlets (Table 2), which indicates either an exaggerated measured flight activity a or an anomalously great average daily activity $\bar{a} \approx 4$ for martlets.

The running of animals is accompanied by friction against the ground, and flight--by friction against the air. With increased speed of running, the friction against the ground does not change, while friction against the air increases $\propto u^2$. Maximal running speeds are attained with equality of energy dissipation due to friction against the ground and against the air (Gorshkov, 1983). As a result, the flight speeds and maximal running speeds are determined by the same equation: $u = k\sqrt{gl}$ (10). At record running speeds $k=13$ for animals of any size (Gorshkov, 1983), i.e., running occurs at $k \leq 13$. According to the data in Table 2 and Figure 3, in flight $k=17.4$ for all sizes of animals ($k^2 = 2\rho\gamma/\rho_0 c \approx \gamma \cdot 10^3$ at $Re > 100$), and for birds $k \geq 13$, (for insects $k \geq 11$ at $Re > 100$). Thus, value $k=13$ may be considered a transitional value from running to flight (see Gorshkov, 1983).

With fixed k , the flight speeds change with size according to the law $u \propto l^{1/2} \propto m^{1/4}$ at $Re \gg 60$ ($c = \text{const}$); $u \propto l \propto m^{1/3}$ at $Re \ll 60$ ($c \propto (Re)^{-1}$). At $a \gg b+1$ and $Re \gg 60$, the full power of locomotion $q \approx aq = um\gamma g/\alpha \propto mu/\alpha \propto m^{1/2}$ in flight as well as in running with α which does not depend on the speed (Wilkie, 1959).

The reduction of energetic cost of flight $\epsilon = \gamma/\alpha$ with growth of l is conditioned, as for running, by the increase in α (Figure 3). The inclines of the lines for ϵ (Figure 1) and for α (Figure 3) do not depend on the selection of the value of resistance coefficient and are approximately equal in flight and in running. In selecting $c = c^M$ (15), the values α in flight and running (Figure 3) differ by 3-4 times for animals of equal size. Here $\alpha_{\max} \approx 0.25$ is achieved in flight at $m \sim 1$ kg, and in running-- at $m \sim 100$ kg.

If the efficiency α does not depend on the type of locomotion, this means that the coefficients of resistance c for living aerobionts are 1/3-1/4 the value of the generally accepted models (15). Positing that α is uniform in flight and in running for animals of the same size, we may obtain a connection between the true (not depending on the models) coefficients c for running and flying animals. According to (10), we have $\alpha = \gamma/\epsilon \equiv (k^2/\epsilon)(\rho_0 c/2\rho)$. Equating the efficiency in flight and in running, we have $c_r/c = k^2\epsilon_r/k_r^2\epsilon$, where index r provides the corresponding values for running. Considering the fact that $k_r \leq 13$, $\epsilon_r = 9.1 (m/m_0)^{0.30}$ (Gorshkov, 1983) for running and $k \geq 13$, $\epsilon = 1.9(m/m_0)^{0.24}$ (Figure 1) for birds in flight, $m_0 = 1g$, we find that the relation $c_r/c \geq 4.8$ and within the margin of error does not depend on l . Consequently, for live birds $c \leq 0.1$ (instead of $c^M \sim 0.3$) and accordingly $\gamma_{\min} \leq 0.005$ and $\gamma_{\max} \leq 0.05$ (instead of $\gamma_{\min} \sim 0.02$ and $\gamma_{\max} \sim 0.2$), and for all flying birds $\alpha < 7$ percent. This would indicate that the aerodynamic characteristics of live aerobionts exceed by several times the best technical achievements for airplanes (Aleksander, 1970; Kokshayskiy, 1970).

Scale invariance. All the measurable values are dimensional. Dimensionless values appear as the relation of various measurable values with identical dimensionality, as for example u^2/gl , $u/u_{\min}$ or $Re = ul/v$. The correlation in variation of two values of different dimensionality should not depend on the selection of the unit of measure and may be determined only between the dimensionless combinations plotted for each of them (cf. (10)). If for a measurable object there are no characteristic values of that dimensionality, then the dimensionless combination may be compiled only from a relation of change in value dz (or dl) to value z itself (or l). In this case, the

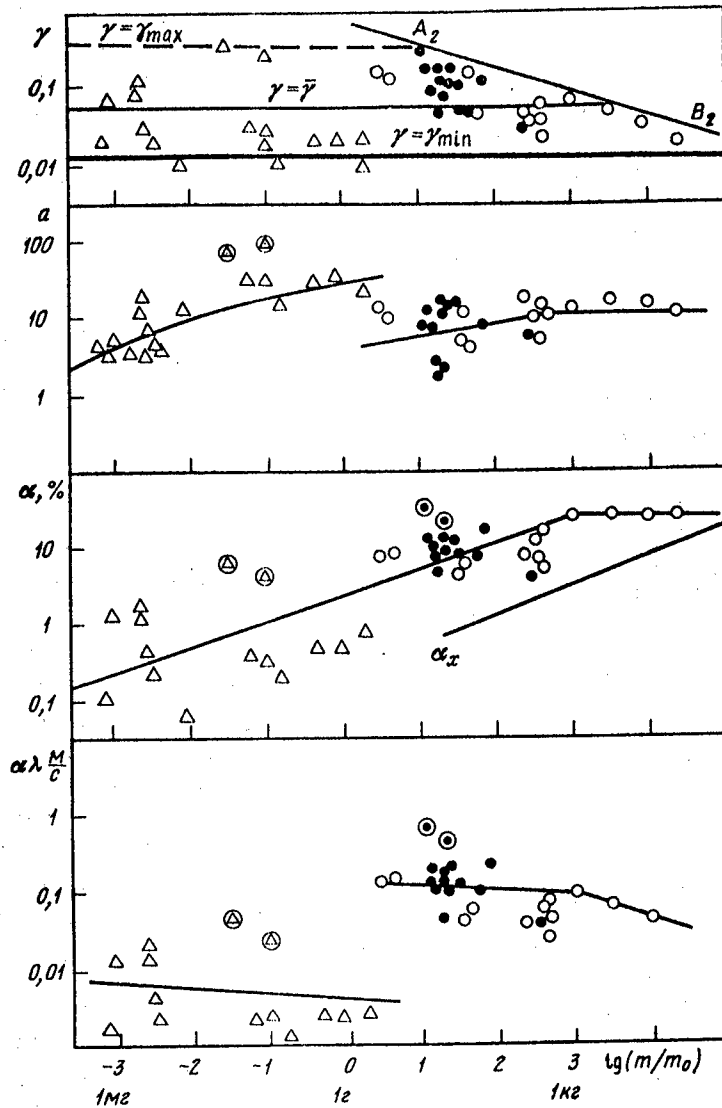


Figure 3. Coefficient of dissipation, activity and efficiency of flight. Designations are the same as in Figure 1. Lines -- description of the observed correlation by functions $z=z_0(m/m_0)^{z'/3}$, $m_0=1$ g, $z=\gamma$, $a:\gamma_0=0.055\pm0.010$, $\gamma/3=0.027\pm0.036$, $N=38$, $r^2=0.014$; $a=r/\varepsilon(2.4\pm0.44)\%$, $a'/3=0.29\pm0.042$, $N=41$, $r^2=0.56$ at $a < a_{\max}$ ($\alpha_0 \approx \gamma_0/\varepsilon_0$, $\alpha' \approx \gamma' - \varepsilon'$), which indicates an absence of a correlation between ε and γ ; line α_x is the efficiency of walking and running; $a_{x0}=(4.2\pm0.3)\%$, $a_x/3=0.32\pm0.02$, $m_0=1$ kg (Gorshkov, 1983). Lines for a and $\alpha\lambda$ are expressed through lines for λ (Table 1), γ and α . Extremal data discussed in the text are circled.

connection between the changes in values of various dimensionalities, for example dz and dl , which are small as compared with the values themselves (z and l), may have only the following appearance:

$$\frac{dz}{z} = z' \frac{dl}{l}, \quad dz' = \psi(z') \frac{dl}{l}. \quad (17)$$

A small increase in dimensionless value dz' may be proportional to a small increase in dimensionless value dl/l (or dz/z) with a proportionality coefficient equal to the arbitrary function of the singular ultimate dimensionless value z' . This is written in the second equation (17). The aspect is determined by dynamic laws (Gell-Mann, Low, 1954). The general solution to (17) has the following appearance:

$$y - y_0 = f(x - x_0),$$

$$x \equiv \lg l, \quad x_0 \equiv \lg l_0, \quad y \equiv \lg z, \quad y_0 \equiv \lg z_0, \quad (18)$$

where function f is synonymously tied with ψ . A characteristic peculiarity of (18) is the retention of the aspect of function f with an arbitrary change in the scope l_0 , which determines the start of counting on the logarithmic scale x_0 . The scope z_0 is fixed by selection of l_0 with z and l measured in the same units. It is evident from (17) and (18) that the function of (18) noticeably changes at intervals $\Delta l \sim l$ (Gorshkov, 1981). In the specific case of a constant z' in a definite sphere of dimensions ($\psi(z') = 0$) we have the scaling dependence (cf: Table 1):

$$\lg\left(\frac{z}{z_0}\right) = z' \lg\left(\frac{l}{l_0}\right), \quad \text{или} \quad \frac{z}{z_0} = \left(\frac{l}{l_0}\right)^{z'}, \quad z' \equiv \frac{d \lg\left(\frac{z}{z_0}\right)}{d \lg\left(\frac{l}{l_0}\right)}. \quad (19)$$

Dependence (19) may arise also in the presence of an isolated scale. In this case (due to linearity of the laws of dynamics), indicator z' is equal to a simple rational number. For example, dependence $u = k \sqrt{gl}$, $k = \text{const}$, may be written in the form of (19) with $z \equiv u$, $z' = 1/2$, $u_0 = k \sqrt{gl_0}$.

Dependence (19) is usually used for processing the results of biological measurements (cf. Table 1). The points of sharp changes in constant inclines z' correspond to the external isolated dimensions. In the case of α , ε and u_p these are body masses, at which α reaches values $\alpha_{\max}$ (5).

Swimming

Swimming is performed in a medium with $p_c = p$, where the weight of the body is equalized by an ejecting force and lift force is absent ($c_1 = 0$). The energetics of swimming does not depend on weight. Therefore, a characteristic value defining locomotion is not the metabolic power per unit of weight $q/mg \equiv \lambda$ but rather the metabolic power $q/cl^2 \equiv j/c$ (Table 1) per unit of characteristic surface cl^2 , and the metabolic rate $w \equiv (2j/p)^{1/3}$ respectively (4). Equation (4) for swimming, which expresses the law of energy conservation, may be rewritten as follows:

$$u = \left(\frac{\alpha a}{c}\right)^{1/3} w, \quad \text{or} \quad \alpha = \frac{c}{a} \left(\frac{u}{w}\right)^3. \quad (20)$$

With constant ratio c/α , the activity a must increase $\propto u^3$. However, experimental data show a weaker dependence of a on u , close to $\propto u^2$. This means that ratio c/α depends on the speed u . A summary of empirical data on prolonged swimming of fish (Klyashtorin, 1982) (with consideration of the statistically average connection between the length of the fish L and the universal size l (1), which has the appearance of $L=5.0 l$ (Chislenko, 1981; Brett, 1965) necessary to compute the metabolic rate w of the fish by Table 1), corresponds to the following dependence of c/α on u :

$$\frac{\alpha}{c} = \frac{\alpha_1}{c_1} \left(\frac{u}{u_1} \right)^n, \quad \frac{\alpha_1}{c_1} = 26, \quad n = 1.07 \pm 0.06; \quad (21)$$

$$0.14 \text{ m/c} \leq u \leq u_1 = 1 \text{ m/c}, \quad 1.5 \text{ cm} \leq l \leq 9 \text{ cm}, \quad (22)$$

where the limits (22) indicate the boundaries of the interval of speeds and sizes in which regularity (21) has been tested. The presence of a dependence on u and the absence of a dependence on l with a random change in speeds and sizes indicates that relation (21) is not a manifestation of the dependence on the Reynolds value $Re = ul/v$. Dependence (21) corresponds to the behavior of $a \propto u^{3-n} \sim u^2$. The observed regularity (21) is commensurate with constancy $c \geq 0.01$ and growth with rate of α in interval $0.03 < \alpha < 0.25$, as well as with constancy $\alpha \leq 0.25$ and reduction with rate of c in interval $0.08 > c > 0.01$ (Cf: Matyukhin, 1973), as well as with the change in both values. We must note that with the output of efficiency α to a maximally allowable value $\alpha_{\max} \approx 0.25$ (5) and resistance coefficient at a minimally allowable value $c_{\min} \sim 0.01-0.001$ (Aleyev, 1976), the change in relation of coefficients with speed (21) must cease (cf: Matyukhin, 1973).

In oxygen deficiency, the maximal observable activities and efficiencies are universal and reach values $a_{\max} \approx 130$, $\alpha_{\max} \approx 0.4$ (Gorshkov, 1983). The record speeds of large fish with $l \sim 1\text{m}$ and $w \approx 0.5 \text{ m/sec}$ (Table 1) reach values of $u_{\max} \approx 30 \text{ m/sec}$ (Aleyev, 1976). From (20) we obtain that coefficients c at such speeds have the order of $c_{\min} \approx 2 \cdot 10^{-4}$. If we consider that c in live fish and non-live models coincide, i.e., $c_{\min} = c_{\min}^M \approx 10^{-2}$, then we obtain that either at $a_{\max} = 130$ we have $\alpha_{\max} = (c_{\min}^M / a_{\max}) (u/w)^3 \approx 40$, which disrupts the law of energy conservation: $\alpha_{\max} \leq 1$, or at $\alpha_{\max} \approx 0.4$ we have $a_{\max} \approx 10^4$, which is never observed in animals (Grey's paradox)⁵.

If we consider the extremal values $a_{\max}$, $\alpha_{\max}$, $c_{\min}$ to be universal and not depending on the size of the body l , then the peak swimming speeds must vary with indicators $u'_{\max} = w'$, cf. (19), i.e., they must be weakly dependent on the dimensions (Table 1). This actually is the case for fish with weight of $m \geq 100 \text{ kg}$ (Aleyev, 1976). However, for smaller size fish $u'_{\max} \approx 0.7-0.9$ (data of Aleyev, 1976: $u'_{\max} = 0.69$; data of Vu, 1980: $u'_{\max} = 0.88$). This singularly indicates that activity a in these fish drops with reduction in their size and does not reach the universal limit $a_{\max} \approx 130$.

For true hydrobionts, whose only means of locomotion is swimming ($A_1 = u_1 = 0$ in (11)), the expression for average daily swimming speed $\bar{u}$ is determined by the formula (14). With $b = 0$ and $n = 1$ from (20), (21) and (14) we have:

$$\bar{u} = \bar{a}u_p = \left(\frac{\bar{a}}{a}\right)^{1/2} \bar{u}_{\max}, \bar{u}_{\max} \equiv \left(\frac{\alpha \bar{a}}{c}\right)^{1/2} = u_{\min}. \quad (23)$$

The activity $a \geq a_{\min} = \bar{a}$, since the animal must expend all its average daily energy. The greatest average daily speed (23) is achieved with the lowest $a = \bar{a}$, which is true with any $n < 2$. In this case the animal must retain its activity round-the-clock with minimal swimming speed $u_{\min}$ (which coincides with $u_{\max}$).⁶ It is more energetically expedient for swimming animals to maintain low activity round-the-clock than to alternate high activity with periods of rest, which is necessary in flight and beneficial in locomotion on land (Gorshkov, 1982a, 1983). The absence of dependence α/c from dimensions in (21) indicates that in approaching $w' = 0$ (cf. Table 1), the average daily swimming speed u_p at $a = \bar{a}$, analogous to walking and flying, does not depend on size for fish within the limits of (22).

Dependence (21) does not contradict the assumption about the universal dependence of effectiveness on body size l , observed in locomotion on land: $\alpha \approx 0.5\% (1/l_0)$, $l_0 = 1$ cm (Figure 3), nor does it contradict the absence of dependence α on activity a (and speed u),⁷ if we assume that within the limits of (22) there is a dependence of the resistance coefficient on the speed and size of the species:

$$c \approx 2 \cdot 10^{-2} \frac{l}{u} \cdot \frac{u_0}{l_0}, l_0 = 1 \text{ cm}, u_0 = 1 \text{ cm/c}.$$

Such a dependence does not contradict the existing empirical data (Matyukhin, 1973). For a singular conclusion about the character of dependence of swimming efficiency on body size, additional measurements of α and c are necessary.

Thus, the empirical data for any animals and any types of locomotion may be coordinated with the assumption about the universal dependence of locomotion efficiency on body size, and with the absence of a dependence on activity in an oxygen balance and output to maximally possible efficiency for all animals of any size in oxygen deficiency.

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List of abbreviations

Independent variables

- l , cm -- universal size of an animal;
- w , m/sec -- metabolic rate;
- a -- activity of locomotion;
- b -- readiness for locomotion;
- α -- effectiveness of locomotion (pure efficiency);
- θ -- angle of lift or descent;
- c -- coefficient of resistance (differs by a factor from the coefficient of frontal resistance C), $c(\theta) \neq c(0)$;
- u , m/sec -- speed of locomotion;
- $u_{\perp}$, m/sec -- vertical speed of air masses creating lift force in flight;

$u_{\perp \min}$, m/sec -- speed of descending air masses in hovering (isolated characteristic speed approximately equal to the minimal speed of free fall of an inactive animal with wings extended, at $u \sim u_{\perp \min}$ the dissipation coefficient γ and the net energetic cost of flight $\varepsilon = \gamma/\alpha$ pass through a minimum).

Utilized physical constants (isolated characteristic dimensional values)

$p = 10^3$ kg/m³ -- density of a living organism;

$p_c = 1.2 \cdot 10^{-3} p$ -- density of air;

$g = 9.8$ m/sec² -- free fall acceleration.

Variables expressed through independent factors

$m \equiv p l^3$, g -- mass of the organism;

$j \equiv p w^3/2$, W/m² -- standard metabolic power per unit of average section of an organism;

$\lambda \equiv j/p g l$, m/sec -- standard metabolic power per unit of weight of the organism;

$q \equiv j l^2 \equiv \lambda m g$, W -- standard metabolic power of the organism (BMR);

$Q(u) \equiv (a+b+1)q$, W -- full power of moving animal;

$A \equiv a+b$ -- full activity;

$\varepsilon \equiv a q / m g u$ -- pure energetic cost of locomotion of a unit of weight per unit distance;

$E \equiv A Q / m g u$ -- full energetic cost of moving a unit of weight per unit distance;

$c_{\perp} \equiv (2p/p_c)(g l / u^2)$ -- uplift coefficient (differs by a factor from the coefficient of lift force C_L), computed for speed u ;

$D \equiv -c p_c u^2 l^2 / 2$ -- force of resistance; $D(\neq) \neq D(0)$. $\gamma \equiv |D| / m g$ -- coefficient of dissipation (in flight: $\gamma = c/c$, γ^{-1} -- ratio of lift force to value of force of resistance);

$k^2 \equiv 2 \rho \gamma / \rho_c c = u^2 / g l$ -- Frude value for speed u ;

$C_{\perp} \equiv (2 \rho / \rho_c)(g l / u_{\perp}^2)$ -- lift coefficient computed for speed $u_{\perp}$;

$k_{\perp}^2 \equiv 2 \rho / C_{\perp} \rho_c = u_{\perp}^2 / g l$ -- Frude value for speed u ;

$u_p \equiv u/a$, m/sec -- attainable speed of locomotion (approximately equal to the average daily speed of locomotion);

$U_p \equiv \frac{u}{A}$, m/sec -- full attainable speed of locomotion;

$\alpha_{tot} \equiv \gamma/E$ -- full efficiency of locomotion.

FOOTNOTES

1. The identity sign ($\equiv$) everywhere indicates the determination of new introduced values, i.e., the replacement of variables; equalities correspond to the laws of nature.

2. Readiness $b < 0$ in a state of hypothermia, in anabiosis $b = -1$.

3. The maximal speed of vertical fall: $u_{\perp \max} = k \sqrt{g l}$ with $\gamma = 1$; with $c = 0.3$; $k = 58$, $u_{\perp \max} = 210$ km/hr for $m = 1$ kg, $u_{\perp \max} = 96$ km/hr for $m = 10$ g.

4. According to the known metabolic power of flight Q , the standard metabolism q , the flight speed u , the efficiency α and the coefficient c or γ , the readiness b may be found by formula $b = (Q - \gamma m g u / \alpha) / q - 1$.
5. The resistance coefficient for tired hooked fish in a current of water may also significantly exceed the resistance coefficients of free swimming fish. The assumption about the coincidence of these coefficients (Matyukhkin, 1973 leads to high values of swimming efficiency in an oxygen balance, disrupting condition (5).

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BIOPHYSICS

USE OF ENZYMES IN ORGANIC SYNTHESIS

Moscow KHIMIYA I ZHIZN' in Russian No 1, Jan 85 pp 21-28

[Article by K. Martinek, corresponding member of the Czechoslovakian Academy of Sciences, winner of the USSR Lenin Prize: "Enzymes for Organic Synthesis"]

[Text] Much is being said these days about the remarkable achievements of biotechnology. Usually what is meant is only the widespread application of industrial microorganisms obtained by methods of selection and genetic engineering for synthesizing various valuable substances from available raw materials. We are talking about a different scientific-technical direction: the direct practical use of enzymes, those biological catalysts which work in every living cell--in the industry of organic synthesis.

How an Enzyme Works

As a result of research begun as early as the end of the 18th century, it has been firmly established that all processes which occur in a living cell are connected with chemical transformations of substances. Now we know that living cells are a sort of chemical reactor in which the role of catalysts is played by enzymes, highly specialized protein macromolecules.

In contrast to the majority of conventional catalysts, enzymes work under so-called soft conditions--at low temperature (near room temperature) and atmospheric pressure, and in almost neutral aqueous solutions. Enzymes manifest exceptionally high catalytic activity, sometimes surpassing the activity of catalysts of nonbiological origin by a factor of 10^{10} - 10^{15} . And, what is particularly important, enzymes possess matchless selectivity and specificity of action--the reactions catalyzed by them are not accompanied by the formation of secondary products.

The active center of the enzyme, located on the surface layer of a protein globule, can be roughly represented as a cavity whose configuration strictly corresponds to the structure of a molecule of substrate--approximately the way a lock corresponds to the key approaching it (Fig. 1). But the matter is not limited to simple geometric correspondence (or, so to speak, complementary structure): on the inner surface of the enzyme's active center, specific groupings of atoms making up part of the protein molecules are precisely distributed, sometimes ions of metals (most frequently transition metals), and also molecules of non-protein organic substances, the so-called co-enzymes (for

example, derivatives of vitamins). As a result, a molecule of the substrate undergoing conversion into the product, upon falling into the active center of the enzyme, is immediately subjected to concerted chemical attack from all sides, seemingly broken to bits which are in the same instant united in a new combination and ejected into the surrounding medium like a manufactured part from a stamp. Many enzymes are able to "stamp out" new chemical molecules at an astounding rate--up to tens and even hundreds of thousands per second, although there are also enzymes which work very slowly, competing in a second only a few dozen cycles (or, to speak biochemically, turns).

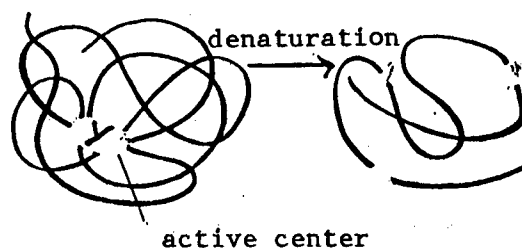


Fig. 1. An enzyme molecule is a protein globule in whose surface layer is a cavity--the active center. Under the influence of various denaturing factors (for example, heating), the globule is deformed or even unraveled, which leads to the enzyme's loss of catalytic activity.

What an Enzyme Can Do

The use of enzymes in precise organic synthesis is warranted most of all in cases when the molecules undergoing chemical restructuring are fairly complex and contain chemical bonds which are similar in properties, of which just one (or only a few) are supposed to be affected. It is for this reason that enzymes are unchanged in synthesizing derivatives of steroids, porphyrins, alkaloids, prostaglandins, polypeptides, and other natural substances of complex structure.

For example, a molecule of benzylpenicillin (Fig. 2, a) contains two CO-N bonds, one of which is located on a side chain, and the other is one of a four-member ring. To affect one of these bonds by purely chemical means, without touching the other, is practically impossible; but the enzyme penicillinamidase is able to detach the side chain while leaving the ring completely untouched. Or yet another example--a modified tropan alkaloid (Fig. 2, b): the enzyme chymotrypsin attacks only one of the two ester bonds of a molecule of this substance, although from the chemist's point of view they have approximately identical reaction capacity.

Many enzymes are able not only to precisely differentiate between similar chemical bonds but also to make a clear choice between molecules of isomers which differ from each other only as does an object from its reflection in a mirror. This is known as stereospecificity of enzyme catalysis, and makes it possible to obtain pure mirror isomers, which frequently have differing physiological action.

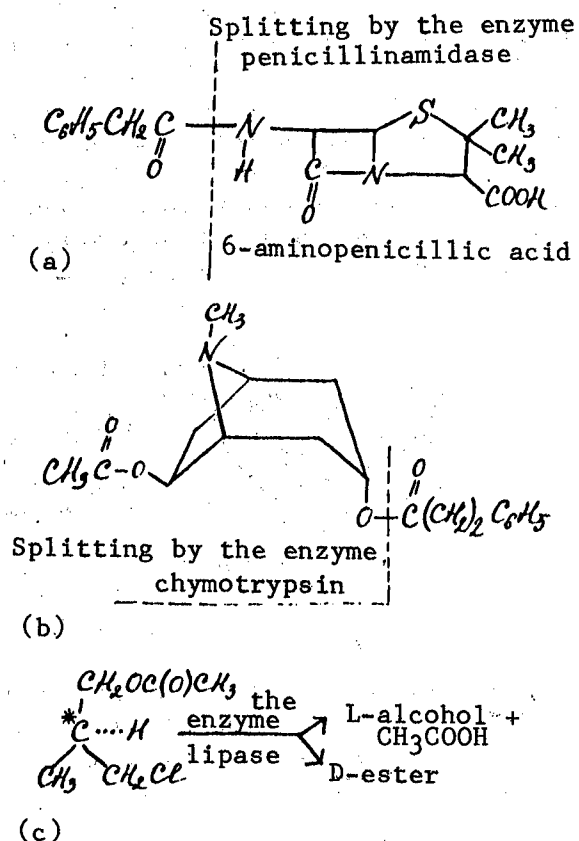


Fig. 2. Specificity of certain hydrolytic enzymes on the example of reactions of conversion of benzylpenicillin (a), tropan (b), and an acetyl derivative of 3-chloro-2-methylpropanol (c).

For example, to obtain certain psychotropic drugs, one of the mirror isomers of 3-chloro-2-methylpropanol is needed. But in conventional chemical synthesis, the result is the formation of an ester which is a mixture of equal quantities of "left" and "right" molecules (Fig. 2, c). But if this ester is hydrolyzed using the enzyme lipase, the ester bond is broken only in the "left" molecules and the product is easily separated from the original substance. This method is also used in other analogous cases, for example to obtain pure mirror isomers of amino acids.

In all these instances, enzymes catalyze different versions of one and the same reaction of hydrolysis (that is, breaking of chemical bonds accompanied by the attachment of water molecules); such enzymes have the overall name of hydrolases. But biocatalysts can also accelerate other types of substance conversions. For example, the enzymes called oxidoreductases catalyze oxidation-reduction reactions, including the oxidation of molecular oxygen and the reduction of hydrogen; transferase enzymes promote the transfer of various groupings of atoms--amines, aldehydes, ketones--from one molecule to another; lyases participate in reactions of forming double bonds and processes of attaching various reagents to these bonds; isomerases carry out the isomerization of molecules--changing their chemical structure without changing their

composition; and ligases (also called synthetases) catalyze the formation of simple hydrogen-hydrogen bonds, and also bonds between atoms of hydrogen and atoms of oxygen, nitrogen, and sulfur. In short, the synthetic possibilities of enzymes are extremely various.

Here is just a short list of the classic operations of organic chemistry which can be carried out using enzymes: reactions of methylation, acetylation, amination, deamination, amidation, decarboxylation, oxidation, hydration and dehydration, condensation.... In principle it is already obvious that the use of biocatalysis in precise organic synthesis opens up the path to waste-free and low-temperature processes, which moreover take place in nonaggressive media. Therefore there is no question that the adoption of biocatalytic processes in chemical technology will inevitably lead to economizing on raw materials and energy and a decrease in the damage modern industry causes to the environment.

Where To Get Enzymes

Thousands of different enzymes function in living organisms; currently, about 3,000 biocatalysts have been isolated from various natural sources and characterized in detail, and of these, approximately 200 are on the market.

The industrial production of enzymes has become possible thanks to the fact that they can be extracted not only from the tissues of various plants and animals, but can also be produced by microbiological means. For example, methods of selection, mutagenesis, and genetic engineering have successfully been used to obtain strains of various species of *Bacillus* bacteria and *Aspergillus* fungi which produce various enzymes in very substantial quantities --sometimes with an output of more than 50 percent of the total mass of cellular protein. According to the data for 1980, major firms of the United States and Western Europe are annually producing up to 100,000-200,000 tons of various enzymes for a total sum of approximately \$300 million. This means that the average value of a gram of enzyme is currently about 0.2 cents.

But such a low cost is by no means characteristic for all enzymes, only those which have long been used in the food industry, mainly for hydrolysis of polysaccharides and proteins (amylase, glucoamylase, rennin, papain, glucosyltransferase, and several others). And although there is a precisely expressed trend to improve large-scale production of enzymes and a corresponding reduction of their cost, at this time the cost of certain biocatalysts is up to \$2,000 per gram--that is, \$2 million per kilogram.

Many enzymes (several dozen designations) are produced in CEMA member countries; the enzyme preparations of the Hungarian firm Reanal are especially well-known. In cases when an enzyme which is necessary is not on the market anywhere, the synthetic chemist can obtain it by means of cooperation with some microbiological or biochemical laboratory. In doing this, one should keep in mind that in organic synthesis not only ideally pure (and therefore sometimes very expensive) enzymes are frequently suitable, but also impure preparations or even simply cells containing them. Thus, currently, the synthetic chemist does not particularly have to worry about the problem of where to get the necessary enzyme.

What the Enzyme Is Not Good For

Enzymes are ideally adapted for work in the living cell; when extracted from their native environment, they become very unstable and lose their activity sometimes in scant minutes, which reduces to nothing all the advantages of biocatalysis. In other words, although the enzyme is capable in principle of literally working chemical miracles, it turns out to be a fakir for an hour, or more precisely for a minute, and besides is capable of working only under conditions which are little suited for industrial production.

It is desirable to carry out certain chemical-technological processes at high temperatures--for example, in order to eliminate contamination of synthesis products (especially medicinal preparations) by microflora; but at high temperatures the stability of enzymes falls catastrophically. In addition, very frequently the necessary organic substances can be obtained with a high output only in a case where the reaction occurs in a medium of organic solvent; but under these conditions ordinary enzymes are also unable to work normally and quickly lose their catalytic activity. In short, an enzyme isolated from a living cell needs to be substantially improved.

How To Improve an Enzyme

In the past 10-15 years, there has occurred a grand gallop in the development of applied enzymology, caused by the fact that chemists have learned how to immobilize enzymes. In the USSR this research was stimulated by the creation in 1974 of a department of chemical enzymology at Moscow State University imeni M. V. Lomonosov, which is led by I. V. Berezin, corresponding member of the USSR Academy of Sciences.

The point is that enzyme molecules began to be joined to water-insoluble particles (for example, pellets of porous glass, nylon tubes, or thin films), and mechanically included in granules of polymer gels, capsules, hollow fibers, and so forth. As a result, scientists have created heterogeneous enzyme preparations (connected to a carrier), having a number of essential advantages in comparison with their natural predecessors.

First, the heterogeneous catalyst (for example, in the form of grains from 0.1-1 millimeter) are easily separated from the reaction medium, which makes it possible to stop the process at the proper moment, use the catalyst repeatedly, and obtain a product which is not contaminated by the enzyme. Second, using the heterogeneous catalyst, the process may be carried on continuously (in flow columns) and the speed of the catalyzed reaction regulated (as well as the output of product), by changing the rate of flow.

Immobilizing enzymes has also made it possible largely to resolve the problem of increasing their stability. The main reason that enzymes lose their catalytic activity is the fact that under the influence of various so-called denaturing factors (increased temperature, strong deviation from optimum pH, and the presence of organic solvents and certain other substances), protein molecules lose their natural configuration; as a result, the active center of the enzyme is deformed or even destroyed and ceases to carry out its catalytic

function. So that this does not happen, the working configuration of the molecule of biocatalyst must somehow be strengthened: mounting on it a kind of reinforcing "bracket," attaching it to the surface of an inert solid carrier, and mechanically including it in the narrow pores of an insoluble matrix (Fig. 3).

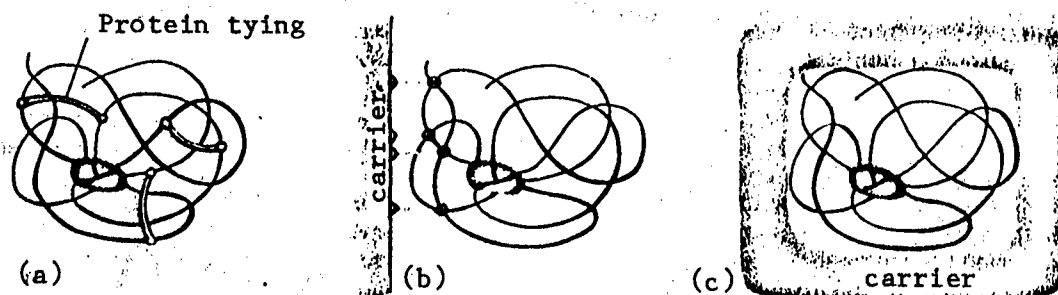


Fig. 3. Different methods of immobilizing enzymes: "tying" the protein chain (a), attaching the enzyme molecule to the surface of an inert carrier (b), inclusion in a porous matrix (c).

These techniques make it possible to slow down the inactivation of enzymes by hundreds, thousands, and even millions of times.

Chemists have also learned how to carry out enzyme reactions in nonaqueous media. For example, Moscow University has used two-phase water-organic systems as the reaction medium.

The two-phase reaction medium is created by one of the following methods: emulsifying a water solution of an enzyme in an organic solvent, suspending in an organic solvent porous particles (for example, pellets of silica gel or ceramics) impregnated with a water solution of the enzyme, or creating a colloid solution of water in an organic solvent* (Fig. 4). In all these cases the enzyme is not inactivated by the organic solvent, since it does not come in direct contact with it; at the same time, the original substances and products of the reaction can be converted from one phase into the other by diffusion, undergoing catalytic transformation in the aqueous phase.

A reaction medium containing two unmixing solvents has very unusual properties (compared to homogeneous solutions). In particular, changing the ratio between volumes of phases makes it possible to shift the position of chemical equilibrium, moving it either in the direction of reaction products or in the direction of original substances (Fig. 5). In addition, the output of products in the two-phase system can substantially exceed the output for each

* Colloid enzyme systems are the foundation of what is known as "micelle enzymology" (PRIRODA, 1984, No 7, p 3).

of the phases individually; consequently, instances are possible in which the reaction practically does not flow at all in one of these solvents, but flows successfully in the two-phase system. This must be remembered in selecting the reaction medium. Two-phase synthesis is extremely simple methodologically. For example, to synthesize dipeptide from two amino acids it is enough to dissolve the original substances in ethyl acetate, add a small amount of porous glass impregnated with the water solution of the enzyme (peptidase), shake it for several hours, filter out the catalyst, evaporate the solvent, and obtain the desired product with an output of 100 percent.

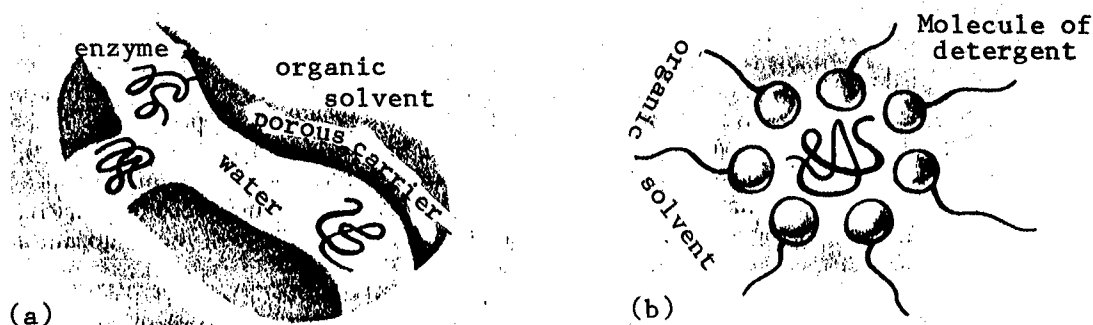


Fig. 4. Methods of creating two-phase reaction systems: suspension in an organic solvent of porous articles impregnated with an aqueous enzyme solution (a), or inclusion of the enzyme in inverted micelles of detergent in an organic solvent (b).

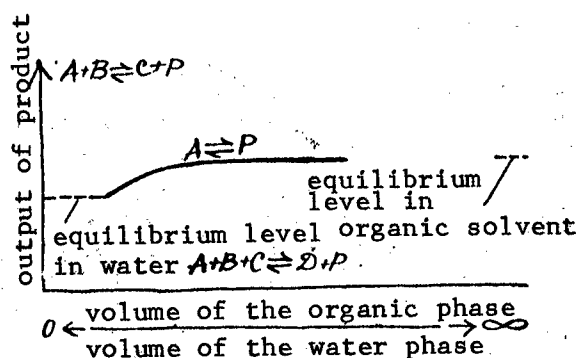


Fig. 5. Depending on the reaction type, the ratio of volumes of the water and organic phases, and the capability of the reagents to spread between phases, the equilibrium (output of synthesis) can be shifted to one side or the other.

What Has Already Been Done

Currently, reactions of enzyme transformation are known for practically all basic classes of organic compounds. Biocatalytic methods are used with particular success in processes such as obtaining optically active amino acids

and other organic acids; modifying antibiotics, steroids, and alkaloids; synthesizing peptides, prostaglandins, oligo- and polynucleotides, and nucleoside triphosphates; introducing radioactive tags into proteins, peptides, amino acids, and nucleic acids; producing phospholipids and processing plant lipid materials; specific splitting of biopolymers; and others.

Biocatalysis has already ceased to be a purely laboratory method. The Soviet Union and many foreign countries--Japan, the United States, Italy, Denmark, Holland, the FRG, Czechoslovakia, and the GDR--have long since developed and are using technological processes which proceed on immobilized enzymes.

Thus, in 1969 Japan put into operation the production of L-amino acids from racemic mixtures of acetyl amino acids obtained by classical chemical methods; using the enzyme aminoacylase, just one mirror isomer is hydrolyzed, which is then easily separated from the nonreacting stereo double. This unwanted isomer is then transformed into racemate and repeatedly undergoes division by enzyme hydrolysis.

The first large-tonnage production in the USSR based on the use of immobilized enzymes was put into operation in 1976 in Saransk Copper Compounds Plant: using penicillinamidase, scientists arranged the manufacture of 6-amino-penicillic acid, which is necessary for synthesizing a number of antibiotics of the penicillin type. Scientific associates of the All-Union Scientific-Research Institute of Antibiotics, Tallinn Polytechnical Institute, and Moscow State University participated in creating this technology, and also specialists of the Riga and Saransk copper compound plants.

About 20 foreign firms are now occupied in creating biotechnology based on catalysis using immobilized enzymes. The processes carried out include the production of L-malic acid by hydration of fumaric acid using the enzyme fumarase (Fig. 6, a) and the production of L-aspartic acid from ammonium fumarate by the action of the enzyme asparaginase (Fig. 6, b); in the latter case, 1700 kg of product is obtained daily in a reactor with a volume of 1 m³. The synthesis of yet another valuable acid, L-tryptophan, from indole and ammonium pyruvate (Fig. 7) is near industrial realization.

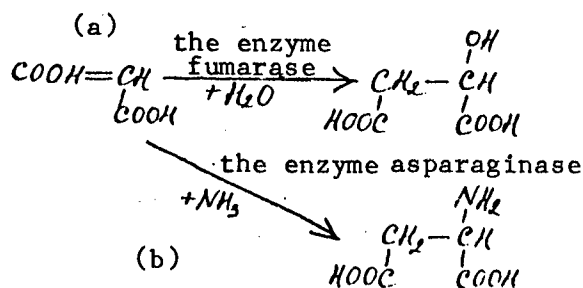


Fig. 6. Biocatalytic transformation of fumaric acid into L-malic (a) and L-aspartic acid (b).

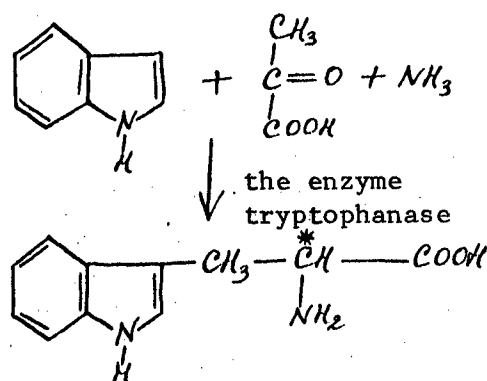


Fig. 7. Enzyme synthesis of L-tryptophan.

Immobilized enzymes are also used successfully in chemical processes of the food industry, in particular for obtaining glucose from starch, obtaining glucose-fructose syrup, or improving the quality of milk by removing lactose from it, as well as a number of other large-tonnage productions.

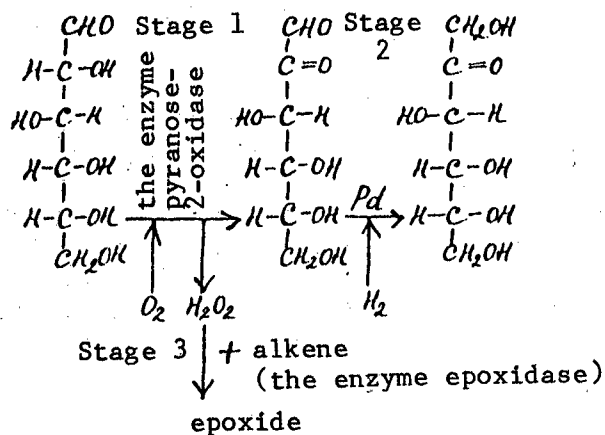


Fig. 8. Production of fructose and epoxides from glucose.

It is interesting to note that thanks to enzyme methods, the border between conventional food techniques and the industry of precise organic synthesis is being eroded. For example, the United States firm Cetus Corporation is developing a process (Fig. 8) which results in the formation of fructose (a food product) and alkene oxides (an intermediate product of organic synthesis). To do this, glucose obtained from starch is oxidized in the presence of the immobilized enzyme pyranose-2-oxidase to gluconic acid, which is then converted into fructose using hydrogen on a palladium catalyst. At the first stage,

hydrogen peroxide forms as a secondary product, which is later used for microbiological oxidation of ethylene or propylene into the corresponding epoxides. Note that three synthetic methods are closely intertwined here: the enzyme method (stage 1), the chemical method (stage 2), and the microbiological method (stage 3). It is this combining of various methods that ensures high economy of production.

Information To Ponder

So, it would seem that everything is going satisfactorily. But I would like to point out what is a deplorable situation for us chemists, namely, that the main contribution in developing enzyme synthesis methods is currently being made by microbiology and biochemistry, while the most fruitful contribution should be the creative combining of biocatalysis with classical, purely chemical methods of organic synthesis. So the future of this biotechnological sector will largely depend on how much we chemists are able to overcome our inertia and traditional prejudice towards biological catalysts.

Obviously, the most rational path would be to teach biotechnological methods not to established specialists, but to students in chemical VUZes. Unfortunately, not even the first timid steps have yet been taken in this direction.

What To Read on the Application of Enzymes in Precise Organic Synthesis

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The Center of Attention

One of the symposia of the 16th Conference of European Biochemical Organizations (FEBO), held last year in Moscow, was devoted to the achievements and prospects of biotechnology. The central problem discussed at this symposium was the use of enzymes and their application in various fields of practice. We suggest for readers' attention these excerpts from papers and speeches of participants in this symposium. [Recorded by A. Iordanskiy]

Possibilities of Immobilized Enzymes

I. V. Berezin, corresponding member of the USSR Academy of Sciences, director of the USSR Academy of Sciences Institute of Biochemistry imeni A. N. Bakh.

Immobilized enzymes are the basis of one of the main directions of modern biotechnology. Today many important products are being produced on a large

scale using them. Primarily, these products are a variety of biologically active substances. For example, in medicine individual amino acids are widely used; but in chemical synthesis of these there is a mixture of natural and nonnatural--left and right forms of amino acids, and the body can assimilate only the natural, left form. It is simplest to separate these mixtures using enzymes.

Also widely used in medicine is the capacity of enzymes to react to strictly determined substances--this is the basis for new, highly sensitive methods of analysis, used, in particular, in diagnostics. For example, if a person is sick, his immune system manufactures specific antibodies--using enzymes they can be found, and the actual diseases causing them can be discovered. Enzymes significantly simplify the analysis of blood: currently, biochemical analysis requires taking a whole test tube full of blood, but the very recently created immunoenzyme method makes it possible to limit it to just one drop of blood in order to determine the concentration of about 50 substances immediately.

Finally, immobilized enzymes also find application directly as medicinal preparations. I remember, for example, that the Lenin Prize was recently awarded to the work of a group of our scientists under the leadership of Academician Ye. I. Chasov--they created the immobilized enzyme drug streptodecase to dissolve blood clots in treating myocardial infarction. After this drug is taken, the blood clot, if it is caught in time, disappears almost without a trace. This is a very important and serious achievement of enzyme technology.

Enzymes can also be used to carry out industrial processes for obtaining various chemical products which are now synthesized by complex and expensive chemical means. I will cite only one example--the synthesis of propylene oxide. This is a small molecule consisting of carbon and hydrogen, into which an atom of oxygen has been introduced in a specific way. This chemically very active molecule is used to synthesize epoxide resins--exceptionally important polymers which are widely used both in industry and in everyday life. Propylene oxide is obtained by complex chemical means; it is very expensive, so epoxide resins are also expensive. But recently a way was found to obtain propylene oxide by enzyme means--cheaply and very effectively.

Enzyme technology is a very young direction of biotechnology, but great successes have already been found in this field. There is no question but that very important advances will be achieved here in the quite near future.

Enzymes and Polymer Chemistry

Prof G. Maneke (Institute of Organic Chemistry, West Berlin)

When we began working on immobilized enzymes some 30 years ago, nothing had yet presaged current successes. Many even said that attaching the enzyme to a solid surface while preserving its activity was in principle impossible. Now no one can any longer bring himself to assert this....

This does not mean that serious problems do not still remain, which must yet be solved. It is very important to set up collaboration between representatives of various specialties: biotechnologists, biochemists, and also--which I would particularly like to emphasize--representatives of polymer chemistry. The point is that many of the currently used carriers of immobilizing enzymes were found by accident, and are by no means always the best carriers. We should learn to select the optimal carriers for a specific goal and specific enzyme, and also create carriers which will not merely serve as the foundation for the enzyme but also, perhaps, do a part of its work for it, for example, concentrating the substrate in direct proximity to its active center. As a polymer chemist, I consider that this is fully possible.

Closer to Biological Membranes

Prof J. Lasch (Institute of Physiological Chemistry, Halle, GDR)

In working on improving carriers for immobilizing enzymes, it is important to make their properties approximate the properties of biological membranes, on which enzymes work under natural conditions. For example, I think a promising method is combining synthetic carriers with the lipids which form cellular membranes. We hope that this will make it possible to improve the orientation of enzyme molecules and at the same time raise the effectiveness of the process.

What To Do With Cellulose?

Prof J. Knowles (Espo, Finland)

More than half of the carbon accumulated by the tissues of plants in the course of photosynthesis is stored in them in the form of cellulose and lignocellulose. The bodies of higher animals and men cannot make direct use of them. But in nature there exist very effective enzyme systems which make it possible to mobilize this carbon in the form of compounds accessible to the body--saccharides. It would be very important for humanity to use these processes in order to change the direction of fixing carbon in plant tissues. This problem is not simple: cellulose and lignocellulose are very complex substrates, and although we know a fair amount about the enzymes participating in their hydrolysis, it is still not enough to be able to control this process or create new, more effective enzymes. Greater efforts are required in this field, but successful resolution of the problem will give us a rich new source of useful substances.

Toward Artificial Enzymes

Prof L. B. Wingard (Pittsburgh University, United States)

We now know about 2,000-3,000 natural enzymes, each of which can catalyze one specific reaction or class of reactions. I hope that further study of the working mechanism of enzymes will make it possible for us to construct new enzymes, not existing in nature, which will catalyze completely new reactions.

Such research also opens up prospects for creating synthetic imitations of natural enzymes. Knowing the three-dimensional structure of the active center and the specific catalytic activity of the enzyme, it will be possible to reproduce the same structure, so to speak, in a different material--not as part of a protein molecule, but in some other compound which nevertheless will work precisely like the enzyme. This is a very interesting direction of research.

Enzyme Combines

Prof K. Mosbach (Lund University, Sweden)

A very promising field of enzyme technology is the creation of multi-enzyme systems, in which, on the very same carrier, in direct proximity to one another, two or several enzymes are immobilized, working consecutively. In doing this it is possible to make sure that the active centers of enzymes have been precisely oriented relative to one another. Thus it is possible to significantly raise the effectiveness of their work: the intermediate products which form under the action of one enzyme in such a system immediately go to another enzyme. This is especially important when the intermediate products are unstable and easily destroyed in the environment: in this system they are not taken out, but immediately processed.

Improving methods of immobilizing enzymes makes it possible to greatly increase their stability. For example, if an enzyme is attached to a carrier not in a single point but in many, its thermostability is markedly increased: if, for example, an enzyme ordinarily cannot withstand temperatures above 65-66 degrees centigrade, it can now work at 80 degrees and higher. This method can also be used to make enzymes more stable to a high concentration of salts or organic solvents in the environment--the latter is especially important for raising the effectiveness of peptide synthesis.

For the work of certain enzymes, co-enzymes are necessary--nonprotein compounds whose presence is an essential condition of the enzyme's activity. These are complex and expensive substances, and they must be added to the reaction medium in great surplus. Recently methods have been developed which make it possible to attach the co-enzyme molecule directly to the enzyme molecule. In addition, the co-enzyme can be placed on a flexible "leg"--a small linear molecule--next to the active center of the enzyme: the leg bends, the co-enzyme approaches the active center, does its work there (for example, reduction), then the leg bends back, the co-enzyme is oxidized in the medium or on an electrode, and is once more ready for work.

In doing this, much less co-enzyme is required, since it is used much more effectively; furthermore, this system is much more resistant to reaction inhibitors, since the cofactor is in direct proximity to the enzyme's active center....

These are only a few of the alluring prospects which research now going on in many laboratories of the world is opening up for enzyme technology.

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12255

CSO: 1841/168

TWO MECHANISMS OF CUMULATIVE SODIUM CHANNEL BLOCKAGE BY LOCAL ANESTHETICS
AND ANTIARRHYTHMICS: ROLE OF INACTIVATION PROCESS

Moscow BIOLOGICHESKIYE MEMBRANY in Russian Vol 1, No 12, Dec 84
(manuscript received 9 Jul 84) pp 1241-1252

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[Abstract] The importance of inactivation in the additive blockage of sodium channels was studied by the voltage-clamp method with myelinated frog (*Rana ridibunda*) fibers pretreated with chloramine T, since this oxidizing agent is effective in abrogating rapid inactivation of sodium channels. Exposure of pretreated nodes of Ranvier to the local anesthetics lidocaine and tetracaine resulted in the loss of the "slow inactivation" stage seen with the anesthetics alone, and the abrogation of cumulative blockage of the sodium channels. However, the antiarrhythmic agents N-propylajmaline and KC-3791 (Giulini Pharma, West Germany) reacted with the open sodium channels with retention of additive blockage despite chloramine T-mediated elimination of rapid inactivation. Nevertheless, in the latter case both agents were less potent than in the absence of chloramine T pretreatment. The data were interpreted to indicate that lidocaine and tetracaine interact with previously inactivated channels to render their cumulative effects, while, in the case of the antiarrhythmic agents reacting with open sodium channels, inactivation appears to play a secondary role in the cumulative effects. Figures 7; references 24: 7 Russian, 17 Western.
[1699-12172]

BLOCKAGE OF BETA-LATROTOXIN-FORMED IONIC CHANNELS IN BILAYER LIPID MEMBRANES BY ANTITOXIN ANTIBODIES

Moscow BIOLOGICHESKIYE MEMBRANY in Russian Vol 1, No 12, Dec 84
(manuscript received 27 Jul 84) pp 1266-1271

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Tashkent

[Abstract] Beta-latrotoxin, isolated from the venom of the spider *Latrodectus tredecimguttatus*, was employed in a study on the mechanism of toxin-mediated ionic channel formation in bilayer lipid membranes (BLM) prepared from azolectin (95%) and cholesterol (5%). Current-voltage studies on the BLM demonstrated that addition of the toxin (4 ± 1 mg/L) to one side of the membrane induced the formation of asymmetric ionic channels. Ion flow through the channels was blocked by the addition of beta-latrotoxin-specific antibody to the other side in the presence of a negative membrane potential, whereas with a positive potential no blocking was demonstrated. In addition, elimination of the toxin and subsequent addition of the antibodies to the same side of the BLM did not affect the channels and, similarly, the use of nonspecific immunoglobulins on the "trans" side was without effect. Finally, toxin preincubated with the specific antibody failed to induce ionic channel formation in the BLM. The data, therefore, indicate that on the trans side the ionic channels contain antigenic determinants of the toxin which are recognized by the specific antibody, with the result that a specific antigen-antibody reaction blocks the transmembrane current flow. Figures 3; references 8: 5 Russian, 3 Western. [1699-12172]

UDC 541.143

PHOTOELECTRIC PROCESSES IN FILMS OF ORIENTED PURPLE MEMBRANES APPLIED TO CONDUCTING SURFACES

Moscow BIOLOGICHESKIYE MEMBRANY in Russian Vol 1, No 12, Dec 84
(manuscript received 14 Jun 84) pp 1290-1301

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[Abstract] Photocurrent generation was studied in oriented films of *Halobacterium halobium* purple membrane formed by electrophoretic deposition, employing various supportive electrodes (Al, Fe, Cu, Ni, Pt, SnO₂). Studies with the lamellar films, consisting of 1000 monolayers, showed that on illumination the

stationary photopotential of a Me/bacteriorhodopsin/SnO₂ was ca. 10 mV and was virtually independent of the nature of the photonegative contact electrode. Replacement of the SnO₂ contact electrode by Al increased the stationary photopotential by about an order of magnitude. Humidity had essentially no effect on the Me/bacteriorhodopsin/SnO₂ and SnO₂/bacteriorhodopsin/Me systems; however, in the former system the decrease in the stationary potential with support could be ranked as follows: SnO₂ > Ni ~ Cu ~ Fe > Al. Highest photocurrents at room humidity and 10⁸ ohm shunt resistance with illumination from a 300 W halogen lamp (KGM-30-300) were obtained with a SnO₂/bacteriorhodopsin/Pt system, which approached values of 15.5 nA/cm²). Figures 7; references 31: 12 Russian, 19 Western.
[1699-12172]

UDC 541.143

KINETICS OF PHOTOINDUCED PROTON TRANSPORT IN BACTERIORHODOPSIN: PHYSICAL MODEL

Moscow BIOLOGICHESKIYE MEMBRANY in Russian Vol 1, No 12, Dec 84
(manuscript received 1 Dec 83; in final form 18 Jun 84) pp 1302-1306

CHERNAVSKIY, D. S., DYUMAYEV, A. K., SAVRANSKIY, V. V., CHERNAVSKAYA, N. M., CHIZHOV, I. V., MEL'NIK, Ye. I., VASIL'YEV, G. V., DYUKOVA, T. V. and MALINA, Z. A., Physics Institute imeni P. N. Lebedev, USSR Academy of Sciences, Moscow; Institute of General Physics, USSR Academy of Sciences, Moscow; Institute of Bioorganic Chemistry imeni M. M. Shenyakin, USSR Academy of Sciences, Moscow

[Abstract] A physical model is advanced to explain earlier data on the kinetics of photoinduced proton transport in bacteriorhodopsin systems, which involves the transport of two protons in one cycle. Particular attention is accorded to the fact that reverse proton flow occurs at low pH (pH 4), but not at higher values (pH 7), and is interpreted as reflecting a return of the proton to its initial state in one of the proton transport chains. The reverse proton transport is regarded as a "parasitic" process that leads to functional failure of the chain, and results in an approximately two-fold decrease in the amplitude of the millisecond processes and total potential. Figures 2; references 14: 5 Russian, 9 Western.
[1699-12172]

PIEZOELECTRIC MECHANISMS IN ACTIVE CHARGE TRANSPORT IN HALOBACTERIUM HALOBIVM PURPLE MEMBRANES

Moscow BIOLOGICHESKIYE MEMBRANY in Russian Vol 1, No 12, Dec 84
(manuscript received 23 May 84) pp 1307-1315

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[Abstract] A scheme is presented for energetic coupling of electronic and ionic subsystems in biological pumps, in which proteins act as electromechanical transducers. A model membrane system is considered with piezoelectric effects due either to deformation of a single protein molecule or to a system of protein molecules. Active charge transport arises as a result of reversible deformations that lead to changes in polarization and conductivity in the proteins. Experimental studies on the purple membranes derived from Halobacterium halobium have confirmed the function of an analogous mechanism in the bacteriorhodopsin system. Dry, oriented, purple membranes responded with a piezoelectric effect on exposure to ultrasonic pressure, measured as a direct current voltage. The hypothesis is advanced that isomerization of retinal results in mechanical deformation of the protein component of the system, and that the findings can be extrapolated to other reversible electrochemical biological systems. Figures 4; references 14: 9 Russian, 5 Western.
[1699-12172]

UDC 573.3

LIQUID CRYSTAL STATE OF DNA-BIOACTIVE COMPOUND COMPLEXES

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 280, No 6 Feb 85
(manuscript received 5 Jun 84) pp 1456-1459

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University of Padua, Italy

[Abstract] Circular dichroism measurements were made of complexes formed between DNA samples and various bioactive compounds (daunomycin, acyclomycin A, adriamycin, Hoechst-33258 compound, etc.) to further analyze the liquid crystal state of such complexes involving intercalated agents. Comparison of the spectra for a variety of complexes demonstrated that the formation of liquid crystal microphases leads to the appearance of intense bands in the DNA absorption regions, regardless of the nature of the external chromophore, and in some cases in the absorption region of the bioactive compound itself. Such observations are indicative of a helical twist in the structure formed by condensation of the DNA molecule. In addition, a positive correlation was seen to prevail between the sign of the band and the angle of the external chromophore group relative to the axis of the DNA helix. This relationship provides

confirmation that the appearance of the new band in the circular dichroism spectrum is due to the linear dichroism of the chromophore inserted into the helical microphase. Figures 1; references 8: 3 Russian, 5 Western.
[260-12172]

UDC 577.354.2

REACTION OF SUPEROXIDE RADICAL WITH OCULAR MELANINS AND OMMOCHROMES

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 280, No 6 Feb 85
(manuscript received 5 Jul 84) pp 1463-1465

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Moscow

[Abstract] Comparative studies were conducted on the effectiveness of ocular pigments in the annihilation of $\cdot O_2^-$ generated by the xanthine oxidase reaction, as a test of the effectiveness of such pigments in preventing lipid peroxidation in ocular tissues and, hence, $\cdot O_2^-$ -induced damage. Annihilation studies with DOPA-melanin, bovine and frog ocular melanosomes, and shrimp ommochrome preparations in aqueous media showed all preparations to be highly effective in preventing superoxide oxidation of epinephrine, photo-reduced riboflavin, and lecithin liposomes. Quantitative assessment showed that the K_i for the ommochrome preparation was $3 \times 10^5 M^{-1} \cdot sec^{-1}$, and for DOPA-melanin $6 \times 10^8 M^{-1} \cdot sec^{-1}$. It appears that the melanins and ommochromes, present in large quantities of the ocular tissues of vertebrates and invertebrates, respectively, are involved in the intracellular regulation of $\cdot O_2^-$ radicals, which are formed during both the light and dark reactions. Figures 3; references 15:
5 Russian, 10 Western.
[260-12172]

BIOTECHNOLOGY

SOVIET GENETIC ENGINEERING APPROACH TO INSULIN SYNTHESIS

Moscow MEDITSINSKAYA GAZETA in Russian 9 Jan 85 p 4

[Excerpt of article by N. Safronova "Insulin...From Bacteria"]

[Text] Progress in molecular biology, genetics, genetic enzymology, the chemistry of nucleic acids and several other fields of modern science has helped to create an arsenal of genetic engineering techniques. In this way, physical-chemical biology has obtained an excellent tool for further understanding of the world, the secrets of the cell, and life itself. And not only of understanding, but also recreating the forms of life. What can this tool not accomplish today! Foremost, in a word: isolate a gene that codes for any given protein from its natural source, or engineer such a gene. Insert necessary corrections into the structure of a gene (enormous possibilities of correcting hereditary diseases!), furnish a gene with regulatory signals to "work" in foreign cells, such as bacteria or yeast. Which means, after transmitting the instruction of its code to the host cell, producing a protein useful to man from the material of the cell.

One such protein is human insulin, a hormone produced by the beta-cells of the pancreas, responsible for processes of biosynthesis in the body. The high level of development of the synthesis of sizeable fragments of DNA and genetic engineering techniques has made possible a microbiological production of human insulin. The problem of start-up and organization of such production is being successfully solved by Soviet scientists. Taking part in the program are a number of scientific and practical agencies of the USSR Academy of Sciences [AS], USSR Academy of Medical Sciences, the Ministries for the Medical Industry and Health, the Glavmikrobioprom of the USSR Council of Ministers. Coordination has been entrusted to the Shemyakin Institute of Bioorganic Chemistry of the USSR AS. The members of the institute have already implemented the critical portion of the program, developing a permanent source of biologically-active human insulin.

12717

CSO: 1840/1752

UKRAINIAN BIOTECHNOLOGY PROGRAM TO BEGIN

Kiev PRAVDA UKRAINY in Russian 23 Dec 84 p 2

[Article by V. Smirnov, UkSSR Academy of Sciences corresponding member and director of the Microbiology and Virology Institute imeni D. K. Zabolotnyy of the UkSSR Academy of Sciences: "Biotechnology"]

[Text] Many achievements already exist on the credit side of Soviet scientists working on the problem of biotechnology. For example, fantastic results (without the slightest exaggeration) are bound to be derived from new biotechnological processes in which genetic engineering procedures make it possible to build microorganisms used for the production of such extraordinarily valuable agents from the standpoint of medical practice as interferons (human defensive proteins), insulin (necessary for diabetes patients), neuropeptides (brain proteins which serve as natural anesthetics in the human body), etc.

A scientific biotechnology program is being set up in the republic for the first time. This circumstance anticipated a number of problems, primarily connected with a different concept concerning the very essence of biotechnology.

Biotechnology is the science dealing with production based on biological processes and the use of cells from microorganisms, plants and animals, subcellular structures and biological molecules. Despite the fact that the program is scientific, we foresee a harmonious combination of basic studies that will become the foundation of the technology of the future. The basic studies are focused on working out a number of genetic engineering problems. Studies dealing with cellular engineering (biology) are provided for in the program, primarily in the area of cell hybridization and development of breeding of economically valuable forms of plants...

Besides the important basic studies, the program provides for a number of studies which will be subjected to experimental-industrial inspection and implementation on a broad scale. Plans are being made for the development of scientific fundamentals and the creation of a biotechnology for nutritive, therapeutic-prophylactic and preservative agents for livestock, for public health and for the food industry. For example, new economical procedures will be implemented for the hydrolysis of vegetable materials and the production of nutritive yeasts; series production of agents for fodder ensilage will be organized; provision will be made for the creation and implementation of virus-free hops planting material; agents for the campaign against gastrointestinal disease in calves will be developed and put to use.

Among the more important basic problems are questions of biological nitrogen fixation, which is not considered to be in competition with mineral fertilizers, but a means for using natural processes that can shorten the time and expense for obtaining mineral nitrogen fertilizers and can lower their secondary effect on the environment.

12262

CSO: 1840/182

UDC 66.085.3

PHOTODECOMPOSITION OF POLYMERS IN CHAIN-REACTION DEPOLYMERIZATION
OF MACROMOLECULES

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 280, No 5, Feb 85
(manuscript received 23 Jul 84) pp 1106-1110

AMERIK, Yu. B., VALIYEV, K. A., corresponding member, USSR Academy of Sciences, VELIKOV, L. V., DUSHENKOV, S. D., MAKHVILADZE, T. M., PROKHOROV, A. M., academician, and SHIROKOVA, L. A., Institute of General Physics, USSR Academy of Sciences; Institute of Petrochemical Synthesis imeni A. V. Topchiyev, USSR Academy of Sciences, Moscow

[Abstract] Rate determination of photodecomposition of polyolefin sulfone films under condition of radical depolymerization showed that the effects of soft x-rays (0.7-6.0 nm) were markedly accelerated. A direct relationship prevailed between the rate of decomposition of the unmodified films and the number of CH_2 groups on the side chains of the monomers. This observation can be ascribed either to a decrease in the temperature of glassy transition in going from polybutene sulfones to polyheptene sulfones and a corresponding increase in the diffusion constant and diffusion path, or to an effect of the average molecular weight of the polymer on the yield of copolymers. It appears that the polyolefin sulfones are a promising starting material for the synthesis of sub-micron structures by treatment with soft x-rays. Figures 2; references 8: 5 Russian, 3 Western.
[259-12172]

UDC 550.4.01:541.136

BIOGEOCHEMICAL IMPORTANCE OF NATURAL RADIOACTIVITY IN EARTH'S CRUST

Kiev GEOLOGICHESKIY ZHURNAL in Russian No 1, Jan-Feb 85
(manuscript received 15 Jun 83) pp 109-118

VOVK, I. F. and VYSOTSKIY, V. I., Institute of Geological Sciences, Ukrainian SSR Academy of Sciences, Kiev

[Abstract] A review is presented of largely Soviet literature on the biogeochemical role of natural ionizing radiation in the earth's crust. Special studies conducted with various microbes have demonstrated that such low-level radiation has both a stimulant and an inhibitory effect and that, in the

various geological formations, the microbial flora is differently affected. The most pronounced effects have been observed in regions with uranium deposits, and such observations in highly radioactive areas have helped resolve some of the conflicting data on the effects of radioactivity on the microbial flora in areas with less background radioactivity. The importance of the flora in pedology and geochemistry has been demonstrated by the fact that the microbial biomass accumulates radioactive elements, and in the Ukraine it has been found that the more fertile soils are much more radioactive than the less fertile samples. Unfortunately, even at the present state of development, many proposed geochemical models neglect the importance of microbial flora in determining background radioactivity. Figures 1; references 32: 28 Russian, 4 Western.
[1046-12172]

UDC 547.7(088.8)+577.154

ACETYLATION OF 2-(AMINO-R-PROPIONYLAMIDO)-BENZOPHENONES BY POLYACRYLAMIDE GEL-IMMOBILIZED ACTINOMYCETES

Kiev DOKLADY AKADEMII NAUK UKRAINSKOY SSR. SERIYA B: GEOLOGICHESKIYE, KHIMICHESKIYE I BIOLOGICHESKIYE NAUKI in Russian No 11, Nov 84
(manuscript received 9 Apr 84) pp 31-35

DAVIDENKO, T. I., MILIYENKO, N. P., KUZNETSOV, V. D. and ANDRONATI, S. A., corresponding member, Ukrainian SSR Academy of Sciences, Physicochemical Institute, Ukrainian SSR Academy of Sciences, Odessa

[Abstract] *Actinomyces roseochromogenes* ATCC 3360 cells, capable of stereospecific transformation of 2-(amino-R-propionylamido)-benzophenones into 2-acylamino-R-propionylamidobenzophenones, were immobilized on polyacrylamide gel and tested for retention of their acetylating activity. The activity of the immobilized cells represented 50% of that of the free cells, with maximum activity obtained in 1/15 M K,Na-phosphate buffer with 20% glycerin. The immobilized cells retained 100% of their enzymatic activity for 7 days at 3-4°C, and 70% of their initial activity for 35 days. Figures 1; references 13: 6 Russian, 7 Western.
[1658-12172]

UDC 581.524.34

ANTHROPOGENIC EFFECTS ON PLANTS: MONITORING, EVALUATION AND PROGNOSIS

Sverdlovsk EKOLOGIYA in Russian No 5, Sep-Oct 84
(manuscript received 8 Jun 84) pp 3-16

GORCHAKOVSKIY, P. L., Institute of Plant and Animal Ecology, Ural Science Center, USSR Academy of Sciences

[Abstract] A practical and theoretical review is presented of the effects of man on the world's plant cover. Anthropogenic effects have now acquired the role of the decisive factor in plant ecosystems, so that synanthropization of phytocoenoses has become one of the most active areas of botanical research. One aspect of the monitoring, evaluative and predictive endeavors is the construction of a 1:4,000,000 scale map of the European plant cover, which represents an international effort in which the USSR is involved. In addition, work is being conducted in the USSR on the preparation of similar maps that would cover the Asiatic portion of the USSR, Soviet Central Asia and the Caucasus. The development of various remote sensing techniques and aerial photography have made significant contributions to the quantification of the plant ecosystems on a global scale, including the effects of human activity. Equally important are the preparation and training of new specialists in this field, and the development of effective means of controlling those aspects of human activity that affect the plant kingdom. References 36: 1 Polish, 23 Russian, 12 Western.
[1696-12172]

UDC 581.524.3

ANTHROPOGENIC EFFECTS ON FOREST/SUBALPINE ZONE BOUNDARY IN CARPATHIAN MOUNTAINS

Sverdlovsk EKOLOGIYA in Russian No 5, Sep-Oct 84
(manuscript received 6 Jun 83) pp 23-31

MALINOVSKIY, K. A. and TSARIK, I. V., Lvov Department, Institute of Botany imeni N. G. Kholodnyy, Ukrainian SSR Academy of Sciences

[Abstract] An assessment was made of the changes occurring in the forest and subalpine interface in the Ukrainian Carpathians under the influence of anthropogenic factors. The combination of recreational activities, lumbering

and cattle grazing has resulted in a 200-300 m downward shift of the natural upper reaches of the forests and the formation of secondary, but extensive, alpine pasturelands. The net effect is that under the soil and climatic conditions of the subalpine zone, the annual solar radiation absorption by secondary grass coenoses stands at 3.5×10^6 kcal/hectare, whereas the primary forest communities accumulated almost three times as much physiologically active radiation (10.6×10^6 kcal/hectare). Translated into the utilization of solar radiation for photosynthesis, the primary forest communities operate with an efficiency of 2.5-3.3% (spruce, pine), whereas the presently dominant secondary phytocoenoses (fescue, matgrass) operate at an efficiency of 0.8-0.9%. The loss of some 80,000 hectares of forest has serious adverse effects on climate regulation, erosion control and water retention in the Ukrainian Carpathians. Figures 1; references 14: 1 Czech, 1 Polish, 12 Russian. [1696-12172]

UDC 591.53:599.32

AGE-RELATED DIFFERENCES IN RUGAE PALATINA OF SMALL SUSLIK (*CITELLUS PYGMAEUS*)

Sverdlovsk EKOLOGIYA in Russian No 5, Sep-Oct 84
(manuscript received 16 Nov 83) pp 55-59

KALABUKHOV, N. I., Astrakhan Anti plague Station

[Abstract] Studies were conducted on the rugae palatina in at least 30 specimens of the small suslik (*Citellus pygmaeus*) obtained from six different geographic regions: left and right banks of the Volga, northern Transvolga region, Ural-Kushum interfluvial area, northern Transural region, and Uil downstream region. The number of rugae were found to vary from region to region, apparently in relation to the food supply and type of prevalent diet. A discordance was evident in the counts obtained for susliks less than a year old and fully mature individuals in a given area. Although the data were in general limited, it appears that the process of natural selection during the first year of life favors the survival of young susliks with the same number of rugae as the adults, whereas those with a smaller or a greater number do not survive in a given area. Figures 2; references 14: 11 Russian, 3 Western. [1696-12172]

ENVIRONMENT

UDC 581.5+577.391

Cs-137 LEVELS IN PLANTS IN VICINITY OF BELOYARSK NUCLEAR POWER STATION IMENI I. V. KURCHATOV

Sverdlovsk EKOLOGIYA in Russian No 5, Sep-Oct 84
(manuscript received 26 Jan 84) pp 81-83

NIFONTOVA, M. G. and KULIKOV, N. V., Institute of Plant and Animal Ecology,
Ural Science Center, USSR Academy of Sciences

[Abstract] Measurements were made of the accumulation of the radionuclide Cs-137 in plants within the 3 km sanitary-protective zone of the Beloyarsk Nuclear Power Station imeni I. V. Kurchatov. The area itself consists of a hilly territory covered for the most part by birch and pine forests. Analysis of the soil samples and various forms of plants over the period 1980 to 1982 demonstrated that the counts were on par with those reported for other similar areas. In other words, after 18 years of operation, the Kurchatov Power Station did not contribute to, or bring about, a noticeable increase in the baseline Cs-137 levels in the soil or plants within the 3 km protected area. Figures 1; references 10: 6 Russian, 4 Western.
[1696-12172]

UDC 574.4

RADIONUCLIDE ACCUMULATION KINETICS IN AQUEOUS ECOSYSTEM PROVIDING COOLING WATER FOR NUCLEAR POWER PLANT

Sverdlovsk EKOLOGIYA in Russian No 5, Sep-Oct 84
(manuscript received 10 Nov 83) pp 84-85

KRYSHEV, I. I. and SAZYKINA, T. G.

[Abstract] The mathematical models advanced by Vollenweider [Schweig. Z. Hydrologie, 37:53-84, 1975; Mem. 1st Ital. Idrobiol., 33: 53-83, 1976] were used to analyze the accumulation kinetics of radionuclides in the ecosystem of a water basin providing cooling water for a nuclear power plant. Hypothetical situations were covered which would lead to an estimation of the period of time for which a nuclear power plant could continuously function ("critical time") until a radionuclide concentration in the upper sediment layer would exceed a control value. Based on the fact that approximately 90% of the radionuclides are concentrated in the upper 3-5 cm, and accounting for the influx and efflux kinetics of the different radionuclides, plankton concentration, etc., an equation was derived for estimating the critical operation time from surface layer radioactivity. References 4: 2 Russian, 2 Western.
[1696-12172]

FOOD TECHNOLOGY

FOOD BASE RESERVES IN KAZAKHSTAN

Alma Ata VESTNIK AKADEMII NAUK KAZAKHSKOY SSR in Russian No 12, Dec 84 pp 65-67

KENESARIN, T., scientific secretary, Republic Interdepartmental Council for Coordination of Scientific Research in Natural and Social Sciences

[Abstract] Improvements and expansion of the food base in Kazakhstan were the primary topics of discussion at a routine meeting of the Interdepartmental Council, in concert with the overall development of the USSR Food Program. The main address was delivered by Academician Ye. V. Gvozdev, vice-president of the Kazakh SSR Academy of Sciences. Gvozdev emphasized the seriousness of the Food Program and the full support that it has from the Party and the Government, and the confirmation of this attitude at the 1983 June Plenum of the CC of the CPSU which put the Food Program into effect to assure the Soviet people of high-quality food products. Of particular concern in Kazakhstan is the state of irrigation and the development of new waterworks for arid lands. Additional emphasis is being placed on the utilization of the solonetz soils which, unfortunately, have been largely neglected. In conclusion, the Council reaffirmed its commitment to improving the food situation in Kazakhstan, and charged the appropriate ministries and departments with fulfilling their goals and plans.

[241-12172]

UDC 613.27-074(048.8)

LEVELS OF MANGANESE, CHROMIUM, IRON, COBALT, MOLYBDENUM AND FLUORINE IN FOOD PRODUCTS

Moscow VOPROSY PITANIYA in Russian No 1, Jan-Feb 85
(manuscript received 19 Jan 84) pp 3-8

SHTENBERG, A. I., Institute of Nutrition, USSR Academy of Medical Sciences, Moscow

[Abstract] An analysis was conducted on data gathered in the past 20-25 years on the levels of manganese, chromium, iron, cobalt, molybdenum and fluorine in Soviet food products in relation to geographical area. The tabulated data demonstrated a paucity of information, but in general showed that the levels of these elements are low, with certain regional differences. Thus, for example,

the concentrations of cobalt, chromium, molybdenum, and manganese are relatively uniform across the USSR, but that the levels of fluorine in the fish products in Belorussia are considerably higher than elsewhere. However, the data are too limited to reach any sweeping conclusions, indicating that such studies must be expanded in the USSR. References 36 (Russian).
[1753-12172]

UDC 613.281:639.512:547(466)-074

FRACTIONATION CHARACTERISTICS AND AMINO ACID COMPOSITION OF KRILL PROTEIN:
POSSIBLE SOURCE OF PROTEIN PRODUCTS

Moscow VOPROSY PITANIYA in Russian No 1, Jan-Feb 85
(manuscript received 2 Nov 83) pp 62-65

ORLOVA, T. A., CHURINA, Ye. Ye. and KURANOVA, L. K., Protein Products
Technology Research Department, "Sevtekhrbybprom" Industrial-Technical Association, Murmansk

[Abstract] Krill specimens harvested in Southeastern Asia and kept frozen for 1.5-4 months at -20°C were analyzed for protein quality as a possible source of protein products. Fractionation studies showed that water-soluble proteins accounted for 48.4-63.9% of the total protein, salt-soluble protein for 3.4-11.6%, and alkali-soluble protein for 10.5-34.9%. Analysis of seasonal variation in solubility patterns revealed that specimens harvested in December had the highest levels of water-soluble proteins, while peak salt-soluble protein concentration was obtained in specimens harvested in June. Highest levels of alkali-soluble proteins prevailed in May, September, and February. The different fractions were quite similar in amino acid composition, with methionine and valine identified as the essential amino acids in short supply. A protein product prepared by salt and alcohol precipitation was, in general, quite similar to soy protein preparations and contained 91% w/w protein. References 17: 10 Russian, 7 Western.
[1753-12172]

UDC 614.31:615.918:582.282.123.2]-074

FOOD CONTAMINATION BY PATULIN

Moscow VOPROSY PITANIYA in Russian No 1, Jan-Feb 85
(manuscript received 17 Jan 84) pp 45-47

DVALI, G. N., MAKSIMENKO, L. V., ELLER, K. I. and TUTEL'YAN, V. A., Institute of Nutrition, USSR Academy of Medical Sciences, Moscow; Scientific Research Institute of Sanitation and Hygiene imeni G. M. Natadze, Georgian SSR Ministry of Health, Tbilisi

[Abstract] An analysis was conducted on 345 samples of fruits and vegetables, their juices and other canned goods to establish the levels of the mycotoxin patulin, produced by *Penicillium* and *Aspergillus* fungi. Studies on the food

samples in RSFSR, Ukraine, Georgia and Armenia revealed that 8 of 160 fruit and vegetable samples contained quantities of patulin ranging from 28.8 to 54,000 $\mu\text{g/kg}$, with the highest concentrations (54,000 $\mu\text{g/kg}$) found in the sea buckthorn. Analysis of various jams, juices and purees revealed 28 contaminated samples out of a total of 185, with patulin levels ranging from 5.0 to 90.00 $\mu\text{g/kg}$ or liter. In general, the levels of patulin were within permissible levels, with the exception of sea buckthorn and its juice, and in some cases of apple juice samples. Special care should be exercised in the storage of juices, since it has been shown that storage of apple juice at 4°C for 2 weeks in a non-hermetically sealed jar resulted in fungal contamination and patulin levels of 12,000 $\mu\text{g/liter}$. References 7: 2 Russian, 5 Western.
[1753-12172]

GENETICS

UDC 575.21:591.18:597.44

NEUROGENETIC ANALYSIS OF VARIABLE REACTIVITY OF YOUNG STARRED STURGEON TO QUINALDINE HYDROCHLORIDE

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 280, No 5, Feb 85
(manuscript received 28 Jun 84) pp 1254-1257

NIKONOROV, S. I., VITVITSKAYA, L. V., KLIMONOV, V. O., KUTERGINA, I. G., KUCHEROV, O. A., PICHUGIN, M. Yu., OFITSEROV, M. V. and SAIDOV, Kh. Yu., Institute of General Genetics imeni N. I. Vavilov, USSR Academy of Sciences; Central Industrial Acclimatization Administration, Moscow

[Abstract] Studies were conducted on the neurogenetic basis of differences in response of one year old starred sturgeons (*Acipenser stellatus*) to the neurotropic agent quinaldine hydrochloride (17.5 mg/liter) in an aquarium. On exposure to the agent approximately one half of the fish went into a deep slumber on the bottom of the tank, while the other half continued active swimming. Analysis of a variety of biochemical, genetic, morphological and functional parameters for the two groups demonstrated that the relatively insusceptible fish evidence significantly greater degrees of physiological and genetic heterogeneity, less intense energy metabolism and lesser plasticity of metabolism in general, and a 'stronger' and more stable type of nervous system. It appears that the insusceptible fish have a greater potential for adaptation to novel environmental situations and are, therefore, more suited for fish breeding. These observations also indicate that neuropharmacological agents can be used in the selection of fish breeding stocks. Figures 1; references 12: 7 Russian, 5 Western.
[259-12172]

UDC 579.252.5:579.8

TRANSFER OF CHROMOSOMAL MARKERS IN *ERWINIA CHRYSANTHEMI* VIA CONJUGATION, PART 4. CIRCULAR LINKAGE MAP OF *ERWINIA CHRYSANTHEMI* ENA49 CHROMOSOME

Moscow GENETIKA in Russian Vol 20 No 12, Dec 84
(manuscript received 23 Feb 84) pp 1961-1967

PROKULEVICH, V. A., BELYASOVA, N. A. and FOMICHEV, Yu. K., Minsk Support Station, All-Union Scientific Research Institute of the Genetics and Breeding of Industrial Microorganisms

[Abstract] Details are presented on the construction of new donor strains of *Erwinia chrysanthemi* ENA49, using *E. coli* Flac⁺ plasmids. Two donors were

isolated that demonstrated highly efficient gene transmission similar to Hfr donors in conjugation with recipient cells. One donor, designated VY2228, showed counterclockwise transmission (0...thr-1...pro-1...his-2...trp-5...arg-3; another, designated VY1448, showed clockwise transmission (0...arg-3...his-2...trp-5...pro-1...thr-1). Both donor strains (with the oriT marker located in different positions), in conjunction with a previously described donor VY1-10, were used in the construction of a closed chromosome map for *E. chrysanthemi* ENA49, which was determined to be 200 min long and to include 35 genetic markers. Figures 2; references 18: 7 Russian, 11 Western.
[238-12172]

UDC 579.252.5

AGROBACTERIUM PLASMIDS

Kiev DOKLADY AKADEMII NAUK UKRAINSKOY SSR. SERIYA B: GEOLOGICHESKIYE, KHIMICHESKIYE I BIOLOGICHESKIYE NAUKI in Russian No 11, Nov 84
(manuscript received 13 Mar 84) pp 78-81

RYMAR', S. Ye., ANDREYEVA, V. K. and STEFANISHINA, T. V., Institute of Molecular Biology and Genetics, Ukrainian SSR Academy of Sciences, Kiev

[Abstract] Agrobacterium strains isolated in Ukraine and Czechoslovakia were studied for the presence of plasmids responsible for the induction of crown gall in *Kalanchoe daigremontiana*. All of the strains studied contained the Ti plasmids, with a number of the 14 strains showing the presence of multiple plasmids, the MW of which ranged from 124 to 145 Mdaltons. In addition, a plasmid free strain (Bt₃) was obtained after ten passages of a virulent strain (Bt) at 37°C. A number³ of cryptic plasmids with a MW exceeding 300 Mdaltons were also detected. Figures 1; references 15 (Western).
[1658-12172]

UDC 572.5:576.312

GENETIC TRANSFORMATION OF MOUSE CELLS BY LIPOSOME-INCORPORATED MINK INTERPHASE NUCLEI

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 280, No 6 Feb 85
(manuscript received 11 Jul 84) pp 1445-1448

SUKOYAN, M. A, BELYAYEV, N. D., BUDKER, V. G., GRADOV, A. A., PAK, S. D. and SEROV, O. L., Institute of Cytology and Genetics, Siberian Department, USSR Academy of Sciences; Institute of Bioorganic Chemistry, Siberian Department, USSR Academy of Sciences, Novosibirsk

[Abstract] Trials were conducted with the effectiveness of a liposomal vehicle for donor nuclei in transforming cells of a different species, using as donor entities American mink interphase nuclei derived from MV cells, and as recipients mouse L cells lacking thymidine kinase (LMTK⁻ line). The

efficiency of transformation with nuclei incorporated into a phosphatidylcholine liposomal membrane was established at 1.9×10^{-5} per recipient cell, with the result that of the 16 clones selected for further analysis 14 evidenced the presence of mink thymidine kinase, whereas two clones lacked thymidine kinase activity and the mechanisms responsible for HAT (hypoxanthine, thymidine, glycine) resistance remain unclear. Long-term (20 days) stability of the thymidine kinase positive phenotype in the transformed cells of some of the clones was interpreted as indicating integration of the mink thymidine kinase gene into the genome of the LMTK⁻ cells. References 12: 3 Russian, 9 Western. [260-12172]

IMMUNOLOGY

PROGRESS IN IMMUNOSUPPRESSION RESEARCH

Moscow MEDITSINSKAYA GAZETA in Russian 15 Feb 85 p 3

[Article by Mirskiy, M., doctor of medical sciences, scientific secretary of the USSR Academy of Medical Sciences' Scientific Council on Transplantology and Artificial Organs (Riga)]

[Text] The problem of immunosuppression is one of the most important in modern transplantology; successes in clinical transplantation of vital organs depend largely on its solution.

Progress in carrying out work in the field of immunosuppression was discussed by a plenary session of the USSR Academy of Medical Sciences' Scientific Council on Transplantology and Artificial Organs, which took place in the capital of Latvia. This field represents one of the sections of the State Program on Genetics and Immunology. New substances with immunodepressive action have been synthesized.

A new direction--low-intensity immunosuppression (weak immunosuppression)--has been advanced in recent years. It calls for the use of cephalosporin, indomethacin and non-steroid antiinflammatory preparations. Scientists have discovered regularities involved in deviations of T- and B-lymphoid populations in standard immunosuppression and found ways of correcting these deviations.

FTD/SNAP

CSO: 1840/1783

NEW ENCEPHALITIS VACCINES AND PREPARATIONS

Moscow MEDITSINSKAYA GAZETA in Russian 15 Feb 85 p 3

[Article by Faybishenko, Yu., correspondent]

[Abstract] In an interview, S. G. Drozdov, member of the USSR Academy of Medical Sciences and director of the academy's Institute of Poliomyelitis and Viral Encephalitis, comments on advances in the prevention of tick-borne encephalitis, particularly development of a new vaccine.

The vaccine is said to develop humoral immunity to encephalitis in 92-97 percent of recipients following two inoculations. Drozdov relates that the vaccine was developed by his institute in collaboration with a number of institutions of the USSR Ministry of Health and USSR Academy of Sciences. It went into series production at the institute's experimental-industrial plant in 1984. Comparing the vaccine with a similar product of an Austrian firm, Drozdov notes that the Soviet vaccine is produced by a chromatographic process, which makes its production simpler, less expensive and more stable. The Soviet vaccine has a similar specific-antigen content and possibly surpasses the foreign product with respect to minimal ballast-protein content.

With regard to other directions of work on combatting encephalitis, Drozdov reports that the institute is now testing new and improved stable acaricides for treating large territories where ticks are found. These substances inhibit certain phases of the ticks' development. In line with a decision of the presidium of the USSR Academy of Medical Sciences, biological studies of carrier ticks are to be expanded for the purpose of developing effective new methods and agents for combatting them, including use of genetic-engineering preparations.

FTD/SNAP

CSO: 1840/1783

INTERFERON PROTECTION OF CELLS AGAINST MUTAGENS

Moscow MEDITSINSKAYA GAZETA in Russian 20 Feb 85 p 4

[Article by Zasukhina, G., doctor of medical sciences, professor, head of the virus genetics laboratory of the USSR Academy of Sciences' Institute of General Genetics imeni Vavilov]

[Abstract] The author reports on results of recent studies of interferon's ability to regulate processes of reparation and mutagenesis in cells.* It has been discovered, in particular, that interferon is capable of protecting living cells against the effects of both physical and chemical mutagens.

Personnel of the virus genetics laboratory of the USSR Academy of Sciences' Institute of General Genetics imeni Vavilov obtained these results through research which began with experiments on chick-embryo cells cultivated in a test tube. Associates of the Moscow Engineering Physics Institute took part in this work. The cells were treated with chicken interferon and then exposed to mutagens (ultra-violet and gamma rays and ethyleneimines). The studies were continued with human interferon in lymphocytes from donor blood. The number of mutations which usually occur from the effect of fast neutrons or gamma irradiation was found to be minimal in cells treated with interferon preparations. Such cells also proved resistant to the chemical carcinogen 4-nitroquinoline-1-oxide.

This phenomenon is said to be based on two molecular-genetic processes. Interferon heightens the DNA molecule's resistance to the effects of mutagens and also stimulates reparation processes in cells and heightens their powers of defense.

*See also the Daily SNAP, January 7, 1985, p. 1, col. 1

FTD/SNAP

CSO: 1840/1783

UDC 612.124.017.1:577.112.088.3:543.544.42

BINDING AND ACTIVATION OF FIRST HUMAN COMPLEMENT COMPONENT ON SYNTHETIC SUPPORTS

Moscow BIOORGANICHESKAYA KHIMIYA in Russian Vol 10, No 12, Dec 84
(manuscript received 19 Apr 84) pp 1629-1637

KOZLOV, L. V., SIZOY, M. N., ZINCHENKO, A. A., IVANOV, A. Ye. and ZUBOV, V. P.,
Institute of Bioorganic Chemistry imeni M. M. Shenyakin, USSR Academy of
Sciences, Moscow

[Abstract] Synthetic supports of copolymer-coated macroporous glass were used in the preparation of a nonspecific column for binding human clq, where amino-ethanol (AE) is bound to the glass, as well as for preparation of biospecific

columns with human IgG is separated from the support by a hexamethylenediamine spacer. Binding to the biospecific column proceeded with an association constant of $4.07 \times 10^7 \text{ M}^{-1}$, which was equivalent to a free energy change of 10.2 kcal/mole. Since the binding energy of Clq to IgG monomers is on the order of 5.0-6.1 kcal/mole, it appears that one Clq molecule was bound to two IgG molecules on the column. Although only weak binding of Clq to the non-specific AE-glass column was detected, both columns led to activation of the classical complement cascade, as indicated by the uptake of C4, C2, C3 and C5 from human serum. The biospecific IgG-glass column was also suitable for the preparation of R1q reagent by removing only the Clq component from the serum. In addition, the IgG-glass column was used for the isolation of the Clq component from human serum with a yield of 63.6% and a specific activity of 446,000 U/mg. Figures 6; references 20: 5 Russian, 15 Western.
[1691-12172]

NEUTRALIZATION AND BLAST TRANSFORMATION AS INDICATORS OF HOST IMMUNE RESPONSE TO TICK-BORNE ENCEPHALITIS VACCINES

Bratislava ACTA VIROLOGICA in Russian Vol 28, No 5, Sep 84
(manuscript received 24 Sep 83; in final form 2 Feb 84) pp 388-394

DZAGUROV, S. G., VOROB'YEVA, M. S., SHALAMBERIDZE, T. D., KARPOVICH, L. G., BLOKHA, V. V. and BUKOVSKAYA, S. N., Scientific Research Institute of Standardization and Control of Medical Biological Preparations imeni L. A. Tarasevich, USSR Ministry of Health, Moscow

[Abstract] Blast transformation was employed as a method of testing for the host immune response, in comparison with standard neutralization tests, following vaccination with several tick-borne encephalitis vaccines. The studies, conducted on 74 males, 18-20 years of age, showed that the index of stimulation of lymphocytes, as measured by the blast transformation reaction, increased with the course of the vaccination, in conjunction with the appearance of neutralizing antibodies. In addition, a highly purified and concentrated vaccine prepared at the Institute of Poliomyelitis and Viral Encephalitides of the USSR Academy of Medical Sciences, was seen to be more immunogenic than a standard vaccine (No 897) used routinely for immunization. References 17: 15 Russian, 2 Western.
[1763-12172]

PREPARATION OF RABBIT ANTITOXIN AGAINST STAPHYLOCOCCAL ENTEROTOXIN TYPE C₂

Moscow VOPROSY PITANIYA in Russian No 1, Jan-Feb 85
(manuscript received 21 Nov 83) pp 70-72

FLUYER, F. S., Laboratory of Bacterial Genetics and Virulence, Institute of Epidemiology and Microbiology imeni N. F. Gamaleya, USSR Academy of Medical Sciences, Moscow

[Abstract] Standard techniques of gel filtration and isoelectric focusing resulted in the isolation of staphylococcal enterotoxin C₂ from the culture filtrate of Staphylococcus aureus provided by M. S. Bergoll (USA). The antigenic preparation, consisting of a 30,000 dalton protein component, was homogenized with Freund's adjuvant (Difco) and used for footpad immunization of chinchilla rabbits. The antisera reacted with C₁ as well as C₂ enterotoxins in gel diffusion studies, but showed no cross-reaction with the other types of staphylococcal enterotoxins. Figures 2; references 11: 5 Russian, 6 Western. [1753-12172]

IMMUNOTHERAPEUTIC METHODS FOR TREATMENT OF BURN INFECTIONS

Moscow MEDITSINSKAYA GAZETA in Russian 30 Jan 85 p 3

[Article by Panchenkov, N., candidate of medical sciences, senior science associate of the department for surgical and transfusion treatment of burns and frostbite of the Central Scientific Research Institute of Hematology and Blood Transfusion]

[Abstract] The author surveys recent advances in the treatment of toxemia, septicotoxemia and other infectious complications of burns. Particular attention is devoted to the development and testing of immunoprophylactic and immunotherapeutic methods and preparations for combating burn infections. The author reports that such methods are now being introduced into clinical practice on a broad scale, and that methodological recommendations have been approved by the USSR Ministry of Health and published in this connection. Among them are recommendations pertaining to "Immunization of Burn Patients with a Native Staphylococcic Anatoxin", "Employment of Antistaphylococcic Plasma in Burn Patients", "Preparation of Plasma from Burn Convalescents for Clinical Use", and "Immunotherapy of Infectious Complications of Burn Disease".

FTD/SNAP
CSO: 1840/1782

LASER EFFECTS

UDC 618.146/.15-006-085.849.19

USE OF LASER IRRADIATION IN TREATMENT OF PRETUMORAL AND TUMORAL DISEASES OF UTERINE CERVIX AND VULVA

Moscow VESTNIK AKADEMII MEDITSINSKIKH NAUK SSSR in Russian No 12, Dec 84
(manuscript received 6 Jun 83) pp 67-69

ZAPLAVNOVA, L. D., KOZACHENKO, V. P. and IVANOV, A. V., All-Union Scientific Center of Oncological Diseases [VONTs] USSR Academy of Medical Sciences, Moscow

[Abstract] Treatment of 40 persons, ranging in age from 22 to 48 years, with diseases of the cervix uteri or vulva, at the Academy of Medical Sciences Scientific Center of Oncological Diseases specially organized department of out-patient laser therapy was described and discussed. The Soviet Scalpel-1, based on a Co laser, and He-Ne lasers LG-38 and OKG-12 were used in the surgical procedures. Use of lasers in cervix uteri surgery produced little pain, improved the cytological picture in the treatment process and eliminated secondary, conventionally-pathogenic microflora. Preliminary study of the effect of laser irradiation showed a definite correlation between the clinical course of the disease and immunological indicators. The studies showed the benefit of use of laser irradiation in out-patient treatment of pretumoral diseases of the cervix uteri and vulva and the advisability of further study in this area. Some aspects of treatment by tissue damaging and non-damaging laser irradiation treatment are discussed briefly. References 15: 12 Russian, 3 Western.
[268-2791]

LASER SURGERY

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 13 Jan 85 p 15

PONARINA, Ye.

[Abstract] Two of the leading Soviet surgeons in the use of lasers in surgery have made a practical reality of operating on the pancreas, liver and the spleen, through the use of surgical lasers. Georgiy Dorofeyevich Litvin and Yevgeniy Ivanovich Brekhov have perfected the use of lasers in surgery and have applied these new tools to surgical intervention on these three sanguineous organs. Successful surgical treatment of these organs relies on a combination

of two types of lasers: a carbon dioxide laser for making the incisions, and a ruby laser for hemostatic control. In recent years lasers have also been extended to the management of cardiac conditions, such as the creation of very fine channels in the myocardium for enhancing the blood and oxygen supply to the ischemic tissue. The advantage of such laser-created channels, which can be regarded as a form of collateral circulation, is that they undergo endothelial lining and do not clog up. From these few examples it is evident that lasers have much to contribute to the future development of surgery.
[181-12172]

UDC 577.353:576.322

LASER DETERMINATION OF VARIABLE PROTOPLASMIC STREAMING RESULTING FROM
EXCITATION OF ALGAL MEMBRANES

Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA, SERIYA 3: FIZIKA, ASTRONOMIYA
in Russian Vol 25, No 6, Nov-Dec 84 (manuscript received 24 Jan 84) pp 48-53

CHERNYAYEVA, Ye. B., Chair of General Physics and Wave Processes

[Abstract] Studies were conducted on transitional processes in protoplasmic streaming in *Nitella* algae resulting from membrane depolarization by a short (0.3 sec) electric stimulation. The rate of streaming was recorded by Doppler laser spectroscopy in real time under conditions of illumination (1700 lux). Generation of an action potential in the membrane resulted in temporary cessation of streaming whenever the stimulus exceeded a threshold value, consisting of an initial rebound to some value (1.1-1.4X) exceeding baseline streaming velocity, and subsequent recovery of baseline velocity via a series of fluctuations in velocity. In situations in which the value of the stimulus coincided exactly with the threshold value only the first phase in the recovery of streaming was recorded. These observations were analyzed and discussed in terms of influx and efflux of Ca ions and a sequence of contraction and relaxation of contractile protein elements. Figures 5; references 13: 5 Russian, 8 Western.
[1697-12172]

MARINE MAMMALS

ICEBREAKER SAVES POLAR DOLPHINS

Moscow APN DAILY REVIEW in English 19 Mar 85 pp 1-2

[Article by V. Zhurba]

[Text] Hour after hour, pressing the ice with her entire strength, and ramming it by her hull, the icebreaker Moskva (Moscow) was assaulting the 20-kilometer neck of ice in the Senyavin Strait off the Chukot shores. The last meters of the neck of ice were finally crushed. A passage was formed in the thick shore ice and hundreds of white whales (polar dolphins) captured by ice could leave for the arctic seas. This was a unique episode in the history of polar navigation--the icebreaker had come to aid not a ship stuck in the ice and not sea-hunters whose canoe was driven by the wind far from the native coast--the seamen were saving a herd of white dolphins.

In mid-December V. Pelyachaivyn, a sea-hunter of the Chukot Zarya Kommunizma (Dawn of Communism) State Farm, was returning home in a dog-sledge from a nearby settlement. Near the ice rim of the Senyavin Strait which was not yet frozen, the dogs got excited. Heavy sighs were clearly heard from the water. Were these walruses? But in that season they leave this place. Whales? But no typical fountains were seen. The hunter was surprised to see a peaceful herd of polar dolphins in the bay.

The news instantly spread over nearby settlements--among coastal Chukchi polar dolphin hunting is traditional.

However, when hunters, who had been given a hunting licence, came to the place, their wish to shoot disappeared. It was evident that the animals had gotten into trouble. Apparently the herd entered coastal waters to pasture. But easterly winds had driven fields of crushed ice to the outlets from the strait, and the severe frost sealed the water openings. The dolphins turned out to be trapped. As a rule, they crush thin ice by their backs, but that solid ice armor was too hard for them.

The frost was making water openings ever narrower. The herd was threatened by hunger or suffocation. Ichthyologists from the local Okhotskrybvod inspection service who responded to the alarm signal could not help the animals either. To make openings in one-meter thick solid ice? But how much time would this take? Besides, it was doubtful whether this would be effective, taking into account that a beluga is five to six meters long and weighs 1.5-2 tons. Would

it be useful to explode the ice with the help of helicopter men? But as bad luck had it, cyclones raged in the sky, continuously attacking the Chukot peninsula. And was it a serious idea to blow up the neck of ice which extended for about 20 kilometers?

In a word, only an icebreaker could come to the white whales' rescue. The icebreaker Moskva (Moscow) was the closest from that place--it was in Providence Bay. It moved to save the white dolphins. But the ice field was a hard nut to crack even for such a giant. The icebreaker came back to load a bunker--that is, to take additional fuel and water to increase the ship's weight.

At last the icebreaker came back. But the job proved to be very difficult even after this. In the first place, the road cleared by the vessel was immediately blocked up by cut ice. The ship had to slowly move back, making small openings. Secondly, the herd would not follow its steel leader. And here someone recalled that white whale's relatives--dolphins--react well to music. Several tunes were played. Classical music proved to be to the arctic dolphins' liking. This way the icebreaker led the herd to the expanses of the arctic seas. [The source of this story, emanating from Magadan City is SOTSIALISTICHESKAYA INDUSTRIYA, February 24.]

MEDICINE

PREPARATION "TSELLOTSIN" FOR DRESSING WOUNDS AND BURNS

Riga SOVETSKAYA LATVIYA in Russian 27 Feb 85 p 2

Rubtsov, V.

[Text] "Tsellotsin" is the name of a new preparation which specialists of the Latvian Scientific Research Institute of Traumatology and Orthopedics and the Belorussian State University's Institute of Problems of Physical Chemistry have developed for the treatment of wounds and burns. This preparation was obtained by the method of chemical modification of cellulose, and it utilizes qualities of cellulose which were previously unknown. Tsellotsin is produced in the form of paste and is applied to fresh wounds. As it dries, it forms a semi-transparent film which is subsequently resolved. Bandages usually are not necessary when tsellotsin is employed.

The new preparation shortens time for the healing of wounds and burns by 30 percent, and it appreciably surpasses all similar medicinal preparations from the standpoint of activity.

FTD/SNAP

CSO: 1840/1777

UDC 534.2.213

ACOUSTIC MICROSCOPY OF ORGANIC AND BIOLOGICAL MATERIALS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 280, No 5, Feb 85
(manuscript received 8 Aug 84) pp 1115-1117

PIRUZYAN, L. A., corresponding member, USSR Academy of Sciences, KOLOSOV, O. V., MAYEV, R. G., LEVIN, V. M. and SENYUSHKINA, T. A., Institute of Chemical Physics, USSR Academy of Sciences, Moscow

[Abstract] Biological (human skin) and organic (polyethylene/polystyrene mixture) materials were subjected to studies by acoustic scanning microscopy, using a working ultrasound frequency of 0.450 GHz with a 3 μ m resolution, to test the suitability of this technique for the evaluation of the mechanical structure of complex materials. In the case of the skin samples the acoustic image intensity was proportional to the density of the collagen fibers. As a result, quantification of transmission is possible and, in turn, the collagen content can be estimated. In the sample under study the collagen content was calculated to be 35%, in good agreement with commonly published data. Studies on the polymeric composites demonstrated that this method lends itself to an analysis of the average concentration of each component in the mixture, as well as to analysis of fractional composition in a given area of the composite. The preliminary studies with scanning acoustic microscopy suggest that this technique will find wide use in biomedical and physicochemical sciences. Figures 3; references 6 (Western).
[259-12172]

UDC 618.5+618.7]-036.88-02-07

MATERNITY RELATED MORTALITY

Moscow ZDRAVOOKHRANENIYE ROSSIYSKOY FEDERATSII in Russian No 11, Nov 84
(manuscript received 1 Feb 84) pp 26-28

ALEKSEYEV, V. A., MUCHIYEV, G. S., MIKHAYLENKO, M. I., GORBUNOV, V. I. and MITEREVA, G. A., Moscow

[Abstract] Study of maternity-related mortality from the position of multiple causes of death included assessment of 3 factors: death from a single cause, death from complications caused by the basic cause of pathology and concomitant diseases, causing death. Causes of maternity-related deaths included:

hemorrhage, late toxicosis, rupture of the uterus, sepsis, embolism of the amniotic fluid, extragenital diseases and other causes associated with pregnancy, parturition and the post-natal period. Complication and concomitant diseases involved in various causes of death are tabulated, described and discussed. Structure of basic causes of death, complications and concomitant diseases and distribution of different pathological states per 100 cases are tabulated and described. Comparison of the structure of multiple causes of maternity-related mortality and results of expertise of medical documentation for each cause of death are described.
[1745-2791]

GNOTOBIOLOGIC ISOLATORS

Moscow VECHERNAYA MOSKVA in Russian 4 Mar 85 p 2

SAMOYLOV, B.

[Abstract] I. M. Lutskiy, chief physician of No 13 City Children's Hospital, has described gnotobiologic isolators that can be applied to any part of the body to avoid contact with pathogenic microorganisms. These isolators are in the form of sleeves and are regularly utilized in the management of pediatric patients with burns, wounds, fractures and other forms of trauma. An added advantage of this form of treatment is that it favors growth of normal skin bacteria which are antagonistic to the pathogens. To date, some 500 children have been successfully treated in this manner, and the method is now being applied to other areas of medicine. The idea for the use of gnotobiologic techniques is attributed to academician, USSR Academy of Medical Sciences who was in charge of a group of scientists who collaborated with Lutskiy's hospital staff on this work.
[1766-12172]

SURGICAL ADVANCES

Moscow PRAVDA in Russian 3 Mar 85 p 3

PETROVSKIY, B., academician, chairman of the All-Union Scientific Society of Surgeons, Hero of Socialist Labor

[Abstract] A survey of modern surgery shows many advances in its service to man, with contributions made in the USSR gaining international recognition. Soviet medical emergency services are second to none, and are the source of admiration even in such highly developed countries as the USA, France, and England. Equally impressive are Soviet achievements in transplantation surgery, with some kidney recipients now surviving for 15-18 years. In addition, surgical operations have served as a stimulus for the development of allied sciences such as anesthesiology and hyperbaric medicine, and in studies on the effects of various physical factors on the human body. Patient monitoring systems have been fully automated and computerized, the design and creation of new surgical

tools is proceeding at a rapid pace, and considerable progress has been made in production of more compatible prosthetic devices. Further stimulus to the development of Soviet surgery will come with the implementation of the next Five-Year Plan.
[1769-12172]

UDC 616.12-005.4+616.12.008.331.1.02:613.2

NUTRITIONAL STUDIES ON INDIVIDUALS WITH ISCHEMIC HEART DISEASE AND HYPERTENSION IN GENERAL POPULATION

Moscow VOPROSY PITANIYA in Russian No 1, Jan-Feb 85
(manuscript received 28 Dec 83) pp 18-21

KHALTAYEV, N. G., DEYEV, A. D. and BURLITSKIY, G. I., Institute of Preventive Cardiology, All-Union Cardiological Science Center, USSR Academy of Medical Sciences, Moscow

[Abstract] A questionnaire study was conducted on the food habits of men in one of the Moscow rayons in the period 1975-1977, which encompassed a total of 525 males between the ages of 40 and 59 years. In that group, 59 were found to suffer from ischemic heart disease and 51 from hypertension. Comparative analysis of data for the group with ischemic heart disease and non-disease individuals showed that the only statistically significant difference consisted of lower carbohydrate consumption and calorie intake by the former on a per kilogram basis. Subjects with ischemic heart disease were generally older (50.5 ± 5.5 years) than the healthy subjects (48.7 ± 5.0 years). The single statistically significant parameter which differentiated the hypertensives from normotensives--in addition to respective age differences, 51.9 ± 4.7 years and 48.6 ± 5.0 years--was the lower cholesterol intake by the former group in a per kilogram basis, as well as of refined sugar. These differences in the food habits of the healthy individuals and those with cardiac conditions apparently reflect patient education conducted by the health authorities. References 25: 8 Russian, 17 Western.
[1753-12172]

UDC 616-002-07:616.153.962.4-097-092:612.398

EFFECTS OF DIFFERENT LEVELS OF OPTIMUM-COMPOSITION PROTEIN DIET ON SERUM LEVELS OF ACUTE INFLAMMATION PHASE PROTEINS

Moscow VOPROSY PITANIYA in Russian No 1, Jan-Feb 85
(manuscript received 31 Jan 84) pp 34-38

VOYTKO, N. Ye. and YATSYSHINA, T. A., Institute of Nutrition, USSR Academy of Medical Sciences, Moscow

[Abstract] Eight male volunteers, 27 to 42 years old, were placed on different levels of optimum-composition protein diets to determine the effects on serum levels of acute inflammation phase proteins (transferrin, α_1 -antitrypsin,

fibrinogen, plasminogen, orosomucoid, haptoglobin, albumin, prealbumin). Serum protein analysis by immunodiffusion techniques showed that reduction in the protein intake to 5.0-8.2 g/day (in terms of nitrogen) resulted in depression of serum concentration of transferrin, ceruloplasmin, antitrypsin, albumin and prealbumin over a 14-day period. These findings indicate that dietary protein depletion compromises the function of nonspecific inflammatory reaction in which these proteins are involved, as well as modulation of the function of immunocompetent cells. References 38: 1 Russian, 37 Western.
[1753-12172]

UDC 612.664.17:612.392.843.549.242](575.12/.13)

COMPOSITION AND HYDROLASE ACTIVITY OF HUMAN MILK IN FERGANA VALLEY IN
RELATION TO ENVIRONMENTAL ANTIMONY LEVELS

Moscow VOPROSY PITANIYA in Russian No 1, Jan-Feb 85
(manuscript received 29 Jul 83) pp 41-43

FUZAYLOV, Yu. M., MIRZAKARIMOV, V. M. and FUZAYLOV, A. Yu., Chair of
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[Abstract] An analysis was conducted on the composition and hydrolase (pepsinogen, amylase, lipase) activities of human milk in areas of the Fergana Valley differing in environmental levels of antimony. The specific areas dealt with were Sokh River Valley where the levels of antimony in hair samples of women are 13.3% higher than in the Andizhan Oblast. Evaluation of the milk samples obtained from 112 lactating women showed that the parameters of interest varied not only with the duration of lactation, but also with the biogeochemical characteristics of the region. Thus, mean milk levels of antimony in Andizhan Oblast were on the order of 0.10 mg/liter, and in Sokh River Valley more than twice as great at 0.26 ± 0.03 mg/liter. In addition, the ash content of milk in the latter region was higher than in Andizhan Oblast, while carbohydrate levels were depressed by comparison. In addition, amylase levels in Sokh River Valley were 12-15% lower than in Andizhan Oblast, while no significant differences were evident in the activities of lipase or pepsinogen. Since antimony tends to concentrate in the thyroid and the Sokh River Valley has a high incidence of endemic goiter, it appears iodine supplements in the Sokh River Valley should be employed to normalize thyroid function and thereby improve the nutrient value of human milk. References 21: 19 Russian, 2 Western.
[1753-12172]

UDC 547.996.02:543.422.25:577.114.5:593.96

¹³C-NMR SPECTROSCOPY IN STRUCTURAL STUDIES ON HOLOTHURIA GLYCOSIDES

Moscow BIOORGANICHESKAYA KHIMIYA in Russian Vol 10, No 12, Dec 84
(manuscript received 14 Feb 84) pp 1655-1663

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Pacific Ocean Institute of Bioorganic Chemistry, Far Eastern Scientific Center,
USSR Academy of Sciences, Vladivostok

[Abstract] ¹³C-NMR spectroscopy was employed in the analysis of model glycosides and subsequently applied as a predictive technique to the elucidation of the structures of a series of glycosides derived from various Holothuria (*H. edulis*, *H. floridana*, *Astichopus multifidus*, *Stichopus chloronotus*, *Cucumaria fraudatrix*, *Bochadschia argus*). A common feature of the various glycosides was the presence of D-glucose, D-xylose, D-quinovose, 3-O-methyl-D-glucose and 3-O-methyl-D-xylose, with all of the glycosidic bonds in the beta-configuration. Correlation with chemical analysis of the structures showed that NMR spectroscopy can be used for the prediction of the structures of novel glycosides. References 14: 8 Russian, 6 Western.
[1691-12172]

UDC 575.224:577.113.4

EFFECTS OF METHOXYAMINE ON TRANSFORMING DNA FROM BACILLUS SUBTILIS:
CORRELATION OF CHEMICAL MODIFICATIONS WITH GENETIC CONSEQUENCES

Moscow BIOORGANICHESKAYA KHIMIYA in Russian Vol 10, No 12, Dec 84
(manuscript received 11 Jun 84) pp 1695-1697

PERUMOV, D. A., MACHKOVSKIY, V. V., YAKOVLEV*, D. Yu and BUDOVSKIY*, E. I.,
Leningrad Institute of Nuclear Physics imeni B. P. Konstantinov, USSR Academy of Sciences, Gatchina, Leningrad Oblast; *Institute of Bioorganic Chemistry imeni M. M. Shemyakin, USSR Academy of Sciences, Moscow

[Abstract] A *Bacillus subtilis* system was employed in an evaluation of the modification of transforming DNA and subsequent formation of indole-dependent mutants (gene *trpC*, *trpD* or *trpF* mutation). The study involved treatment of the transforming DNA with 1 M methoxyamine at pH 4.5 and 6.0 and determination of ⁴mo Cyt and ^{4,6}mo₂ hCyt formation. The number of mutations reached a maximum when approximately 10% of the cytosines in the transforming DNA were chemically

altered with $\text{mo}_2^{4,6}\text{hCyt}$ accounting for approximately a third to a half of the modified bases. The absence of a significant effect on the transforming activity suggests that $\text{mo}_2^{4,6}\text{hCyt}$ is either repaired before or after integration of the modified DNA into the recipient chromosome, or--as is the case with mo_2^4Cyt --does not block replication in *B. subtilis*. Figures 1; references 11: 2 Russian, 9 Western.
[1691-12172]

EXTRANUCLEAR GENOMES IN HIGHER PLANTS

Moscow PRIRODA in Russian No 2, Feb 85 pp 60-67

NEGRUK, V. I., Institute of Plant Physiology imeni K. A. Timiryazev,
USSR Academy of Sciences

[Abstract] One of the areas in molecular biology that is undergoing intense research concerns the nature and function of extranuclear genomes in higher plants, in other words, the DNA molecules in mitochondria and chloroplasts. Such studies are conducted in conjunction with efforts directed at elucidating the nature of interaction among the genomes found in the nucleus, mitochondria and the chloroplasts, with a view toward applying such information in plant breeding. To date, plant breeding and genetics have concentrated on the nuclear genome, while the potential contribution of the extranuclear DNA to crop improvement has been largely neglected. In order to close this gap, extensive studies are being conducted on the nature of the DNA in the mitochondria and chloroplasts, the manner in which they are transcribed, the genes which they encompass and the effects of mutations in these genes, and the translational events that lead to final manifestation of the functional potential of extranuclear DNA. Taking a look forward, it is evident that application of the methods of genetic engineering to the extranuclear DNA may lead to crops with a more efficient and productive photosynthetic mechanism, as well as to varieties with increased energy production. Figures 3; references 5: 1 Russian, 4 Western.
[1761-12172]

PHARMACOLOGY AND TOXICOLOGY

PHARMACEUTICAL SHORTAGE

Moscow MEDITSINSKAYA GAZETA in Russian 14 Dec 84 p 1

[Article "Word and Deed" from the Department of Medical Industry, Construction and Pharmacy]

[Text] At the beginning of the year, "MG" (No 47 from 08 June) posed a question, in the name of our readers, to the Main Pharmaceutical Administration of the USSR Ministry of Health, concerning which measures have been undertaken for improving provision of arterial pressure lowering drugs to the population. In reply, M. Klyuyeva, director of the Main Pharmaceutical Administration, said, "The drugs adelphan-esidrex, crystepin and reserpin have been introduced into the pharmaceutical network. Supplemental supplies of these agents have been produced, and medical industry has prepared more clophelin than the quota." In other words, there is no reason for special concern, we must wait only until the medicines, traveling the long road from bases and storehouses, arrive at pharmacies. The newspaper published this reply.

Almost 6 months has passed, enough time for the long-awaited medicine to reach the furthest points of our nation. But the flow of letters with complaints of their absence has not subsided.

"On November 11, I entered Pharmacy No 1 in Odessa. There was no clophelin, and it was not known when there would be any. B. Belenko." "In Mozdok, only apressin and pyroxan hypertensives are offered. They do not work for me, but there are no other medicines. Lakhmanova." "There is no clophelin in Sukhimi. Is it possible to purchase this medicine with a prescription in another city? Khachaturova."

What is one to think? Is it really possible that the inhabitants of these cities simply were unlucky? And they are available in other places.

Our correspondent in Tashkent met with S. Sagatov, director of the Main Pharmaceutical Administration of the Uzbek SSR Ministry of Health. He said, "In comparison with the first half of this year, the matter has improved. But, of course, it is early to speak of complete provision. Instead of 16,000 packages of the promised crystepin, only 11,000 have been received. 1,950 packages of adelphan were ordered, but the entire amount has not been received."

Our correspondent in Chelyabinsk spent time at a polyclinic of the electro-metallurgy combine medical unit. Here is what Z. Pantyukhov, deputy head physician, told her: "In recent years, we are simply in need of hypotensive agents. Once a month, pharmacies Nos. 4, 21 and 258 send us prepared prescription forms, which we distribute at a meeting of the special peoples commission. So, for example, in October we received 60 packages of rauvasan; 10 were retained for World War II invalids, 20 were given to the chronically ill, and those remaining were at the disposal of the sector service. In November, we did not receive raunatin and other rauwolfia drugs at all. We did not receive clophelin either."

M. Avarnitsyn, deputy chief of the Chelyabinsk Oblast' Pharmaceutical Administration, evaluates the situation in this way, "In 10 months, we received 225,000 packages of raunatin instead of 450,000, that is, half of the amount. We only received 179,000 packages of clophelin out of 540,000, but 85,000 are on the way. The uneven supply and the receipt of a significant part of ordered medicines in the fourth quarter aggravates the shortage of these agents.

We could continue our journey to pharmacies in Kiev and Minsk, Khabarovsk and Tbilisi, throughout settlements and villages, but the result, believe me, would be the same: it is too early to be reassured. No, all has not been done to ensure that these vitally important drugs are continually in the pharmacy.

12473

CSO: 1840/1694

TWO-DIMENSIONAL NMR ANALYSIS OF COBRA (NAJA NAJA OXIANA) VENOM TOXIN-3

Moscow BIOORGANICHESKAYA KHIMIYA in Russian Vol 10, No 12, Dec 84
(manuscript received 4 Jun 84) pp 1606-1628

KONDAKOV, V. I., ARSEN'YEV, A. S., PLUZHNIKOV, K. A., TSETLIN, V. I.,
BYSTROV, V. F. and IVANOV, V. T., Institute of Bioorganic Chemistry imeni
M. M. Shemyakin, USSR Academy of Sciences, Moscow

[Abstract] Two-dimensional ^1H -NMR spectroscopy (500 MHz) was used for the construction of density maps of toxin-3 (alpha-cobrotoxin) derived from cobra (*Naja naja oxiana*) venom, to define structural features of the toxin in relation to pH and temperature. In the deprotonated state ($\text{pH} \geq 7.5$) the imidazole ring of the His²² moiety is surrounded by the side chains of Cys¹⁷, Pro¹⁸, Val²³, Cys²⁴, Cys⁴⁵, Ala⁴⁶ and Thr⁴⁸. In the protonated state ($\text{pH} < 4.0$) the imidazole ring of His²² is exposed to the solvent, and the ionization of the His²² side chain is accompanied by a change in the orientation of the phenol ring of Tyr²⁵, as well as by changes in the conformational mobility of Cys¹⁷, His²², Cys⁴⁵ and Ala⁴⁷ side chains. Differences in the conformational status of the toxin at different pH values do not as yet account for the differences in the reactivity of the long (toxin-3) and short toxins with acetylcholine receptors. However, the structural lability of the binding site of the long toxin may be a factor determining its slower rate of association with the receptor. Figures 15; references 52: 5 Russian, 47 Western.
[1691-12172]

PHARMACOKINETICS IN MICE OF 3-[BIS(2-HYDROXYETHYL)AMINO]ACETOPHENONE-(4,5-DIPHENYLOXAZOL-2-YL)HYDRAZONE (ZIMET 98/69)

Bratislave ACTA VIROLOGICA in Russian Vol 28, No 5, Sep 84
(manuscript received 4 Jan 84) p 445

AMLACHER, R. and ULBRICHT, H., Central Institute of Microbiology and Experimental Therapy, Scientific Research Center of Molecular Biology and Medicine, GDR Academy of Sciences, Jena

[Abstract] Tritiated 3-[bis(2-hydroxyethyl)amino]acetophenone-(4,5-diphenyloxazol-2-yl)hydrazone was administered per os to ABD2F₁ mice to study its

pharmacokinetics. Maximum serum concentration after administration of 10 mg/kg was 7.5% of the dose, and 0.3% after administration of 1820 mg/kg. The half-time for the elimination of the agent from the body after the two respective doses was 28 and 42 h. Repeated administration resulted in a calculated accumulation ratio of 2.1. The highest levels of the agent were found in the liver, followed by the kidneys, and then equivalent levels in the serum and the brain. These observations indicate that ZIMET 98/69 is poorly absorbed from the GI tract and is rapidly eliminated from the body. References
4 (Western).
[1763-12172]

PHYSIOLOGY

INFORMATION PATHOLOGY RESEARCH

Moscow MEDITSINSKAYA GAZETA in Russian 23 Feb 85 p 3

[Article by Melkonyan, M., correspondent (Tbilisi)]

[Abstract] The article records comments of Mikhail Mikhaylovich Khananashvili, member of the USSR Academy of Medical Sciences and director of the Georgian Academy of Sciences' Institute of Physiology, regarding information pathology, a direction of this institute's research. Information pathology is said to be concerned with physical and mental symptoms resulting from relationships within what Khananashvili calls the 'information triad': shortage of time for making important decisions, information overloads, and information insufficiency.

The article describes how associates of the institute's laboratory for the study of animal behavior worked out an experimental model of information pathology in dogs. Studies were made of relationships between information pathology and hypodynamia, genetic predisposition, physical ailments and other factors. One of the researchers' conclusions is that this experimental model can serve as a model of similar pathology in humans who are exposed to adverse effects of the information triad over long periods of time. Khananashvili cited the example of pilots and polar explorers who are forced to make important decisions daily or hourly in stressful conditions and on the basis of sparse information. Prolonged stress of this type can give rise to both neuroses and psychosomatic symptoms. Specialists are therefore considering the possibility of distinguishing 'psychoneural information disease' as a new nosologic form.

Experimental models of information pathology may also provide a basis for ascertaining the etiology of human illnesses more precisely, according to Khananashvili. He mentioned in this connection that a testing system has been developed at the physiology institute as an aid for vocational orientation and medical prognoses. This system makes it possible to determine individual functional capabilities of the human brain in conditions of various combinations of the information triad, it is claimed. Each person's information-pathology threshold is determined in relation to his functional condition and type of occupation, with the aid of a computer.

Studies of physiological reactions are mentioned as another direction of information-pathology research. Pharmacologic methods are being sought for counteracting changes in various structures of the brain which characterize certain

stages of information pathology, for example. In collaboration with organic chemists of Irkutsk, who are under the direction of M. G. Voronkov, corresponding member of the USSR Academy of Sciences, the Georgian scientists are searching for compounds which would heighten the brain's resistance to the information triad's effects.

FTD/SNAP

CSO: 1840/1783

STATUS OF OLIGOPEPTIDE RESEARCH EXPLORED BY SOVIET EXPERTS

Moscow MEDITSINSKAYA GAZETA in Russian 27 Feb 85 p 3

[Article by Sherstnev, V., candidate of medical sciences, head of a laboratory of the Institute of Normal Physiology imeni Anokhin, USSR Academy of Medical Sciences]

[Text] An All-Union workshop for young scientists which was held in the Moscow suburb of Pushchino was devoted to the topic "Neuropeptides: from the Neuron to Behavior". The selection of the topic was dictated by the fact that a large number of short protein fragments called oligopeptides have been discovered and isolated during the last decade. Their range of regulatory functions is extremely wide. They take part in the process of transmitting nervous impulses, control the release of the large peptide hormones, and possess analgesic, opiate and myotropic activity and vasoactivity. Among them are thermal regulators and exciters and inhibitors of molecular, cellular and organic processes. Lastly, a large number of them take part in the regulation of complex processes of behavior and learning.

Despite the abundance of experimental and theoretical data which has been amassed in the world, most of this data has not been integrated and requires serious interpretation, as well as further study in greater depth. The purpose of the workshop was to enable young scientists to obtain knowledge in this field from leading specialists. I. P. Ashmarin and A. V. Val'dman, members of the USSR Academy of Medical Sciences (AMN SSSR), and K. V. Sudakov, corresponding member of AMN SSSR, spoke at the workshop, as did other major scientists--neurochemists, physiologists and pharmacologists. The workshop was organized by the young scientists' council of AMN SSSR's Institute of Normal Physiology imeni Anokhin, and much assistance was rendered by the USSR Academy of Sciences' Institute of Biological Physics.

FTD/SNAP

CSO: 1840/1777

INFRARED IMAGER RECORDS BRAIN'S PROCESSING OF VISUAL INFORMATION

Moscow SOVETSKAYA ROSSIYA in Russian 5 Mar 85 p 4

[Article by Korepanov, S., correspondent]

[Excerpt] The first thermographic images of physiological processes which take place in the cerebral cortex of animals have been obtained in a joint project by scientists of two institutes of the USSR Academy of Sciences--the Institute of Higher Nervous Activity and Neurophysiology, and the Institute of Radio Engineering and Electronics.

Professor I. Shevelev, head of a laboratory of the Institute of Higher Nervous Activity and Neurophysiology, demonstrated on a display screen the thermal images of objects perceived by the visual center of the cerebral cortex--a triangle, a circle, and a cross.

"It was not possible to prove with existing methods the scientific hypothesis that the brain acts like a screen, on which objects seen by the eye are depicted," related I. Shevelev. "That's when we turned to the infrared imager."

"In our device, the infrared imager transmits heat maps of the cerebral cortex to a computer at a rate of 25 frames per second. On the display, we can 'run through' the observed process at any speed. Thanks to the instruments' high sensitivity (the sensors of the infrared imager record temperature changes of hundredths of a degree!), we were able to see for the first time how the cerebral cortex responds to acoustic, cutaneous and light stimuli. It became possible to make an exact study of what areas of the brain are involved in the processing of a particular bit of information, and to record the thermal responses of the cerebral cortex to conditioned and unconditioned stimuli."

We went into an adjacent test chamber, where the animals subjected to the experiments are kept. That designation is used very loosely: there are no sensors or intertwining wires on them.

Only the receiving camera of the infrared imager observes the animals from a distance. With it, telemetry data can be obtained from 11,000-16,000 points of the cerebral cortex!

"We are pioneers in this area of physiology," I. Shevelev said in conclusion. "But in order to maintain our leading position, more sophisticated technology

is needed for conducting experiments. This must be done as fast as possible, for we have come very close to an understanding of one of the most interesting and mysterious processes--the recording and processing of visual information in the cerebral cortex. More far-reaching studies of the mechanisms of memory and learning in animals and humans seem possible in the years immediately ahead."

FTD/SNAP

CSO: 1840/1777

UDC 612.822.3.087

INTEGRAL EVALUATION OF EEG CORRELATIONAL FIELD

Leningrad FIZIOLOGICHESKIY ZHURNAL in Russian Vol 70, No 12, Dec 84
(manuscript received 14 May 84) pp 1691-1693

GENKIN, A. A. and SOLOGUB, Ye. B., Chair of Physiology, State Institute of Physical Culture imeni P. F. Lesgaft, Leningrad

[Abstract] Mathematical rationale is provided for factor analysis of correlational EEG fields through the construction of a correlation matrix. The key element involves an assessment of the ratio of factors under consideration to the number of leads providing data, leading to an integral evaluation of the matrix. The close correlation between the integral and positive correlation coefficients ($r = 0.75$) confirms the adequacy of this type of analysis.

Figures 1; references 7 (Russian).

[254-12172]

UDC 612.813.08

PORTABLE INTEGRATOR OF BIOELECTRIC SIGNALS

Leningrad FIZIOLOGICHESKIY ZHURNAL in Russian Vol 70, No 12, Dec 84
(manuscript received 18 Oct 83) pp 1694-1696

DIVERT, V. E., Thermoregulation Laboratory, Institute of Clinical and Experimental Medicine, Siberian Department, USSR Academy of Medical Sciences, Novosibirsk

[Abstract] An electric schematic is described for the integration of various bioelectric signals, e.g., EEG or EMG, which involves integration of the amplitude of a signal during a given interval of time. The unique feature of this small instrument (50 x 50 x 150 mm; without power source) is the use of a quartz resonator for stable time measurement; with a resonator frequency of 69.905 kHz the duration of analysis is limited to 15 or 30 sec. With the circuitry employed, the magnitude of error in measurements is $\pm 5\%$ with an input potential of 20 mW, $\pm 3\%$ with 30 mW, $\pm 2\%$ with 50 mW, $\pm 1\%$ with 100 mW and $\pm 0.5\%$ within the 200-4000 mW range. Figures 1; references 2 (Russian).

[254-12172]

INVOLVEMENT OF AUDITORY CENTERS IN ECHOLOCATIVE TRACKING OF MOVING TARGET IN GREATER HORSESHOE BAT

Kiev NEYROFIZIOLOGIYA in Russian Vol 16, No 6, Nov-Dec 84
(manuscript received 20 Jun 83) pp 737-745

MOVCHAN, Ye. V., Physiological Scientific Research Institute imeni
A. A. Ukhtomskiy, Leningrad State University imeni A. A. Zhdanov

[Abstract] Behavioral and bioacoustic methods were employed in assessing the role of auditory centers and the inferior colliculi in echolocative tracking of a moving target in the greater horseshoe bat (*Rhinolophus ferrum-equinum*). Bilateral destruction of the auditory centers by thermocoagulation led to irreversible changes in Doppler-shift compensation, but had no effect on signal emission. Complete bilateral destruction of the inferior colliculi by electrolysis resulted in loss of responsiveness to moving target and in a drastic change in the spectrum of emitted signals, consisting of the appearance of a large number of low- and high-frequency spectral components. The energetically most pronounced low-frequency harmonic components ranged from 8 to 45 kHz. These observations indicate that the inferior colliculi function in echolocative tracking of moving targets by linking the emission and reception systems, while the auditory centers optimized Doppler-shift compensation. Figures 4; references 12: 6 Russian, 6 Western.
[1776-12172]

UDC 612.826.5:612.822

PATHWAYS BETWEEN SUPERIOR OLIVARY AND INFERIOR COLLICULAR NEURONS RESPONDING TO AMPLITUDE-MODULATED STIMULI WITH SYNCHRONIZED DISCHARGES IN BATS

Kiev NEYROFIZIOLOGIYA in Russian Vol 16, No 6, Nov-Dec 84
(manuscript received 26 Jul 83) pp 800-807

ANDREYEVA, N. G. and ZHARSKAYA, V. D., Physiological Scientific Research
Institute imeni A. A. Ukhtomskiy, Leningrad State University imeni A. A.
Zhdanov

[Abstract] Electrophysiological studies and orthograde and retrograde migration of horseradish peroxidase monitoring were combined to characterize the connections between superior olivary and inferior collicular neurons responding with synchronized discharges to amplitude-modulated ultrasonic stimuli in the bat. The data showed that from both formations projections lead to the nucleus reticularis pontis oralis. The neurons of the latter nucleus respond to the amplitude-modulated stimuli with synchronized discharges in a manner analogous to the response of the superior olivary and inferior collicular neurons. These observations indicate that action potentials from neurons involved in encoding amplitude modulated signals at the level of superior olive and the inferior colliculi are directed out of the auditory system in the bat. Figures 3; references 12: 6 Russian, 6 Western.
[1776-12172]

TOPOGRAPHIC SYSTEM OF AMPULLAE OF LORENZINI IN RELATION TO ELECTRO-ORIENTATION IN SKATES

Kiev NEYROFIZIOLOGIYA in Russian Vol 16, No 6, Nov-Dec 84
(manuscript received 10 Aug 83) pp 815-821

ANTIPIN, N. P., KRYLOV, B. V. and CHEREPNOV, V. L., Institute of Physiology imeni I. P. Pavlov, USSR Academy of Sciences, Leningrad; Karadag Department, Institute of Biology of Southern Seas, Ukrainian SSR Academy of Sciences, Kurortnoye, Crimean Oblast, Feodosiya

[Abstract] Electrophysiological studies were conducted on the Black Sea skate (*Raja clavata*) to provide a topographic map of the peripheral electroreceptor system of the ampullae of Lorenzini. Combination of the physiologic and morphologic used in determining predominating energetic directional diagrams, based on the response of the ampulla to the direction of uniform electric field strength vectors, demonstrated that the two ampullae possess circular directional diagrams. In addition, experimentally mapped thresholds (0.3 pA currents) of respiratory reflex responses were also circular. These observations indicate that the Black Sea skate possesses a highly sensitive alert system that can detect any direction of an electric field strength vector in a horizontal plane. Figures 4; references 12: 5 Russian, 7 Western.
[1776-12172]

EFFECTS OF EPITHELIAL RECEPTOR POLARIZATION ON RESPONSE OF SKATE AMPULLA OF LORENZINI TO ELECTRICAL STIMULATION

Kiev NEYROFIZIOLOGIYA in Russian Vol 16, No 6, Nov-Dec 84
(manuscript received 11 Jul 83) pp 836-838

BROUN, G. R., GOVARDOVSKIY, V. I. and CHEREPNOV, V. L., Institute of Physiology imeni I. P. Pavlov, USSR Academy of Sciences, Leningrad; Institute of Evolutionary Physiology and Biochemistry imeni I. M. Sechenov, USSR Academy of Sciences, Leningrad; Karadag Department, Institute of Biology of Southern Seas imeni A. O. Koval'skiy, Ukrainian SSR Academy of Sciences, Karadag, Crimean Oblast

[Abstract] The Black Sea skate (*Raja clavata*) was employed in electrophysiological studies on the effects of polarization of the receptor epithelium in the ampulla of Lorenzini on responsiveness to electrical stimulation. In polarization the transepithelial potential was shifted by ± 30 mV, followed by stimulation with $+10^{-10}$ - 10^{-7} A current shocks. Beginning with a negative polarization of -4 to -6 mV (vis-a-vis the resting potential) reversal of changes in spike frequency appear--acceleration in response to anodal and deceleration to cathodal pulses--without loss of sensitivity. In the case of a greater degree of polarization ($+10$ to $+30$ mV) sign reversal also prevailed,

but in conjunction with a sharp decrease in sensitivity. These observations were in agreement with a previously proposed N-shaped model for the voltage characteristics of the apical membrane of the ampulla of Lorenzini [Broun, GR, et al., NEYROFIZIOLOGIYA, 15(3):235-241, 1983]. Figures 1; references 6: 4 Russian, 2 Western. [1776-12172]

MYRIAD FUNCTIONS OF THE BRAIN

Leningrad VECHERNIY LENINGRAD in Russian 9 Jan 85 p 2

ODINTSOVA, N.

[Abstract] A discussion with A. A. Orlov, senior scientist in physiology at Leningrad State University, has underscored some of the recent neurophysiological advances achieved by electrophysiological techniques. By means of electrical stimulation of various regions and individual neurons of the brain it has become possible to identify formations and areas responsible for individual functions, as well as the interrelationship among different areas of the brain and the manner in which neurons communicate. In addition, the so-called associate areas have also been identified, areas that on stimulation do not respond by changes in behavior, emotion, vision, or hearing, but which appear to be involved in processing the various forms of sensory information. Studies on individual neurons and their networks have demonstrated changes in different situations, indicating the plasticity and adaptability of the brain. Figures 1. [1767-12172]

UDC 612.591.1.014.49-06:612.392.99

PHYSIOLOGICAL EFFECTS OF PRESERVED FOOD DIET DURING ACCLIMATIZATION TO HOT CLIMATE

Moscow VOPROSY PITANIYA in Russian No 1, Jan-Feb 85
(manuscript received 1 Feb 84) pp 27-30

TSYGANOV, E. P., KOLCHIN, Ye. V., DUPIK, V. S., BURMISTROV, G. P.,
OVCHINNIKOV, G. A. and KLIMOV, B. N., Moscow

[Abstract] The physiological effects of a diet consisting of preserved and canned food on eight 19-25-year-old males were evaluated under conditions of adaptation to a hot climate and physical work requiring the expenditure of 3600 to 4100 kcal/day. During the three week study the subjects were maintained on a diet providing 3860 kcal/day. Functional testing showed that the central and peripheral nervous systems remained unaffected, and there were no deviations in higher nervous activity throughout the period of observation. However, the PWC₁₇₀ test indicated that orthostatic stability and tolerance of physical load were diminished in the initial phases of the study, as indicated by an increased level of fatigue at the end of a working day. With full

adaptation these differences abated by the 10th day into the study. These observations point to the importance of diet in maintaining physiological balance under unusual climatic conditions, particularly the tonic effects of vitamin supplements and various concentrates intended to replace electrolyte loss in hot climates. References 12 (Russian).
[1753-12172]

PUBLIC HEALTH

NEW MOTHER-CHILD INSTITUTE TO OPEN IN VILNIUS

Vilnius SOVETSKAYA LITVA in Russian 29 Dec 84 p 3

[Article based on interview between ELTA correspondent V. Petrauskayte and O. Rachkauskene, deputy health minister of the republic: "The New Scientific Institute"]

[Text] Next year, the Lithuanian SSR's Ministry of Health Scientific Research Institute for Mother and Infant Health will commence operations in Vilnius. O. Rachkauskene, deputy minister of health of the republic, told ELTA correspondent V. Petrauskayte of the goals and program of operation of this newly established scientific center.

Children are given special attention in our country. As a result, their training and education are taken care of, and vast amounts of money are allocated for protecting the health of young citizens. Soviet Lithuania has had substantial successes in this area. Not long ago, a modern building, the Republic Children's Hospital, was built on the outskirts of Vilnius, in Santarishkes. The first patients will soon be admitted to the new Vilnius City Children's Polyclinic, built with money earned during communist "subbotniks" [labor freely given to the state on days off or overtime]. Remodeling of the Vilnius Women's Consultation No 1 is being completed. The network of medical institutions of this specialty is also being expanded in other cities and rayons. In order to further consolidate the efforts of scientists in this area and to improve the operation of educational-preventive institutions, it was decided to establish the Scientific Research Institute for Mother and Infant Health. Basic directions for scientific studies were planned according to an agreement with the USSR State Committee on Science and Technology.

For a human being who has just made his appearance in the world, the first days of life are often crucial. Therefore, at the institute priority will be given to study of the physiology and pathology of newborns during this period and methods for guaranteeing health to each newborn will be sought.

Implementation of an extensive program for preventing chronic noninfectious diseases has recently begun in our republic and the new institute's scientists are actively participating in this work.

CENSUS FIGURES OFFER STATISTICS ON USSR MEDICAL INSTITUTIONS AND PERSONNEL

Moscow VESTNIK STATISTIKI in Russian No 11, Nov 84 pp 69-70

[Tables dealing with medical personnel and institutions for the USSR as a whole and broken down by major cities]

Text] Table 1. Number of physicians and mid-level medical personnel at the end of 1983¹

		1) Численность врачей всех специальностей		2) Численность среднего медицинского персонала	
		тысяч 3)	на 10 000 ⁴⁾ человек населения	тысяч 3)	на 10 000 ⁴⁾ человек населения
5)	СССР	1104,3	40,4	3035,4	111,0
6)	в том числе по городам:				
7)	Алма-Ата	9,3	90,0	16,3	157,1
8)	Ашхабад	3,1	90,3	4,1	119,0
9)	Баку	12,5	76,2	22,2	134,8
10)	Вильнюс	3,9	74,1	8,1	152,3
11)	Горький	8,6	61,7	17,5	125,6
12)	Днепропетровск	6,7	59,1	11,7	102,5
13)	Донецк	6,9	65,3	14,3	134,9
14)	Душанбе	4,4	80,8	7,8	142,6
15)	Ереван	7,9	71,4	13,2	119,1
16)	Казань	6,7	65,0	12,2	118,1
17)	Киев	19,7	82,5	34,1	142,4
18)	Кишинев	5,6	93,9	9,7	161,0
19)	Куйбышев	7,8	62,2	16,8	134,7
20)	Ленинград	40,7	84,7	70,6	146,9
21)	Минск	9,8	67,6	19,6	134,3
22)	Москва	86,4	102,2	149,6	176,9
23)	Новосибирск	8,9	64,8	16,6	120,6
24)	Одесса	9,4	86,4	17,4	159,2
25)	Омск	7,2	65,5	15,5	141,5
26)	Пермь	6,5	62,3	12,3	117,2
27)	Рига	6,8	78,0	13,6	157,1
28)	Свердловск	8,4	65,1	16,9	131,7
29)	Таллин	3,2	70,4	6,5	142,7
30)	Ташкент	15,0	76,3	27,7	140,6
31)	Тбилиси	13,6	120,3	17,2	151,7
32)	Уфа	6,8	64,5	12,1	115,9
33)	Фрунзе	4,9	84,4	8,7	148,3
34)	Харьков	10,1	66,1	18,4	121,0
35)	Челябинск	6,7	62,1	13,3	122,8

1 In this and the following tables, data are presented by cities, including city settlements subordinate to the city soviet.

Key to Table 1:

1. Number of physicians, all specialties
2. Number of mid-level medical personnel
3. Thousand
4. Per 10,000 of the population
5. USSR
6. By City
7. Alma-Ata
8. Ashkhabad
9. Baku
10. Vilnius
11. Gorkiy
12. Dnepropetrovsk
13. Donetsk
14. Dushanbe
15. Yerevan
16. Kazan
17. Kiev
18. Kishinev
19. Kuybyshev
20. Leningrad
21. Minsk
22. Moscow
23. Novosibirsk
24. Odessa
25. Omsk
26. Perm
27. Riga
28. Sverdlovsk
29. Tallinn
30. Tashkent
31. Tbilisi
32. Ufa
33. Frunze
34. Kharkov
35. Chelyabinsk

Table 2. Number of medical institutions and number of hospital beds at the end of 1983.

	1) Число вра- чебных уч- реждений, оказываю- щих амбу- латорно-по- ликлиничес- кую помощь	2) Число боль- ничных уч- реждений	3) Число больничных коек	
			4) тысяч	5) на 10 000 человек населения
6) СССР	37 722	23 131	3497,5	127,9
7) в том числе по городам:				
8) 7) Алма-Ата	84	49	17,5	169,2
9) 9) Ашхабад	32	19	5,6	160,6
10) 10) Баку	211	91	21,6	131,5
11) 11) Вильнюс	31	20	9,8	184,2
12) 12) Горький	127	69	20,3	146,2
13) 13) Днепропетровск	108	43	16,6	146,0
14) 14) Донецк	63	49	17,8	167,9
15) 15) Душанбе	67	26	7,7	140,8
16) 16) Ереван	115	41	11,1	100,1
17) 17) Казань	105	56	15,9	153,7
18) 18) Киев	210	92	33,2	138,9
19) 19) Кишинев	94	29	9,7	161,5
20) 20) Куйбышев	112	62	16,9	135,6
21) 21) Ленинград	475	139	56,8	118,1
22) 22) Минск	116	33	18,6	127,5
23) 23) Москва	939	232	115,9	137,0
24) 24) Новосибирск	121	64	20,2	146,4
25) 25) Одесса	103	43	13,9	127,1
26) 26) Омск	96	54	16,8	153,3
27) 27) Пермь	60	46	15,5	148,3
28) 28) Рига	67	34	14,1	162,5
29) 29) Свердловск	81	61	21,2	165,1
30) 30) Таллин	41	22	6,7	147,3
31) 31) Ташкент	238	88	29,8	151,4
32) 32) Тбилиси	172	58	16,1	141,9
33) 33) Уфа	69	40	17,1	163,3
34) 34) Фрунзе	61	27	10,3	177,4
35) 35) Харьков	114	64	21,5	141,0
36) 36) Челябинск	71	50	16,3	150,4

Key:

1. Number of medical institutions with ambulatory-polyclinic services
2. Number of hospital institutions
3. Number of hospital beds
4. Thousand
5. Per 10,000 of the population
6. USSR
7. By city
8. Alma-Ata
9. Ashkhabad
10. Baku
11. Vilnius
12. Gorkiy
13. Dnepropetrovsk
14. Donetsk

Key to Table 2 (continued)

15. Dushanbe
16. Yerevan
17. Kazan
18. Kiev
19. Kishinev
20. Kuybyshev
21. Leningrad
22. Minsk
23. Moscow
24. Novosibirsk
25. Odessa
26. Omsk
27. Perm
28. Riga
29. Sverdlovsk
30. Tallinn
31. Tashkent
32. Tbilisi
33. Ufa
34. Frunze
35. Kharkov
36. Chelyabinsk

Among medical institutions rendering ambulatory-polyclinic service to the population are included all medical institutions who see patients on an out-patient basis (polyclinics, outpatient clinics [ambulatoriya], prophylactic dispensaries [dispanser], and polyclinic departments of hospital institutions, medical health points, etc.).

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CSO: 1840/182

HEALTH OF MULTI-CHILD FAMILY

Moscow ZDRAVOOKHRANENIYE ROSSIYSKOY FEDERATSII in Russian No 11, Nov 84
(manuscript received 1 Nov 83) pp 8-12

[Article by I. S. Cherepanova, Moscow]

[Text] The problems of working out an effective demographic policy, which have been raised by the 25th and 26th Congresses, are at the center of attention for Soviet scientists. An especially important question of this type is the effect of the laws of reproduction and those regulating the status of the population's health.

One of the contemporary and urgent problems in Soviet demography is the study of the widespread phenomenon, caused by the lowering of the birth rate, of families with a small number of children.

More than half of all children born in the RSFSR are first-born children, less than one third are second-born and only about one tenth are in third or a higher place in the birth order. Considering that about 10 percent of marriages are childless either because of primary or secondary sterility or out of a conscious desire not to have children, the problem of the low birth rate, especially in the central oblasts of the Russian Federation, becomes extremely urgent, demanding close attention from agencies and institutions concerned with health care, scientists and the medical community.¹

The social and medical aspects of the multi-child family are discussed only in a few papers.^{2,4,6} We found neither studies devoted in particular to the study of the state of health of parents of multi-child families and the characteristics of child development in such families nor reports which analyzed the measures and medical care provided to multi-child families. There has been no study of problems of organizing dispensary observation of children from such families. No one has undertaken to publish a comprehensive sociomedical analysis of the characteristic conditions under which children in such families live and are brought up.

Accordingly, we carried out a comprehensive sociomedical investigation of multi-child families whose purpose it was to develop medicosocial methodological recommendations for improving therapeutic and prophylactic care given to multi-child families.

The family unit studied was that with three and more children. On the basis of characteristics of regions with a low birth rate, including Moscow, we followed the suggestion of L. I. Bel'skaya to consider a family with three children to be a multi-child family.

The methodological foundation of the sociomedical study of the multi-child family was the principle of multi-stage selection.

The statistical group of multi-child families in four Moscow rayons, selected in Stage 1 of the study for observation by 17 pediatric polyclinics, was made up of 1627 families. The polyclinics were selected by the criterion of availability of specialized medical care and maintenance of medical documentation with the required thoroughness.

Observation of each family was to produce a detailed sociomedical description to yield data on the features of the multi-child family in its organization and living conditions. In the second stage of the investigation a survey was made of 400 full multi-child families, those with not less than four children.

According to the sociomedical analysis of multichild families surveyed in Stage 1, families with three children constituted 69.3 percent of the group, with four--17.1 percent and with five and more--13.6 percent.

In 40.3 percent of multi-child families there were children of preschool age (including children up to one year old in 8.5 percent) and in 50.7 percent of these families, school-age and adolescent children.

The families were distributed according to type as follows: complete families made up 79.9 percent of the group and incomplete families (in which one parent is lacking or the children are raised by a guardian)--9.22 percent, with families in which the parents had remarried making up 10.9 percent.

The complete families were distributed as follows: simple nuclear families (parents + children) constituted 94.3 percent; large traditional families (nuclear family + grandmother and grandfather or one of these) made up 4.9 percent and nuclear families with other relatives--0.5 percent, while 0.3 percent of the group consisted of four-generation families (large traditional family + grandchildren of the nuclear family).

Among the incomplete multi-child families the great majority consisted of maternal families (mother and children), making up 87.9 percent of the group; paternal families made up 8.7 percent, while 3.4 percent consisted of families headed by a guardian.

Family age is a significant sociomedical indicator for determining the family's stage of development. The average of 45.3 percent of multi-child families was 13.8 years; that of 42.4 percent was 17.4 years and that of 12.3 percent was 29.8 years.

In addition, the families differ according to the maturational stage of their type and structure. Here those families are to be singled out that have special medicosocial needs and require greater medical attention, the so-called high-priority families. They include some multi-child families. In planning the health-improvement programs of various sociomedical services and dispensary care by physicians of different specialties this is a necessary distinction.³

The average number of births throughout the formation of the family is the most significant result of the family's reproductive function. Among the multi-child families studied there were families with up to 12 children. The average number of children per family was 3.4.

At the time of the study, the majority of fathers and mothers of multi-child families was between 30 and 39 years old.

As is well known, the formation of the family is the most crucial period in the family's life cycle. Age at marriage is among the variables characterizing the formation of families, or the growth of the family nucleus. Thus, a general nationwide tendency toward a lower age in marrying has a positive effect on how early the first, second and later children are born, as the present study confirms. Additionally, interpretation of data on the age at which marriage takes place has identified some special features of husbands and wives who will produce multi-child families: the majority has married by age 24 (56.6 percent of fathers and 82.5% of mothers).

Data from a number of studies on the effect of female educational level on the number of children in the family show a linear negative correlation between female educational level and number of children per family. In selective study of multi-child families, parents were found to have a relatively high level of education. Two thirds of them had achieved secondary general, secondary specialized and secondary technical as well as incomplete and complete higher education. Mothers predominated in the group with general, specialized and technical secondary education, while fathers predominated in the higher-education groups (secondary: 58.5 percent of mothers vs. 51.8 percent of fathers; higher: 23.5 percent of fathers vs. 15.9% of mothers).

In the multi-child families studied workers constituted the largest segment both of mothers and fathers (42.3 and 61.5 percent respectively). The second occupational group in size, specialized employees, was composed of 30.4 percent of the fathers and 23.7 percent of the mothers; in the nonspecialized-employee group there were more mothers than fathers (17.1 and 7.5 percent respectively). Among mothers of multi-child families, 11.8 percent were housewives and 4.8 percent worked at home.

Family maturational stage (extension from the birth of the first child to that of the last) is determined by reproductive behavior. The total years duration of married life of the study couples was 6023. There were 451.6

pregnancies, 326.2 births and 111.7 abortions respectively, per thousand years of marriage. In the multi-child families there were 6.8 pregnancies per mother, of these the outcome was 4.9 births, 1.6 abortions and 0.3 miscarriages.

The most intensive childbearing period was the first 10 years of marriage, during which 1685, or 86 percent, of the total births (1960) occurred. In the third half-decade of marriage, only 10.5 percent of all the births took place (2.6 and 0.9 percent respectively occurred in the fourth and fifth half-decades).

In the initial five years of marriage study families produced 98.6 percent of first-born children, 83.6 percent of second, 39.7 percent of third, 12.5 percent of fourth and 3.9 percent of fifth children. In the tenth year of marriage 85.4 percent of the families had 4 children, 66.5 percent had 5 and 35.4 percent had 6 and more children.

Regardless of their age at marriage or the number of children per multi-child family, 40.9 percent of mothers bore children at one to two-year intervals. Among all children in the study families, 75 percent of the first-born were produced in the first year of marriage, 19.9 percent in the second and 2.8 percent in the third.

Contraception, an important determinative factor, was not used by 43 percent of the couples. Interestingly, the overwhelming majority of these couples did not consider it necessary to use any contraceptive methods. The husbands' and wives' educational level did not influence this attitude.

Thus, the regularity of births in multi-child families is determined by early marriage, the mother's age at parturition and short intervals before the first child and between births. In addition, several socio-biological factors mentioned above (induced abortions, intervals between pregnancies and births etc.) affect the course and outcome of pregnancies and births and often have a negative effect on maternal and child health.

At the present time, the health of children is an important social and medical problem.

Our data on pediatric disorders and the results of specialized prophylactic surveys have helped identify the developmental features, structure and rate and dynamics of illness in 1350 children up to age 14 in multi-child families, the total disease rate for which group was 3678.0 per thousand in the first year of life. Data analysis showed that illness tended to occur more frequently in the second year of life, at a rate of 3948.5 per thousand. This indicator was lower in the third year of life (3536.5 per thousand) than the first and second years. It would be interesting to establish the

correlation between total incidence rate of pediatric disorders and place in the birth order per thousand children of corresponding ages.

As B. Mamatkulov⁵ states in a study of the relation between the incidence of disease in the first three years of life to the number of children in Uzbek multi-child families, the lowest rate of illness is found in children born fourth or more in order. However, his data agree with ours in that third children show a lower rate of illness. The incidence rate of disorders begins to increase as the order of birth progresses. The total rate in the first year of life for first-born (3655.4 per thousand) and second-born children (3489.1) is higher than that for third-born children (3451.7); in fourth-born and successive groups this indicator rises (3782.4 and 4011.3 respectively).

The study of distribution of children according to frequency of illness is one of the basic indicators in assessing their health.

In the first year of life children from multi-child families have a 7.5 percent health index; 43.4 percent have episodic and 49.1 percent have frequent illnesses. Thus, more than half the children in multi-child families had four or more illnesses in the first year of life.

At ages one to six years, the percentage of children suffering no illness increases to 26.5, that with frequent disease falls to 19.3 and the percentage having episodic disorders is 54.2.

The higher a child's age, the less likelihood of illness during a given year. Thus, at ages 7-14 the health index is 30 percent. At this age over one third of children (35.8 percent) suffer episodic illness and 34.2 percent have four and more illnesses.

On the whole the incidence rate of disease among first-born children and the children who are high in the birth order unquestionably affects the total disease rate.

To obtain more complete information on the health status of children and for a comprehensive assessment of each child's condition, we used dynamic observation of families over two years during which they were visited numerous times. The study children underwent a special program which we worked out in conjunction with the Chair of Hospital Pediatrics, Second Moscow Medical Institute, including an evaluation of the child's health status according to the following criteria: early ontogenesis, degree of resistance, level of compatibility of physical and neuropsychological development, functional state of the organism, occurrence or non-occurrence of chronic illness and

the effect of sociobiological and sociomedical factors. This evaluation showed that 61.6 percent of children from multi-child families are "high-priority", requiring differentiated observation and therapeutic and prophylactic care in polyclinics.

The state of parental health unquestionably influences the status of child health besides being one of the factors in the birth rate. In connection with the above the distribution of chronic illness among parents of multi-child families was studied using data from the family study. The rate was 17.6 percent; it was higher in mothers than fathers (10.9 and 6.7 percent respectively), as a consequence of the increased physical and neuropsychological demand placed on the mother by multiple parturition, child-rearing and homemaking.

In connection with parameters characterizing health status, parents and other members of multi-child families were divided into three groups. The first group consisted of healthy subjects, all adult members of the family who did not seek medical help or report sickdays at work over two to three years (sickdays resulting from the care of sick children were not counted); there were no chronically ill persons in this group. A second group comprised those family members who were almost completely healthy, that is, who sought medical help no more frequently than once a year, whether or not functional deviations from the norm were present. This group likewise included no chronically ill persons. The third group comprised: Subgroup A, parents and other adult family members, including the compensated chronically ill, who sought medical help each year at an average rate of three times per person and Subgroup B, consisting of parents and other adult family members who sought medical help four and more times annually. This subgroup included the chronically ill in subcompensation and decompensation stages and the invalids of all groups.

In assessing the sociomedical features of the multi-child family comprehensively, fundamental factors were taken into account which described the health status of all family members as a function of age. The following picture of family health emerged: healthy families--22.7 percent, families with infrequent illness--23.5 percent, the high risk group (those suffering illness at a moderate rate)--37.4 percent and the frequently ill--16.4 percent. Thus, comprehensive sociomedical evaluation of the health status of multi-child families assigned 53.8 percent of families to the highest-risk groups.

In connection with the parameters of sociomedical research on the family (demographic, social, medical and biological, material and living conditions, cultural level, psychological factors and special traits of the disease rate among others) and in association with the comprehensive evaluation of the

health of children, parents and the family as a whole, it is vital to identify multi-child families as a group requiring differentiated dispensary observation.

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1840/1746

BRIEF

CEMA CONFERENCE CONVENES--The conference of specialists and representatives of CEMA [Council for Mutual Economic Aid] member-countries, PRB, HPR, GDR, PPR, CSSR and USSR, has been concluded, in which they presented goals of scientific research on the problems of "studying the influence of the chemical factor of production environment on workers' health and creating safety standards for work".

The conference unified PDK values [Maximum Permissible Levels] for ten chemical compounds. Participants coordinated several methodical approaches to conducting toxicological and epidemiological studies for hygienic norm setting. It was proposed to review the draft of the perspective plan of collaborations for 1985-1990, and to develop themes containing priority directions of research. [By I. Fetisenko] [Text] [Moscow MEDITSINSKAYA GAZETA in Russian 14 Dec 84 p 2] 12473

LIVING AND WORKING ALONG BAIKAL-AMUR RAILWAY

Moscow MEDITSINSKAYA GAZETA in Russian 5 Dec 84 p 1

SIBILEV, V. M., chief, Main Medical and Sanitary Administration, USSR Railway Ministry

[Abstract] The medical service of the Baikal-Amur Railways serves not only the railway personnel and construction crews, but has also acquired importance for the new and established settlers along its tracks. At the present stage of development much of the medical service is undergoing re-evaluation and consolidation into a more efficient operation. However, more often than not the lag time for the construction of new health facilities is too long. In addition, the scope of medical services that are being offered must be significantly expanded to encompass all medical specialties, including pediatric services and clinics. Despite an overall decrease in the morbidity of the work force, that of the medical personnel remains higher than the average. This is due to prolonged exposures and inadequately heated mobile or stationary health facilities, as well as the shocking fact that in many cases the medical personnel are not provided with special protective clothing supplied to other workers. With the increasing urgency with which the Far East and Siberia are being developed, increasing attention has to be accorded to the health of people who will settle and work there.

[1689-12172]

MEDICAL SERVICE FOR BAIKAL-AMUR RAILWAY

Moscow MEDITSINSKAYA GAZETA in Russian 14 Dec 84 p 3

YEVSIKOVA, I., MEDITSINSKAYA GAZETA correspondent in Tynda

[Abstract] Medical problems pertaining to the Baikal-Amur Railway were the topics of discussion at a conference in Tynda, jointly organized by the Coordination Council of the USSR Academy of Medical Sciences and the RSFSR Ministry of Health. More than 150 talks and reports were presented on the health problems and medical services along the Baikal-Amur Railway, both from the practical-clinical and theoretical viewpoints. At the present time, over fifty medical institutes and establishments are involved in assessing the health problems unique to the Far North, Far East and Siberia. Particular attention

is accorded to devising screening methods for the selection of workers suitable for the harsh climatic conditions of these regions and to health maintenance of personnel already employed in those regions. The institution of annual mass screening and the development of a network of strategically located health facilities are of particular importance in the health plans. Equal weight is now being given to the importance of efficient data collection and the need for the creation of computerized data banks to provide easy access to vital medical statistics along the Baikal-Amur Railway.
[1695-12172]

SUBSTANCE ABUSE EXPERTS IN NOVOSIBIRSK

Moscow MEDITSINSKAYA GAZETA in Russian 7 Dec 84 p 4

TUCHIN, B., Physician, Novosibirsk

[Abstract] The success of the substance abuse program at the Sibtekstil'mash plant in Novosibirsk is due largely to the personnel and the understanding administrators. Since 1978 the program has been headed by A. V. Yudina, ably assisted by the young feldsher G. A. Omel'chenko, who exhibited the type of personal characteristics and concern for the work environment that cannot help but assure success. The educational and supportive efforts of the staff, particularly in the prevention of alcoholism, receive strong moral and practical support from key individuals at various medical establishments in Novosibirsk. Equally important are the efforts of former alcoholics in instilling in their fellow workers a sense of social responsibility and work ethic. As underlined by V. V. Fedorchuk, USSR Minister of Internal Affairs, close cooperation between his ministry and the USSR Ministry of Health is a prerequisite for a successful anti-alcoholism campaign. Unfortunately, problems are encountered by the various drug and substance control programs in the form of inadequate facilities and limited support from local authorities. On the whole, however, the substance abuse programs in Novosibirsk have received recognition from all those concerned with work discipline and ethics.
[1693-12172]

ADVANCES IN PUBLIC HEALTH IN UKRAINE

Kiev PRAVDA UKRAINY in Russian 5 Feb 85 p 2

LEVASHOVA, S.

[Abstract] With the 11th Five Year Plan in its final year, an interview with A. Ye. Romanenko, Minister of Health of the Ukrainian SSR, summarized some of the advances made in health care in the Ukraine in recent years. In 1984, for example, new hospitals were opened up with a capacity of 11,000 beds, which exceeded by 3,000 beds the figure that had been set by the planning agencies. Further efforts are being expended on providing the hospitals and clinics with the most modern medical technologies, as well as on improving the qualifications of the medical personnel. In the past year, some 23,525 physicians

and 8962 medical assistants received various forms of advanced training at the three Ukrainian institutes for the advanced training of physicians and 8 faculties at medical institutes specializing in that form of educational endeavors. In addition, periodic health examinations [dispensarization] have been put into effect in every urban and rural area, and the medical personnel in the latter regions are being complemented by additional specialists. The various medical establishments are actively involved in both basic and clinical research. A kidney transplant program has already been started in Kiev, and in the 1985-1986 period that program will be expanded to L'vov, Donetsk and Dnepropetrovsk.
[1739-12172]

SOCIOPSYCHOLOGICAL ASPECTS OF BIRTH RATE

Moscow PSIKHOLOGICHESKIY ZHURNAL in Russian Vol 5, No 6, Nov-Dec 84
(manuscript received 26 Oct 81) pp 55-61

BOYKO, V. V., Higher Trade Union School of Culture, Leningrad

[Abstract] Sociopsychological aspects of birthrate underlie demographic politics, which are directed at controlling a given population. The sociopsychological aspects of propaganda are the key means by which birthrate can be regulated. The motivation underlying such goal-directed propaganda represents the desires and interests of the majority in a society in determining the reproductive policy. In addition, the psychological tactics utilized in the propaganda are, or should be, designed to demonstrate the concordance of social and individual needs and objectives. The key role of a social and psychological approach to birthrate and reproductive planning lies in understanding the target population and instilling in them a sense of social responsibility. Successful application of these principles demands tactfulness, cooperation, and steadiness of purpose in demonstrating the need to achieve socially acceptable goals in family planning. References 19: 1 Czech, 9 Russian, 9 Western.
[252-12172]

PREVENTIVE YEARLY PHYSICAL EXAMINATIONS IN NOVOSIBIRSK

Moscow MEDITSINSKAYA GAZETA in Russian 11 Jan 85 p 2

BRAYLOVSKIY, I., candidate of medical sciences, Honored Physician of the RSFSR, chief physician of No 1 City Hospital, Novosibirsk

[Abstract] With the implementation of the periodic health examination program [dispensarization] in the USSR, primary responsibility has fallen on preventive medicine in health maintenance. At the No 1 City Hospital in Novosibirsk the responsibility for periodic health examination, follow-up, and maintenance of vital medical statistics has been assigned to the three preventive medicine polyclinics. It is their responsibility to coordinate diagnosis and treatment

and make the appropriate referrals to specialists. The medical personnel has been alerted to this new approach to health care via a series of lectures and seminars. In addition to the positive aspects of this program, measures have also been taken to deal with increased workload, demand for bed space, and an increasing reliance on laboratory medicine. Much help in this direction could be obtained by assigning medical students to serve as ancillary medical workers during their third 'work' semester. Unfortunately, the local authorities generally assign them to work as painters, bakers, plasterers, etc., rather than place them in a position where they would benefit more and be of greater service to society.
[1759-12172]

UDC 615.38:008(470)

PROSPECTS OF DEVELOPING RSFSR BLOOD SERVICE

Moscow ZDRAVOOKHRANENIYE ROSSIYSKOY FEDERATSII in Russian No 11, Nov 84
(manuscript received 19 Feb 84) pp 3-8

SHABALIN, V. N. and YEROFEYEV, I. A., Leningrad Scientific Research Institute of Hematology and Blood Transfusion, RSFSR Ministry of Health

[Abstract] Problems related to provision of preserved donor blood, blood components and preparations to medical institutions in the RSFSR are discussed and problems of organization of transfusion therapy described. The present status of development of transfusion technology and the blood service is described and discussed. The need to improve existing methods of blood fractionation within the next few years in order to use 50 percent to 60 percent of the protein in donor blood is emphasized. While 15 basic blood plasma preparations are now being issued by the service, it is technologically possible to produce up to 40 biologically active preparations for different purposes. Greater production and higher productivity must come from improved technology and more research. There must be a unified complex program of blood service activity, a balanced relationship between the volume and nature of production processes and further improvement of the unified technological regulation of production of blood components in order to ensure total use of donor blood. The need for closer communication and closer cooperation between the blood service and the hospital network in order to increase the efficiency of use of blood components is emphasized.
[1745-2791]

REFUSALS OF HOSPITAL ADMISSIONS AND THEIR CAUSES

Moscow ZDRAVOOKHRANENIYE ROSSIYSKOY FEDERATSII in Russian No 11, Nov 84
(manuscript received 21 Jun 84) pp 15-19

DMITRIYEV, V. I. and NIKOL'SKIY, A. V., Republic Scientific Research Laboratory of Medical Demography (director-professor M. S. Bednyy), RSFSR Ministry of Health.

[Abstract] Results of a study of reasons for refusal of hospital admission, based on comparison of data of a sociological study and a sampling of primary medical documentation, are presented and discussed. Basic causes of refusal of hospital admission included: disease did not require hospitalization, patient refused to be hospitalized, patient was referred to the wrong area and no hospital bed was available. Definite differences in rates of hospitalization in different areas were illustrated and discussed on the example of primary medical documentation from Stavropol' Kray and Kostroma Oblast. The percentages for each cause of refusal of hospital admission in these regions are presented and discussed. Causes of refusal of hospital admission as a function of age showed the highest percentage of refusals among persons up to the age of 20 years and those over the age of 40 years. Comparison of causes of refusal of hospital admission in urban and rural areas as a function of the age of persons involved is presented and discussed. Recommendations for improving hospital admissions and reducing refusals of admission are presented and discussed.

[1745-2791]

UDC 614.88:008

SOME PROBLEMS OF IMPROVEMENT OF FIRST AID AND EMERGENCY MEDICAL AID

Moscow ZDRAVOOKHRANENIYE ROSSIYSKOY FEDERATSII in Russian No 11, Nov 84
(manuscript received 5 Dec 83) pp 22-24

KAVERIN, N. M. and YELKIN, P. A., (Moscow)

[Abstract] Analysis of operation of Moscow first aid and emergency medical aid stations was used to propose measures for its improvement. A scheme of collection, accumulation and processing information concerning patients hospitalized in Moscow hospitals was diagrammed, described and discussed. Use of this plan makes it possible to improve the efficiency of the Moscow first aid and emergency medical aid service. Implementation of this procedure for centralizing and automating the Moscow emergency medical service is improving the present operation of this service and this procedure will become one of the basic links of the Emergency Medical Assistance automatic control system now being developed. Figure 1.

[1745-2791]

DISCUSSION OF JUSTIFICATION OF VISITS OF MEDICAL BRIGADES TO RURAL REGIONS

Moscow MEDITSINSKAYA GAZETA in Russian 4 Jan 85 p 2

MELKONYAN, M., Medical Gazette Correspondent, Azerbaijan SSR

[Abstract] Advantages and disadvantages of provision of medical assistance in rural areas of Azerbaijan by consulting physicians from Baku are described and discussed. Planned visits to these areas provide vital service, especially to children and workers in remote areas. Use of specialized, well-equipped mobile medical offices have improved this service greatly. A model of a mobile diagnostic laboratory, staffed by a cardiologist and a functional diagnosis specialist, developed by the Azerbaijan Ministry of Health Scientific Research Institute of Cardiology and the All-Union Cardiological Scientific Center will be quite useful in providing medical care in these areas. Some visits of medical brigades to these rural areas were said to have little medical usefulness and to be economically inadvisable. These include the presence of consulting physicians at harvesting operations and some aspects of helicopter medical services. A great need for improved telephone communications to improve rural medical service is emphasized.
[1750-2791]

ACCESSIBILITY OF POLYCLINICS

Moscow MEDITSINSKAYA GAZETA in Russian 5 Dec 84 p 1

[Abstract] MEDITSINSKAYA GAZETA correspondents in a number of cities--Chelyabinsk, Kuybyshev, Moscow, Tashkent, Krasnodar and Yerevan--tested the accessibility of the medical services to the populace-at-large by phoning and attempting to make an appointment to see a physician or to arrange for a home visit by a physician from a polyclinic. To say the least, the results were generally discouraging, with the respondents making excuses for not being able to make a home visit or for not accepting one more patient for a variety of reasons (working overtime, home too far, staff shortage, etc.). The experience of the correspondents indicated that the work habits and practices of the polyclinics should undergo careful scrutiny for adherence to standard norms of medical practice, particularly when dealing with the ambulatory services of many polyclinics. Telephone operators should be trained in appropriate telephone manners and instructed to refrain from an unsympathetic and a perfunctory attitude.
[1690-12172]

NEONATAL HEALTH CARE

Moscow SOVETSKOYE ZDRAVOOKHRANENIYE in Russian No 2, Feb 85
(manuscript received 5 Apr 84) pp 19-24

AKHMETOVA, G. Kh., candidate of medical sciences, deputy minister, Kazakh SSR Ministry of Health

[Abstract] In line with the concerns of the party and the government for the health and welfare of children, the maternal and neonatal services in Kazakhstan have been considerably improved. In addition, it is anticipated that prior to the conclusion of the present Five-Year Plan an additional 1700 beds will be added to the pediatric hospitals, and 900 to the maternity hospitals. This will complement beds in ten pediatric hospitals that have already been constructed in recent years and which added 2185 beds to those reserved for children, and in 8 maternity hospitals with a total of 2835 beds. Particular efforts, however, have been made in neonatology and in other spheres pertaining to infant health. Clinical care will be complemented by more extensive educational measures for the parents, and a new system of radio and television programs has been devised to inform parents about month-by-month child development during the first year of life. These measures will go a long way in meeting the concern for child health embodied in the decisions of the 26th CPSU Congress.

[1762-12172]

UDC 616.12-008.331.1-08-036.8-003.1

COST EFFECTIVENESS OF TREATMENT OF ARTERIAL HYPERTENSION PATIENTS

Moscow SOVETSKOYE ZDRAVOOKHRANENIYE in Russian No 2, Feb 85
(manuscript received 18 Jul 84) pp 24-27

TULEPBAYEV, M. Zh., ADIBAYEV, O. A., SATBEKOV, Zh. S., AKANOV, A. A., KAIRBEKOV, A. K., SHIPULIN, V. G. and IVANOVA, O. B., Kazakh Scientific Research Institute of Cardiology, Alma-Ata

[Abstract] Cost effectiveness studies were conducted on hypertension workers in Alma-Ata with constant clinical monitoring and drug adjustment, involving 40-54 year old males. The subjects were divided into a treatment group (140 individuals), and a group of 44 who refused treatment. Over the period 1980-1982 the financial loss to the enterprise per 100 treated workers was 5644.8 rubles in 1980, 4789.2 rubles in 1981, and 6582.5 rubles in 1982. In the group that refused treatment the financial loss per 100 untreated workers was 11485.1, 14165.7 and 33834.5 rubles for the respective year. Constant treatment and monitoring of the hypertensive workers was obviously a cost-effective measure for the enterprise, which at the end of the third year of the study was equal to 3 rubles and 31 kopecks for each ruble in expenditure on this group of workers. References 6 (Russian).

[1762-12172]

REVIEW OF BOOK BY NOVGORODTSEV, G. A., DEMCHENKOVA, G. Z. and POLONSKIY, N. M.--
DISPANSERIZATSIYA NASELENIYA V SSSR (SOSTOYANIYE I PERSPEKTIVY) [PERIODIC
PREVENTIVE HEALTH EXAMINATIONS IN THE USSR (CURRENT STATUS AND PROSPECTS)],
2ND REVISED AND ENLARGED EDITION, MOSCOW, MEDITSINA, 1984, pp 336

Moscow SOVETSKOYE ZDRAVOOKHRANENIYE in Russian No 2, Feb 85 pp 73-75

USHAKOV, G. N., Moscow, reviewer

[Abstract] With the implementation of a program of annual health examinations in the USSR, the authors of this book present an authoritative analysis of periodic health examinations ["dispensarization"] within the context of a country with developed socialism. The monograph contains a preface, an introduction, and four chapters. Chapter one, Periodic Health Examination of Various Groups in the Population, concentrates on preventive medicine as applied to the industrial setting, taking into consideration the anticipated decrease in the natural gain in productive resources. The second chapter, The Role of Ambulatory and Polyclinic Facilities in Periodic Health Examinations, deals with the methodological and organizational aspects of annual health examinations. This chapter is particularly relevant since most of the examinations are conducted within the walls of polyclinics. The third chapter, entitled "A System of Dynamic Monitoring", is perhaps the most important chapter since it covers clinical monitoring and follow-up of individuals identified as being at risk and with a diagnosis of pathology. The last chapter, "Prospects in the Development of Periodic Health Examinations--an Object of a Programmed Approach", covers the need for an extensive information network in the management of this program. Despite its many fine points, the book neglects to treat the cost effectiveness of annual health examinations, and the role of hospitals.

[1762-12172]

ADVANCES IN MATERNAL AND CHILD CARE

Kiev PRAVDA UKRAINY in Russian 22 Feb 85 p 4

VILENSKIY, YU., Chernigov

[Abstract] A true manifestation of the concern of the Communist Party of Ukraine for the welfare of the people is cited as the construction of a new 3,000,000 ruble, maternity hospital in Chernigov. It was the brainchild of the chief physician, Sergey Il'ich Bogdan, and was constructed through the efforts of people who volunteered their Saturdays to this effort--they worked, without pay to finance the project. The hospital is staffed by highly-qualified specialists and enjoys the latest in medical technology. It even has provisions for mud baths. The care rendered at the hospital has received widest recognition and, for their excellence, the staff has been twice awarded diploma citations by the USSR Ministry of Health and the Central Committee of the Union of Medical Workers.

[1765-12172]

PSYCHOLOGY

DEVELOPMENT OF SOVIET PSYCHOLOGY AND TASKS OF PSYCHOLOGICAL SERVICES

Moscow PSIKHOLOGICHESKIY ZHURNAL in Russian Vol 5, No 6, Nov-Dec 84 pp 3-20

ZABRODIN, Yu. M., doctor of psychological sciences, deputy director of the Institute of Psychology, USSR Academy of Sciences

[Abstract] The First All-Union Conference on Problems of Psychological Services held in Moscow in 1984, addressed the application of psychological expertise to practical problems and the administration of such services. At the present time, the full potential of psychology is not realized in the USSR, despite the fact that the USSR has three faculties of psychology, eight departments, and annually graduates about 700 psychologists. Soviet efforts in psychology are too concentrated on the theoretical, and lag behind other countries in the practical application of the science. In addition, the number of psychologists on a population basis in the USSR is two-fold lower than, for example, in Great Britain and Italy, and at least thirty-fold lower than in the USA. These numbers indicate that despite the considerable advances made in Soviet psychology over the past two decades, much remains to be accomplished to utilize psychology to the fullest extent. The complexity of modern society demands greater emphasis on applied psychology in such fields as medicine, industry, agriculture and other special environments, such as outer space exploration. A more extensive network of services must be established in the areas of adult and pediatric clinical psychology, and in educational psychology and social psychology.

[252-12172]

COMPLEMENTARITY PRINCIPLE IN DESCRIPTION OF MENTAL PROCESSES

Moscow PRIRODA in Russian No 2, Feb 85 pp 94-101

FEYGENBERG, I. M., professor, doctor of medical sciences, Central Institute for the Advanced Training of Physicians

[Abstract] A theoretical discussion is provided for the implementation of the principle of complementarity in psychology, in analogy to the formulation devised by Bohr for quantum mechanics in 1927. In quantum mechanics, the principle finds appreciation in the recognition that nature has complementary aspects; for example, the particle and wave nature of light, and that a mathematical equation relates the two. The application of this principle to

psychology involves the recognition that seemingly contradictory results of psychological tests and experiments reflect simply different ways of looking at problems and in analyzing the results. For a full appreciation and understanding, complementarity has to be applied, i.e., different conditions will yield different results, but the results complement each other to give a holistic picture. This approach is at odds with those who would seek 'objectivity' in psychology by concentrating on one approach, while neglecting complementary data obtained by other investigative techniques. Figures 2; references 12: 10 Russian, 2 Western.

[1761-12172]

UDC 577.123.3:577.346

BRAIN LEVELS OF CYCLIC NUCLEOTIDES IN RATS IN INITIAL STAGES OF ACUTE RADIATION SICKNESS

Kiev DOKLADY AKADEMII NAUK UKRAINSKOY SSR. SERIYA B: GEOLOGICHESKIYE, KHIMICHESKIYE I BIOLOGICHESKIYE NAUKI in Russian No 11, Nov 84
(manuscript received 3 Feb 84) pp 82-84

SKOPENKO, Ye. V., BRATUS', N. I., VASIL'YEV, A. N., PARKHOMETS, T. I. and KUCHERENKO, N. Ye., Kiev State University imeni T. H. Shevchenko

[Abstract] Brain levels of cAMP and cGMP were studied in the gray matter of rat brains following whole-body x-irradiation with a 0.21 coulomb/kg dose. Determinations of the cAMP/cGMP ratios in control and irradiated rats showed a sharp increase of the ratio in the control animals within a minute of cellular depolarization with 60 mM KCl, with a return to baseline level in 3-10 min, whereas in the experimental animals depolarization elicited a more moderate and slower rise with a maximum in 2-3 min. These differences in the cyclic nucleotides were due to a greater adenylate cyclase/guanylate cyclase ratio in the control animals, as well as greater phosphodiesterase activity in the control animals within the first minute following depolarization. These observations underscore the significant alterations that occur in the brain within 1 h of irradiation with respect to nucleotide metabolism. Figures 1; references 14: 10 Russian, 4 Western.
[1658-12172]

UDC 612.337.1.014.482

EFFECTS OF FOOD INTAKE ON WEIGHT AND LENGTH OF SMALL INTESTINE IN IRRADIATED ALBINO RATS

Moscow VOPROSY PITANIYA in Russian No 1, Jan-Feb 85
(manuscript received 7 Apr 83) pp 44-45

KUKEL', Yu. P., Moscow

[Abstract] The length and weight of the small intestine were studied in outbred albino rats in relation to starvation, satiation, and gamma irradiation (500 or 1000 R). Radiation was found not to alter the weight and length parameters between starved and satiated animals. However, the length in animals who succumbed 3 days after irradiation was 1.29-fold shorter than in

unirradiated controls, while in animals that died on the 4th day the length was somewhat greater. In addition, animals that died from 500 R irradiation presented with 1.38-fold greater weight of the small intestine than seen in control animals, while animals dying from 1000 R irradiation showed a loss in intestinal weight. The length of the small intestine in animals dying from bone marrow failure after irradiation was 1.26-times greater than in unirradiated control rats. These observations suggest that simple physical determination of small intestine parameters may be an indicator that is useful in assessing effectiveness of radioprotectors. References 10: 6 Russian, 4 Western.
[1753-12172]

VIROLOGY

WORK IN HERPES PREVENTION AND TREATMENT METHODS

Moscow MEDITSINSKAYA GAZETA in Russian 23 Jan 85 p 3

[Article by Terekhov, A.]

[Abstract] This lengthy article discusses work on the development of herpes virus vaccines and new methods for the treatment of herpes disease. The work has been in progress for 20 years. Organizations and individuals that took part in it are identified.

Basic research was done by scientists of the Institute of Virology imeni Ivanovskiy of the USSR Academy of Medical Sciences (AMN SSSR). The work was headed by V. M. Zhdanov, member of AMN SSSR. The scientists' work led to the development of a vaccine which heightens general and local immunity to herpes virus, according to Professor I. F. Barinskiy, a member of the group. Scientists of the Central Dermatovenerologic Scientific Research Institute, the Moscow Scientific Research Institute of Eye Diseases imeni Gel'mgol'ts, the Moscow Medical Institute No. 1 imeni Sechenov, the All-Union Chemical-Pharmaceutical Scientific Research Institute imeni Ordzhonikidze, and the Uzbek Academy of Sciences' Institute of Bioorganic Chemistry took part in the development and testing of new treatment methods and medicines. New medicines were produced at the Odessa Enterprise for the Production of Bacterial Preparations, and the "Organika" Production Association.

In conclusion, mention is made of new facilities which have been created for the more effective treatment of herpes and for coordination of scientific research in this field. They include an All-Union Herpes Center, which has been established at the virology institute by the USSR Ministry of Health.

FTD/SNAP

CSO: 1840/1782

SPLITTING OF MOUSE rRNAs BY ENDONUCLEASES ASSOCIATED WITH NEWCASTLE DISEASE VIRUS

Bratislava ACTA VIROLOGICA in Russian Vol 28, No 5, Sep 84
(manuscript received 16 Jan 84) pp 353-361

ROSENBERGOVA, M., Institute of Virology, Slovak Academy of Sciences,
Bratislava, Czechoslovakia

[Abstract] Polyacrylamide gel electrophoresis was used to analyze the degradation products obtained by subjecting rRNA derived from mouse ascitic cells to endonucleases associated with Newcastle Disease virus. Treatment of the purified 28S and 18S rRNA from Ehrlich cells with the virus isolated from allantoic fluid of infected chick embryos showed that the former rRNA species was reduced to 1.7×10^5 MW fragments, which were resistant to further endonuclease attack. The 18S rRNA was degraded to much smaller fragments. These observations indicate that 28S rRNA contains relatively large nucleotide segments that are highly resistant to the virus-associated endonuclease, and that these resistant fragments account for about 10% of all the degradation products. Figures 6; references 19: 1 Russian, 18 Western.
[1763-12172]

TS MUTATIONS IN COLD-ADAPTED VARIANTS OF HUMAN INFLUENZA A/KRASNODAR/101/59 (H2N2) VIRUS IN TISSUE CULTURE AND THEIR REPRODUCTION IN HAMSTER LUNGS

Bratislava ACTA VIROLOGICA in Russian Vol 28, No 5, Sep 84
(manuscript received 20 Jan 84) pp 369-379

PANZIG, B., DOHNER, L., LISOVSKAYA*, K. V. and GENDON*, Yu. Z., Institute for Medical Microbiology and Epidemiology, Ernst-Moritz-Arndt University, Greifswald, GDR; *Moscow Scientific Research Institute for Viral Preparations, USSR

[Abstract] Serial passage of human influenza A/Krasnodar/101/59 (H2N2) virus in chick embryo fibroblast tissue cultures at low temperatures (28 or 27°C) eventually resulted in the isolation of several ts (temperature sensitive) and ca (cold-adapted) variants that were then propagated in hamster lungs. Since the reproduction of the various tissue culture isolates in the hamster lung was reduced by 2.5 to $4 \log_{10}$ units, it was obvious that variants with ca and ts phenotypes possess lesser pathogenicity for the lung tissue, and that they are a promising source of attenuated characteristics that may be useful in the creation of recombinant strains for live influenza vaccines. In the different isolates, the ts mutation was found located on gene 4, or genes 1,3,4,5 and 6, or on genes 1,3,4,5,6 and 7, but in no case was a ts mutation located on gene 8. Figures 1; references 15: 2 Russian, 13 Western.
[1763-12172]

HEMORRHAGIC FEVER VIRUS IN CONJUNCTION WITH RENAL SYNDROME IN SMALL RODENTS
IN CZECHOSLOVAKIA

Bratislava ACTA VIROLOGICA in Russian Vol 28, No 5, Sep 84
(manuscript received 2 Feb 84) pp 416-421

GRESIKOVA, M., RAJCANI, J., SEKEYOVA, M., BRUMMER-KORVENKONTIO*, M.,
KOZUCH, O., LABUDA, M., TUREK, R., WEISMANN, P., NOSEK**, J. and LYSY**, J.,
Institute of Virology, Slovak Academy of Sciences, Bratislava; *Chair of
Virology, Helsinki University, Helsinki, Finland; **Institute of Experimental
Biology and Ecology, Slovak Academy of Sciences, Bratislava, Czechoslovakia

[Abstract] In view of the failure of attempts at isolation of causal viruses from fatal cases of hemorrhagic fever with renal syndrome in Eastern Slovakia, a survey study was conducted on small rodents in the region as a possible reservoir. The hemorrhagic fever antigen was identified in the lungs of the following rodents in Eastern Slovakia by indirect fluorescent antibody technique: *Clethrionomys glareolus* (2 positives out of 7 samples (2/7)), *Apodemus flavicolis* (1/24), and *Apodemus agrarius* (7/66). The antiserum for the test was provided by a reconvalescent human case of Scandinavian endemic nephropathy. Intramuscular injection of positive lung homogenates into suckling rats eventually resulted in the isolation of the viral antigen from the rat lungs and demonstration of its activity in CF tests with the prototype human antiserum. These studies strongly suggest that the small rodents in Eastern Slovakia and elsewhere may serve as a natural reservoir of the hemorrhagic fever virus. Figures 3; references 15: 1 Czech, 14 Western.
[1763-12172]

SITE OF ACTION OF N,N'-BIS(METHYLISATIN-BETA-THIOSEMICARBAZONE)-2-METHYLPIPERAZINE IN REPRODUCTIVE CYCLE OF SMALLPOX VACCINE VIRUS

Bratislava ACTA VIROLOGICA in Russian Vol 28, No 5, Sep 84
(manuscript received 10 Jan 84) pp 428-432

RADA, B. and ZGORNIAK-NOWOSIELSKA, I., Institute of Virology, Slovak Academy of Sciences, Bratislava, Czechoslovakia; Department of Virology, Institute of Microbiology, Medical Academy, Krakow, Poland

[Abstract] Dose-effects studies were conducted on the effects of N,N'-bis-(methylisatin-beta-thiosemicarbazone)-2-methylpiperazine (I) on the reproduction of smallpox vaccine virus in He-La cells. Analysis of the WR strain virus yield showed that a concentration (30 μ M) of I which was nontoxic for the cells reduced the virus yield by 2.0 log₁₀ units. Analysis of the kinetics of virus formation showed that a late component or a late functional step was involved in the action of I, preceding, by 30 min, the appearance of the mature viral particle. These observations indicate that the mechanism of action of I on the reproduction of smallpox vaccine virus WR is similar or identical to the action of the unsubstituted isatin-beta-thiosemicarbazone. Figures 3; references 12: 1 Russian, 11 Western.
[1763-12172]

NEW ASPECTS OF COWPOX VIRUS BIOLOGY

Bratislava ACTA VIROLOGICA in Russian Vol 28, No 5, Sep 84
(manuscript received 9 Nov 83) pp 437-444

MARENNIKOVA, S. S., SHELUKHINA, E. M. and YEFREMOVA, Ye. V., Scientific
Research Institute of Viral Preparations, USSR Ministry of Health, Moscow

[Abstract] A review is presented largely of Western literature on the recent advances in the biology and ecology of the cowpox virus. With the eradication of the human smallpox virus, greater attention is being accorded to the cowpox virus as a potential mammalian pathogen, especially as this pertains to human cases. In particular, cases have been reported in Great Britain and Poland which appear to have been unrelated to bovine cases. Increasingly, the conviction is growing among virologists and epidemiologists that rodents may function as natural reservoirs for these viruses, and hence may account for some human cases of the disease. The route of infection may be indirect, since rodents have been demonstrated to excrete the virus with urine and feces. Consequently, it appears prudent to maintain an index of suspicion with regard to cowpox as a human pathogen. Figures 1; references 47: 12 Russian, 35 Western. [1763-12172]

CONFERENCES

UDC 616.12:061.22.053(470.311-25)

INFORMATION ON SESSIONS OF MOSCOW CITY SCIENTIFIC CARDIOLOGY SOCIETY

Moscow KARDIOLOGIYA in Russian No 12, Dec 84 pp 122-123

[Article by T. A. Ayvazyan, Moscow]

[Text] The regular plenary session of the Moscow City Scientific Cardiology Society (MGNKO) took place on 21 December 1983 at the Institute of Prophylactic Cardiology of the All-Union Cardiological Scientific Center (VKNTs), USSR Academy of Medical Sciences. Chief Supernumerary Cardiologist of Moscow B. A. Sidorenko presented a paper entitled "The Present Status and Future Development of Cardiology Services to the Moscow Public." A unified system of rendering assistance to patients with cardiovascular diseases has been organized in Moscow which includes medical first aid service, polyclinics and medical health units, hospitals, and Moscow suburban medical departments for the rehabilitation of patients who have suffered myocardial infarctions. The Municipal Cardiological Dispensary, based at the Scientific-Research Institute of First Aid imeni V. V. Sklifosovskiy has begun to operate, and the Center for EKG Teletransmission has opened. The VKNTs of the USSR Academy of Medical Sciences has been rendering considerable scientific-methodological and consultative assistance to the practice of public health in Moscow. A coordinating council for the treatment of cardiovascular diseases is facilitating the consolidation of efforts on the part of scientific and practicing institutions. Included in the working group of the council are representatives of GUZM [expansion unknown], VKNTs of the USSR Academy of Medical Sciences, and all teaching and prophylactic scientific-research institutes. The paper analyzed the cardiovascular disease mortality rate, persistent loss of work capability, and examined the basic shortcomings in rendering aid to cardiology patients, and indicated ways by which those shortcomings might be eliminated.

On 18 January 1984 V. A. Lyusov and I. Yu. Postinov presented a paper at the plenary session entitled "A New Clinical Test in the Differential Diagnosis of Arterial Hypertension and the Identification of Hereditary Predisposition to Hypertension." The paper summarized results from a study of erythrocyte membrane permeability in rats with experimental hypertension (spontaneous genetic, vasorenal, and steroid-salt hypertension), in 190 humans aged 20 to 75 years with normal arterial pressure, in 115 hypertension disease patients, in 54 patients with renogenic arterial hypertension, and in 198 laborers and white-collar personnel from one of Moscow's plants. A significant increase in erythrocyte membrane permeability in comparison to corresponding control

groups with normal arterial pressure was observed in rats with spontaneous genetic hypertension and in hypertension disease patients. No changes in sodium membrane transport were found in secondary arterial hypertension either in the animal experiment or in humans. Erythrocyte membrane permeability changes were not affected by sex, age, kidney function disturbances, or stage of hypertensive disease. The following data were obtained on the hereditary nature of sodium transport disturbance in primary arterial hypertension: Extensive erythrocyte membrane permeability disturbances for sodium, and an earlier onset of the disease was noted in hypertensive disease patients whose closest relatives suffered from arterial hypertension. Among the laborers and white-collar personnel with elevated erythrocyte membrane permeability, the frequency of arterial hypertension increased with age up to 68 percent. This index did not increase with age in persons with normal or low permeability, and was found to be 20-23 percent. Thus, erythrocyte membrane characteristics, particularly membrane permeability factors for sodium, may be used for the differential diagnosis of arterial hypertension and for identifying individuals who are predisposed to hypertensive disease.

On 15 February 1984 two papers were presented at a plenary session of the MGNKO. V. N. Zakhraov and coauthors, in the paper "The Use of Prolonged EKG Recording for the Diagnosis of Arrhythmias and for the Evaluation of Antiarrhythmia Therapy," presented the results of their examination of 330 IBS [expansion unknown] patients through the use of various methods of prolonged EKG studies which included continuous 24-hour tape recordings, prolonged intermittent recordings, and visual monitoring. A comparative analysis was made of the information obtained from these methods for recognizing arrhythmias and for evaluating the effectiveness of their treatment by Cordaron, Etmozin, Meksitil, Ritmodan, and other preparations.

Kh. Kh. Shugushev and coauthors, in their paper "Mechanisms of Action and Antiarrhythmic Activity of the New Cardiotropic Preparations--Etmozin and Etatsizin," reported on the results of a study of the electrophysiological mechanisms underlying the action of the new domestic antiarrhythmic drugs--Etmozin and Etatsizin--on the function of the sinoatrial node, the atria, the atrioventricular node, the His-Purkinje system, and the ventricles as well as their antiarrhythmic effectiveness in patients with various forms of cardiac rhythm disturbance. Etmozin and Etatsizin were shown to have no side effects on sinoatrial node automation and suppress sinoatrial conduction in patients with normal and disturbed sinus node function. They were also shown to suppress conduction along the atria, the atrioventricular node, and the His-Purkinje system, and increase the refractory periods of the anomalous pathway for both ante- and retrograde conduction. At intravenous doses of 50-70 mg, Etatsizin was shown to arrest paroxysms of tachycardia and fibrillation in 66-85 percent of the patients, and eliminates ventricular and epiventricular extrasystoles in 70-85 percent of the cases in which case the antiarrhythmic activity of Etatsizin continues for at least one hour. The paper offered a detailed analysis of the antiarrhythmic action, pharmacodynamics, and side effects of Etatsizin in comparison to Etomozin in ventricular disturbances of cardiac rhythm. The optimal therapeutic dose of Etatsizin was shown to be 150-200 mg daily. The preparation was also shown to eliminate ventricular rhythmic disturbances in 85-90 percent of the patients without exhibiting any serious side effects.

On 21 March 1984, the paper by M. Ya. Ruda and coauthors "Diagnosis of Myocardial Infarction by Detection of Myoglobin Content" was presented at the MGNKO session. A summary was given of results obtained from a study of myoglobin (MG) blood concentration in 118 patients with confirmed myocardial infarction (IM). On the average, the MG content was three times above normal from the onset of illness. The MG level was already elevated 1.5 hours after the onset of the angina seizure in 70 percent of the cases. After two hours it was elevated in 85 percent of the cases, and by the sixth hour, it was elevated in 100 percent of the cases. Maximum MG level was noted by 7.5 hours after which the MG level began to decrease rapidly and reached a normal concentration by the 34th hour after the seizure. The relatively rapid reduction in MG concentration makes it possible to diagnose the extent of the myocardial infarction. Another use of the myoglobin test is an evaluation of the disease's gravity, particularly for making a prognosis. The higher the MG concentration, all other things remaining equal, the greater is the damage to the myocardium. This is also confirmed by determining the cumulative activity of KFK [expansion unknown]. "Critical" levels of MG concentration were computed for corresponding time periods. The calculations showed that if the MG concentration is greater than 400 ng[sic - mg?]/ml by the fourth hour after the seizure's onset, mortality is practically 100 percent. If the MG level is lower than that, 89 percent of the patients survive. The authors have designed a unique radioimmunological kit for assaying the MG level. Myoglobinuria may also be used for diagnosing myocardial infarction. Under normal conditions, MG is not detected in the urine. In MI it appears in the urine on an average of 4.6 hours after onset, reaches a maximum level by the end of the first day, and then maintains an average concentration of 9.5 mcg/ml. Thus, the detection of blood MG concentration makes possible the early diagnosis of MI, and the test can be used for diagnosing MI recurrence and prognosis modification. Detection of MG in the urine, on the other hand, is a simple diagnostic test which can be used at the pre-hospitalization stage for rendering medical assistance.

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MISCELLANEOUS

MEDICAL EQUIPMENT COMMERCE AMONG CEMA NATIONS

Moscow SOVIET EXPORT in English No 4, Nov-Dec 84, pp 22-23

GLUSHNEV, V. D., chief engineer, Soyusmedpribor Amalgamation, USSR; comments by DVORAK, J., manager, Chirana Concern, Czechoslovakia, HOFMANN, R.-R., department head, MLW Intermed-export-import, GDR and KRYSTEV, K., representative of Electroimpex Co., Bulgaria

[Photos of these four authors are included in text]

[Text] The cooperation of CEMA member-states in the field of medical equipment development and manufacture has produced tangible results. In the past decade, medical equipment trade between the USSR and other CEMA member-states increased fourfold, while the volume of exports from the USSR experienced a sixfold growth.

The share of socialist countries in the Soviet Union's medical equipment trade turnover is as high as 70%, the principal partners being Hungary (27%), the GDR (23%), and Czechoslovakia (22%). As to the Soviet exports of medical equipment, the leading recipients are Bulgaria (20%) and Cuba (16%), whereas the bulk of Soviet imports comes from Hungary (29%), the GDR (24%), and Czechoslovakia (23%).

The range of medical equipment exported from the USSR to other CEMA member-states also increased during the past decade, and at present includes, apart from medical equipment and instrumentation, diverse medical instruments, artificial teeth and dental materials.

The export list of the Soviet medical equipment industry now includes a broad range of radiological and X-ray apparatus, medical monitors for multipurpose investigations, and ultrasonic instruments for gynecological and ophthalmological examination and for studying brain diseases. Up-to-date anesthesia and physiotherapeutic apparatus, forced pulmonary ventilation units, endoscopic instruments and surgical staplers are also manufactured.

In the immediate future, public health services will receive numerous medical equipment items of new design developed in the USSR, such as instrumentation and signal systems for monitoring the parameters of forced pulmonary ventilation, inhalation narcosis apparatus for children, and a novel series of portable inhalation anesthesia units. Means of respiration parameter control and radioimmunological research would likewise be of interest to the medical profession in the CEMA member-states.

Soviet imports of medical equipment from socialist countries is an example of the advantages derived from international division of labor. Hungary supplies the USSR mostly with X-ray apparatus, medical instruments and electroencephalographs, the GDR exports to the USSR X-ray apparatus, monitoring systems, and electrocardiographs, and Czechoslovakia, stomatological units, anesthesia apparatus, and hydrotherapeutic equipment.

The Agreement on Multilateral International Specialization and Cooperation in the Production of Medical Equipment signed by the CEMA member-states in 1976 stimulated a substantial increase in the volume of mutual deliveries. The Agreement stipulated specialization in the production of more than 300 medical equipment items, including instrumentation for the measurement and recording of physiological parameters, endoscopes and ultrasonic diagnostic instruments. Specialization progress also embraces the manufacture of electrotherapeutic instruments, sterilization and disinfection means, ophthalmological apparatus, and cardiac pacemakers. In the next few years, the overall number of specialized items on the list of mutual deliveries will exceed 1,500.

The share of specialized production items in mutual exports in the current five-year plan period equals 27.3% as against 7.6% in 1975.

Specialization affords substantial advantages to the parties concerned, insofar as it provides for production concentration and output growth. Export potentialities are accordingly expanded as exemplified by the situation in the field of dental drill to manufacture. The USSR supplies dental drills to all stomatological establishments in the GDR where at the former dental drill production facilities the manufacture of other medical equipment items has been expanded.

In determining the range of mutual deliveries, an ever increasing role is played by the enlargement of joint production items wherein cooperation involves the manufacture of different components and assemblies by the partners. This form of cooperation can be illustrated by deliveries from the USSR to the GDR of semiconductor pressure transducers for inhalation anesthesia apparatus and to Hungary of differential transducers for functional lung diagnostic instruments. In the Soviet Union, use is made of Hungarian fiberoptical elements for the production of endoscopes and other instruments, while volumeters from the GDR are employed in inhalation anesthesia apparatus.

The CEMA member-states pool their efforts in raising the technical standards of and modernizing the currently produced medical equipment. Medical equipment based on microelectronics is being designed. Production and mutual deliveries of advanced manufacturing equipment for the medical industry are acquiring an ever growing significance and, for example, equipment for polymeric coating application has been delivered from Hungary recently for installation at Soviet plants.

Mutual trade and vast experience in the field of production, specialization and cooperation enable the CEMA member-states to meet more fully the requirements of their public health service in high-quality medical equipment.

J. Dvorak comments that the Coordination Center of CEMA member-states for medical equipment is responsible for the cooperation of socialist countries in this field, and experts from seven countries represented in the Center have worked out a program of joint work for the next two five-year periods.

A half of all contract jobs are carried out jointly by the USSR and Czechoslovakia and have so far culminated, for example, in the development of implantable cardiac pacemakers, a versatile biosignal amplifier, and a range of surgical instruments from titanium alloys. The RUM-20 automated high-power X-ray apparatus designed in the USSR recently has undergone successful tests in Czechoslovakia, and is now produced jointly by the two countries, with Chirana supplying the image brightness amplifier, the stand and the operator's desk.

The top-class six-channel electrocardiograph, Model Chiracard-600T, developed by the CSSR in collaboration with Soviet experts is being produced in Czechoslovakia at Chirana plants and in the Soviet Union at the Lvov medical radio-electronic equipment plant. An advanced modification of this apparatus, Chirastar, has been designed and will be supplied to all CEMA member-states where its employment on a large scale is expected to enhance the quality of cardiac and rheumatic disease diagnostics. [end of Dvorak's comments].

R.-R. Hofmann points out that work on nearly 180 research projects is carried out jointly by medical men in the GDR and the Soviet Union at 75 medical establishments. The logical continuation of scientific and technical cooperation is collaboration in the field of production.

Experts in both countries successfully cooperate in the production of endoscopes based on the latest advances of optics and elaborate jointly the technical and medical characteristics of instruments.

Medizinische Gerate Fabrik, Berlin, produces broncho- and laparoscopes for the Soviet Union, while the Krasnogvardeyets plant in Leningrad manufactures gastro- and rectoscopes for medical establishments in the GDR.

Specialization helps raise production efficiency and opens up new possibilities in bringing the manufacture of novel medical equipment items to a commercial status. Suffice it to mention in this connection the results of cooperation in the production of dental equipment. The GDR's requirements in artificial teeth are fully met by the Soviet Union, the number of artificial teeth to be delivered to the GDR in 1984 being 28 million, while in the GDR we have concentrated our efforts, in compliance with the specialization program, on the production of stomatological installations. Keradenta Radeberg, the former manufacturer of artificial teeth in the GDR, has mastered the production of components for dialysers. [end of Hofmann's comments].

K. Krystev asserts that the share of the USSR in Bulgaria's export of medical equipment equals 90%, and the equipment produced in compliance with the specialization program constitutes 80% of this. It should also be noted that about 80% of the range has been developed jointly by the Bulgarian and the Soviet sides.

Physiotherapeutic equipment is a major item of specialized deliveries from Bulgaria to the USSR and, for the most part, have been designed by Bulgarian

experts in cooperation with their Soviet counterparts. On the other hand, apparatus such as Stimul and Tonus, developed in the USSR, are manufactured in Bulgaria according to Soviet documentation.

Specialization in the field of medical equipment production gives a strong impetus to the progress of the Bulgarian medical equipment industry. For example, sterilizers manufactured in the USSR are furnished with electronic units made in Bulgaria. We also deliver some assemblies for use in stomatological installations.

At present, experts in our two countries are on the threshold of a qualitatively new stage of joint activity, viz., the creation of complete medical complexes for the mass medical examination of the population. Soviet specialists render assistance to their Bulgarian colleagues in creating up-to-date equipment for hospitals, clinics.

Tangible results attained so far include a psychophysiological system for the simultaneous examination of eight patients, developed by the Institute of Medical Equipment (Bulgaria) in collaboration with the All-Union Research Institute of Medical Equipment Industry (USSR). Electronic control of this system is performed by the Soviet SM-4 computer, whereas the terminals are supplied by Bulgaria. The entire complex is assembled in Moscow in conformity with the technical documentation prepared jointly by the parties concerned. [end of Krystev's comments].

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PRODUCTION OF MEDICAL MICROANALYSIS INSTRUMENTS

Moscow MEDITSINSKAYA GAZETA in Russian 30 Jan 85 p 2

[Article by Lepekhin, A., correspondent (Leningrad)]

[Abstract] This article reports on plans for a plant for the production of medical analytical instruments. The plant, which will be the largest of its kind in the industry, is under construction in the city of Pitkyaranta, Karelian ASSR.

Yu. B. Komissarov, director of the All-Union Scientific Research and Design Institute of Medical Laboratory Equipment is quoted in regard to the progress of the construction project, which his institute is supervising. He relates that his institute is developing a new generation of instruments for automated microanalysis. As compared with conventional methods, these instruments will make it possible to perform various laboratory analyses 2-10 times as quickly and far more reliably. Existing plants of the Ministry of the Medical Industry lack the capacities and skilled personnel to meet public health's requirements for new laboratory technology of this type. The decision was therefore made to build the new plant. Komissarov reports that its first phase is scheduled to go into operation during the next 5-year plan.

FTD/SNAP

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M. N. KOLOSOV

Moscow IZVESTIYA 1 Mar 85 p 6

[Obituary]

[Text] Academician Mikhail Nikolayevich Kolosov, an eminent scientist in the field of biochemistry and molecular biology, has died.

The announcement of the death is made with deep regret by the Presidium of the USSR Academy of Sciences, the academy's Department of Biochemistry, Biophysics and Chemistry of Physiologically Active Compounds, and the academy's Institute of Bioorganic Chemistry imeni Shemyakin, and sincere condolences are expressed to the family and friends of the deceased.

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