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They were leaders in building the early foundation of modern programming and unveiled the structure of DNA Their work inspired environmental movements and led to the discovery of new genes They've gone to space and back taught us about the natural world dug up the earth and discovered the origins of our species They broke the sound barrier and gender barriers along the way The world of research wouldn't be the same without the pioneering efforts of famous research works made by these women Be inspired by these explorers and early adopters- the women in research who helped to shape our society We invite you to sit with their stories and enter new areas of understanding This list is by no means a complete record of women to whom we are indebted for their research work but here are of history's greatest research contributions made by...

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Consequences of a Rotating Universe for the Standard Model of Cosmology

Ardeshir Irani

ABSTRACT

Dark Energy from the void makes our Universe rotate. The centrifugal force due to the rotation flings galaxies in the outward direction which leads to the experimentally observed accelerated expansion of our Universe. We provide further experimental proof that out Universe is rotating which keeps it from being isotropic and homogeneous, a necessary and sufficient condition for the Cosmological Principle and the introduction of the scale factor a(t), a distance function only of time, while in fact distances measured must be functions of both time and space. This erroneous assumption invalidates all equations within the Cosmological Principle that contain a(t) and its derivatives. We point out some of these erroneous equations of the Cosmological Principle which is based on a non-rotating Universe since a Universe that is not rotating violates the Conservation of Angular Momentum Principle. Subatomic particles, atomic nuclei, planets, stars, galaxies, that are all rotating get their rotation from the Angular Momentum of the Universe.

Keywords: dark energy, rotating universe, non-isotropic universe, non-homogeneous universe, cosmological principle, scale factor a(t), conservation of angular momentum principle.

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Keyterms: dark energy, rotating universe, non-isotropic universe, non-homogeneous universe, cosmological principle, scale factor a(t), conservation of angular momentum principle.

Author: Downey Research Institute, Downey, California, USA.

I. MAIN TEXT

1.1 Experimental Proof

1.) The accelerated expansion of the Universe is due to the centrifugal acceleration created by the rotation of the Universe caused by Dark Energy from the void.

2.) The dipole distortion of the CMB (Cosmic Microwave Background) temperature, which is a Picture of the birth of our 3-D Universe is shown in Figure 1. We see that the blackbody spectrum is shifted to higher brighter temperatures on the right and to lower dimmer temperatures on the left. This implies that our 3-D baby Universe was given a rotational spin in the westerly direction; counterclockwise as viewed from above.

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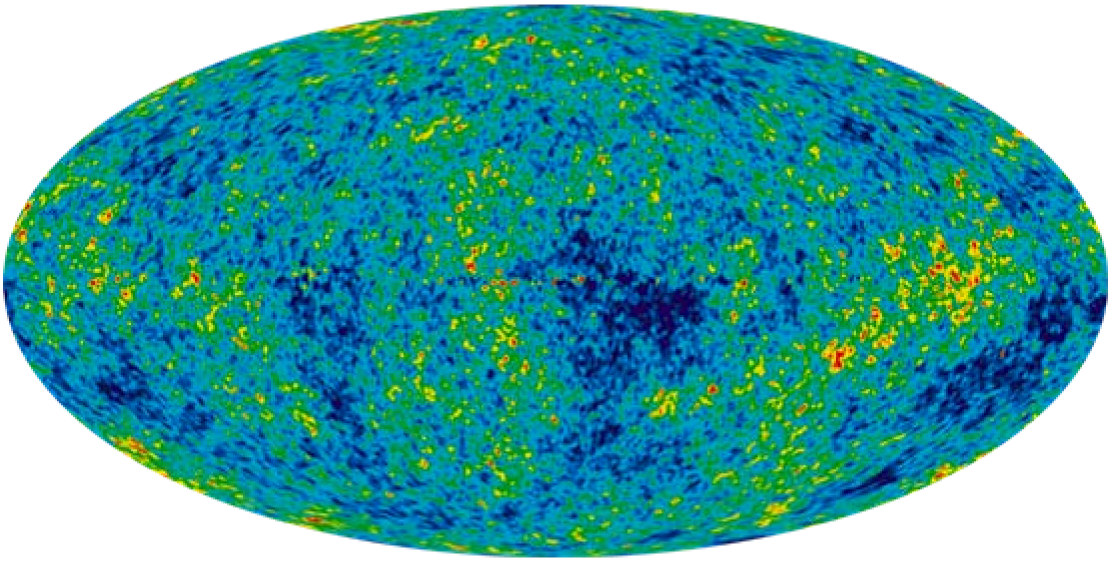

Figure 1: Cosmic Microwave Background Radiation (CMB).

3.) Everything in our universe is spinning which comes from the rotational energy of our Universe. Since our 3-D Universe is rotating in the counterclockwise direction all subatomic particles: the electron, proton, neutron, neutrino, muon, etc. are given a clockwise spin due to their inertia. Since Galaxies, Black Holes, Stars, Planets, and Subatomic particles rotate, this implies that our baby 3-D Universe was born with a rotational spin. Moreover, Stars revolve around their Galactic center while Planets revolve in orbits around their Star, and electrons revolve around the nucleus. Hence all these large and small structures have Angular Momentum due to their rotation and revolution motion. A Universe that is not rotating would have zero Angular Momentum which would go against the Conservation of Angular Momentum Principle since all matter within the Universe has Angular Momentum. The advantage of giving the Universe a spin is to keep it from collapsing on itself due to the inward gravitational force. The outward centrifugal force is greater than the inward gravitational force due to the rotational energy thereby flinging galaxies in the outward direction (Reference 1). This rotational motion is responsible for the experimentally observed outward acceleration of our 3-D Universe.

4.) Since a rotating Universe created from the Dark Energy of the void (Reference 2) has a preferred direction which is the axis of rotation, hence it cannot be isotopic. Being isotropic means that the Universe must be the same in all directions implying that it cannot have a preferred direction because only from the location of the preferred direction can it be isotropic, but it cannot be isotropic from all other locations within the Universe. Because of the rotation that causes the accelerated expansion of the Universe galaxies are being flung in the outward direction, hence our Universe cannot be homogeneous. Being homogeneous means the Universe must look the same from all points within it. The further away one goes from the axis of rotation, the more separated the galaxies become due to the centrifugal force. There is more space between galaxies further out from the axis of rotation, therefore the Universe can never be homogeneous. As secondary to the galaxies being flung in the outward direction due to the accelerated expansion of the Universe for its non-homogeneous nature, we consider the expansion of space within the gaseous region between galaxies being greater than the expansion of space inside a galaxy where matter is more solidified, just as the speed of light in air is greater than the speed of light in a transparent solid. The denser the object, the slower the speed of light and the expansion of space.

1.2 Consequences

Since the Cosmological Principle is based on the Universe being both homogeneous and isotropic at all points within it, parts of which contain the scale factor a(t) are erroneous. That is the reason the current theory of Cosmology does not give satisfactory results without Lambda (λ), but even with the inclusion of λ, it can explain in only a very small region of the energy density parameter with $\Omega_0 = 0.3$ and $\Omega_\lambda = 0.7$, several experiments (Reference 3), including the accelerated expansion of the Universe that was determined experimentally from observations of distant type 1a Supernovae, theoretical calculations for which have also been performed (Reference 4).

The Standard Model of Cosmology is built around the Cosmological Principle which leads to the scale factor a(t), a distance function only of time. Starting with the Friedmann Equation for calculating the total Energy U of the Universe, measured distances $\bar{r}$ within the Universe cannot be a function of time only but must also be a function of space since one cannot use the same scale factor a(t) at different positions of space, but that makes the mathematical calculations impossible to solve without knowing the exact nature of space at all positions within the Universe because space is not expanding at the same rate and in the same direction everywhere. *Mathematical convenience using the same* a(t) everywhere *does not prove physical reality.*

The Friedmann Equation based on the Cosmological Principle and the scale factor a(t) that it starts with are erroneous and all equations derived using a(t) and derivatives of a(t) also become erroneous. We use the equations and page numbers from "An Introduction to MODERN COSMOLOGY---Third Edition by Andrew Liddle" (Reference 5) to state all the equations below that are erroneous because they contain a(t) or derivatives of a(t). *Also, the Friedmann Equation is missing the term* $I\omega^2/2$ *for the rotational Kinetic Energy of the Universe, implying all equations derived using the Friedmann Equation would also be missing equivalent terms for rotational motion.*

Equation (3.8) Page 23: $\bar{r} = a(t)\bar{x}$ where $\bar{x}$ represents the comoving coordinate system that is carried along with the expansion of the Universe which is deemed to be uniform (a constant) because of the Cosmological Principle that depends on the Universe being homogeneous and isotropic.

Equation (3.9) Page 24: $U = T + V = m\dot{a}^2 x^2/2 - 4\pi G\rho a^2 x^2 m/3$ where U is the total energy of the system and $\dot{a} = \frac{da}{dt}$. Note that $\dot{x}^2 a^2$ has been left out of the equation since x has been assumed to have a constant value. The same term $\dot{x}^2 a^2$ has also been left out of the Friedmann Equation below to simplify it.

Equation (3.10) Page 24: $\left(\frac{\dot{a}}{a}\right)^2 = 8\pi G\rho/3 - kc^2/a^2$ where $kc^2 = -2U/mx^2$ which is the standard form of the Friedmann Equation. The habit of setting c = 1 means that the Friedmann Equation is written without c in the above equation which gives us:

Equation (3.19) Page 28: $\left(\frac{\dot{a}}{a}\right)^2 = 8\pi G\rho/3 - k/a^2$. The geometry of the Universe is based on 3 values of k as stated on Page 33:

Spherical for k > 0 implies a Closed Universe.

Flat for k = 0 implies a Flat Universe.
Hyperbolic for k < 0 implies an Open Universe.

Most of the equations described below are derived by omitting x, $\dot{x}$ and $\ddot{x}$, containing only a, $\dot{a}$ and $\ddot{a}$. Unless we know all these three values of x and a, at all locations of the Universe, these equations would become impossible to solve correctly.

Equation (3.15) Page 26: $\dot{\rho} + 3\frac{\dot{a}}{a}(\rho + p/c^2) = 0$ is the fluid equation.

Equation (3.18) Page 27: $\frac{\ddot{a}}{a} = -4\pi G(\rho + 3p/c^2)/3$ is the acceleration equation.

Equation (5.4) Page 38: Hubble's Law $\bar{v} = H\bar{r}$ becomes $H = \frac{\dot{a}}{a}$ as is being used throughout the equations below when in fact it should be written as $H = (\dot{a}x + \dot{x}a)/(ax)$. As soon as we use the incorrect value of $H = \frac{\dot{a}}{a}$, all the equations derived using H become erroneous.

Equation (5.5) Page 38: $H^2 = 8\pi G\rho/3 - k/a^2$ is the Friedmann Equation as an evolution equation for H(t). $\frac{\lambda}{3}$ is added to the above equation to include the Cosmological Constant λ as in:

Equation (7.1) Page 55: $H^2 = 8\pi G\rho/3 - k/a^2 + \frac{\lambda}{3}$

Equation (5.10) Page 39: $1 + z = \lambda_r/\lambda_e = a(t_r)/a(t_e)$ as the definition of redshift z in terms of the scale factor, and λ_r/λ_e, in this case is the ratio of the wavelength of light received at the detector and the wavelength of light emitted by the source, not to be confused with the Cosmological Constant λ.

Equation (5.12) Page 40: $\rho \propto 1/a^3$ for matter from the fluid equation.

Equation (5.18) Page 41: $\rho \propto 1/a^4$ for radiation from the fluid equation.

Equation (6.9) Page 52: $\Omega - 1 = k/(a^2H^2)$ where $\Omega = \rho/\rho_c$ is the energy density parameter; and according to which for $\Omega > 1$ (positive k) we have a Closed Universe, for $\Omega = 1$ (zero k) we have a Flat Universe, and for $\Omega < 1$ (negative k) we have an Open Universe.

Equation (6.14) Page 53: $q_0 = -a(t_0)\ddot{a}(t_0)/\dot{a}^2(t_0)$ for the deceleration parameter q_0 at the present time t_0.

Equation (7.2) Page 55: $\frac{\ddot{a}}{a} = -4\pi G(\rho + 3p/c^2)/3 + \lambda/3$ for the Cosmological Constant λ added to the acceleration equation.

Equation (13.6) Page 105: $\ddot{a}(t) > 0$ for the Inflationary Expansion of the Universe which also indicates erroneously that our Universe is flat.

Equation (A1.5) Page 122: $ds^2 = -c^2dt^2 + a^2(t)[dr^2/(1 - kr^2) + r^2(d\theta^2 + \sin^2\theta d\phi^2)]$ which is the Robertson-Walker Metric.

II. CONCLUSION

Having provided experimental proof that our Universe is rotating, we have pointed out some of the incorrect equations of the Cosmological Principle based on the scale factor a(t) and its derivatives, to which must be added all others that come from the false assumption of the Universe being isotropic and homogeneous. A non-rotating Universe based on the Cosmological Principle violates the Conservation of Angular Momentum Principle. The Cosmological Principle has no experimental basis to prove its validity without Lambda, and in a very small region of the energy density parameter with Lambda, while the Conservation of Angular Momentum Principle has stood the test of time repeatedly everywhere.

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Ancient Vedic Mathematics: Rare Methods of Indian Mathematics

Dr Prof Avinash Challelwar

INTRODUCTION

Ancient Vedic Mathematics offers several techniques and principles that can be applied to geometry, particularly in the context of geometric constructions, measurements, and calculations. While it may not have a separate branch dedicated solely to geometry, many of its sutras (aphorisms) and methods can be used to solve geometric problems efficiently. Here are some key aspects of Vedic Mathematics about geometry:

Geometric Constructions: Vedic Mathematics provides techniques for geometric constructions, particularly those described in the Sulba Sutras, ancient Indian texts related to Vedic rituals and ceremonies. Techniques like Urdhva-Tiryagbhyam (Vertically and Crosswise) and Yavadunam Tavadunikritya Vargaancha Yojayet (Whatever the Deficiency, That Many Times the Deficiency) can be used to construct geometric shapes and structures with precision.

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Author: M Sc/Ph D/D Sc/Hon D Litt/D Div Mathematics, Researcher/Professor/Guide.

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Measurement and Calculation: Vedic Mathematics offers methods for geometric measurement and calculation, such as finding areas, perimeters, and volumes of geometric figures. Techniques like the Paravartya Yojayet (Transpose and Apply) sutra can be applied to calculate measurements and solve geometric problems involving triangles, quadrilaterals, circles, and other shapes.

Geometric Proportions: Proportional reasoning is a key aspect of Vedic Mathematics that can be applied to geometry. Principles like Anurupyena (Proportionately) and Shesanyankena Charamena (The Last Digit from the Last) can be used to establish and solve geometric proportions in various contexts.

Geometric Patterns and Symmetry: Vedic Mathematics emphasizes the recognition of patterns and symmetry, which are essential in geometry. Techniques like Nikhilam Navatashcaramam Dashatah (All from 9 and the Last from 10) and Shunyam Saamya Samuccaye (When the Sum is the same that Sum is Zero) can be applied to identify and exploit geometric patterns and symmetries in problem-solving.

Geometric Transformations: Methods for geometric transformations, such as translations, rotations, reflections, and dilations, can be facilitated using Vedic Mathematics principles. Techniques like the Ekanyunena Purvena (One More Than the Previous One) sutra can be employed to perform transformations and manipulations on geometric figures.

Application to Three-Dimensional Geometry: Vedic Mathematics techniques can also be applied to three-dimensional geometry, including solid figures and spatial reasoning. Principles such as Gunita Samuchchaye (Factors the Sum) and Shunyam (Zero) can be used to solve problems involving volumes, surface areas, and other properties of three-dimensional shapes. By leveraging pattern recognition, proportional reasoning, and simplified algorithms, Vedic Mathematics provides alternative approaches to geometry that can complement conventional methods and enhance problem-solving skills in geometric contexts. The number system in Vedic Mathematics is based on a decimal system, similar to the modern decimal system used worldwide. However, Vedic Mathematics offers unique insights and techniques for performing arithmetic operations and calculations within this number system. Here are some key aspects of the Vedic Mathematics number system.

Geometric Constructions: Vedic Mathematics techniques, such as the Urdhva-Tiryagbhyam Sutra (Vertically and Crosswise), can be applied to construct geometric shapes and structures with precision. These techniques can help in laying out foundations, determining angles, and creating symmetrical designs in architectural plans.

Measurement and Calculation: Vedic Mathematics offers methods for geometric measurement and calculation, which can be useful in construction projects. Techniques for calculating areas, perimeters, and volumes of geometric figures can aid in estimating material quantities, determining spatial requirements, and optimizing space utilization.

Proportional Reasoning: Proportional reasoning, a key aspect of Vedic Mathematics, can be applied to establish and maintain harmonious proportions in architectural design. Principles like Anurupyena (Proportionately) can guide the scaling of architectural elements and ensure visual balance and coherence in construction projects.

Geometric Patterns and Symmetry: Vedic Mathematics emphasizes the recognition of patterns and symmetry, which can enhance the aesthetic appeal and structural integrity of buildings. Techniques for identifying and exploiting geometric patterns and symmetries can inform design decisions and contribute to the artistic and functional aspects of construction projects.

Calculation of Structural Parameters: Vedic Mathematics calculations can be used to determine structural parameters such as load-bearing capacities, stress distributions, and material strengths in construction. Techniques for solving linear and quadratic equations, as well as manipulation of algebraic expressions, can aid in analysing structural elements and optimizing structural designs.

Optimization and Efficiency: By leveraging Vedic Mathematics techniques for mental calculation and rapid computation, construction professionals can streamline planning, design, and execution processes. Efficient use of resources, optimal spatial arrangements, and effective problem-solving can be facilitated by applying Vedic Mathematics principles to construction projects. Integrating Vedic Mathematics calculations with modern construction practices can foster creativity, innovation, and precision in building projects.

Vedic Mathematics can be applied in various engineering disciplines due to its efficient problem solving techniques, mental calculation methods, and emphasis on pattern recognition. While it may not replace conventional engineering methodologies, it can complement them and offer alternative approaches to problem-solving. Here are some ways Vedic Mathematics can be useful in engineering:

Quick Calculations: Vedic Mathematics offers mental calculation techniques that enable engineers to perform arithmetic operations rapidly without relying on calculators or computers. Engineers can use Vedic Mathematics methods for quick estimations, feasibility studies, and initial design calculations, saving time and effort.

Optimization Problems: Vedic Mathematics principles, such as proportionality and optimization techniques, can be applied to solve engineering optimization problems. Engineers can use Vedic Mathematics to optimize parameters such as cost, efficiency, energy consumption, and resource utilization in engineering designs and processes.

Numerical Analysis: Vedic Mathematics techniques can enhance numerical analysis methods used in engineering simulations and computational modelling. Engineers can apply Vedic Mathematics

principles to improve numerical stability, convergence, and accuracy in solving differential equations, linear algebra problems, and optimization algorithms.

Structural Engineering: Vedic Mathematics calculations can aid structural engineers in analyzing and designing various structural elements such as beams, columns, and trusses. Techniques for solving linear and quadratic equations, as well as manipulation of algebraic expressions, can be applied to determine structural loads, stresses, and deformations.

Electrical Engineering: Vedic Mathematics can be useful in electrical engineering for calculations involving circuits, signals, and systems. Engineers can apply Vedic Mathematics techniques to analyze electrical networks, solve circuit equations, and optimize system performance in terms of power consumption, signal processing, and communication.

Mechanical Engineering: In mechanical engineering, Vedic Mathematics can assist in solving problems related to kinematics, dynamics, and fluid mechanics. Techniques for solving equations of motion, analysing mechanical systems, and optimizing design parameters can benefit from Vedic Mathematics principles.

Civil Engineering: Vedic Mathematics calculations can be applied in civil engineering for tasks such as surveying, transportation planning, and environmental analysis. Engineers can use Vedic Mathematics techniques to perform geometric calculations, estimate quantities of construction materials, and optimize infrastructure designs.

Innovation and Creativity: By incorporating Vedic Mathematics principles into engineering education and practice, engineers can foster innovation, creativity, and critical thinking skills. Alternative problem-solving approaches inspired by Vedic Mathematics can lead to novel solutions, improved design methodologies, and more efficient engineering practices. Vedic Mathematics can play a role in research across various fields due to its unique problem-solving techniques, mental calculation methods, and emphasis on pattern recognition. While it may not be the primary focus of research endeavours, Vedic Mathematics principles and methods can complement conventional research methodologies and offer alternative approaches to problem-solving. Here are some ways Vedic Mathematics can be applied in research.

Data Analysis: Vedic Mathematics techniques can be applied in data analysis and statistical research to perform calculations, analyze trends, and derive insights from datasets. Researchers can use Vedic Mathematics methods for quick estimations, hypothesis testing, and exploratory data analysis, particularly in fields such as economics, finance, and social sciences.

Algorithm Development: Vedic Mathematics principles can inspire development of computational algorithms and optimization techniques for solving complex problems in various domains. Researchers can explore the application of Vedic Mathematics concepts in algorithm design, machine learning, and artificial intelligence to improve efficiency and accuracy in computations.

Mathematical Modelling: In mathematical research, Vedic Mathematics can offer alternative methods for solving equations, optimizing functions, and analysing mathematical structures. Researchers can investigate the applicability of Vedic Mathematics techniques in mathematical modelling, numerical analysis, and mathematical physics to address research questions and theoretical problems.

Educational Research: Education research can explore the effectiveness of integrating Vedic Mathematics principles into educational curricula and pedagogical practices. Researchers can investigate the impact of Vedic Mathematics instruction on student learning outcomes, cognitive development, and problem-solving skills in mathematics education.

Interdisciplinary Studies: Vedic Mathematics principles can be applied in interdisciplinary research projects that require mathematical reasoning, computational skills, and analytical thinking. Researchers from different disciplines can collaborate to explore the integration of Vedic Mathematics with fields such as engineering, biology, medicine, and environmental science to address complex research challenges.

Historical and Cultural Studies: Research in history and cultural studies can examine the historical development, cultural significance, and philosophical foundations of Vedic Mathematics. Researchers can investigate the historical context of Vedic Mathematics, its role in ancient Indian civilization, and its influence on mathematical thought and education.

Innovation and Problem-Solving: Vedic Mathematics can inspire innovation and creativity in research by offering alternative problem-solving approaches and mathematical techniques. Researchers can explore the application of Vedic Mathematics principles in addressing real-world problems, fostering interdisciplinary collaborations, and advancing knowledge in diverse research fields. Integrating Vedic Mathematics into research endeavours can broaden perspectives, stimulate interdisciplinary thinking, and contribute to advancements in scientific knowledge and scholarship.

The history of Vedic Mathematics traces back to ancient India, where mathematical concepts and techniques were documented in various ancient texts known as the Vedas. Here's an overview of the past and historical context of Vedic Mathematics.

Origins in Vedic Literature: Vedic Mathematics finds its roots in the Vedas, the oldest sacred texts of Hinduism, composed in ancient India between 1500 BCE and 500 BCE. Mathematical concepts and techniques are mentioned in several Vedas, including the Rigveda, Samaveda, Yajurveda, and Atharvaveda, reflecting the significance of mathematics in Vedic culture.

Sulba Sutras: The Sulba Sutras, a collection of ancient Indian texts dating from around 800 BCE to 500 BCE, contain mathematical and geometric principles related to ritualistic and architectural practices. These texts provide instructions for constructing altars and fire pits with precise geometric proportions, showcasing advanced mathematical knowledge and techniques of ancient Indian mathematicians.

Ancient Indian Mathematicians: Ancient Indian mathematicians, known as "Rishis" or sages, made significant contributions to the development of mathematical knowledge and techniques. Scholars such as Baudhayana, Apastamba, Katyayana, and others authored mathematical texts containing geometric, algebraic, and arithmetic principles used in various practical applications.

Mathematical Treatises: Mathematical treatises & texts from ancient India, such as "Brahmasphutasiddhanta" by Brahmagupta & "Lilavati" by Bhaskaracharya, further expanded on mathematical concepts & techniques. These texts covered topics such as arithmetic operations, algebraic equations, geometry, trigonometry, and numerical calculations, demonstrating the depth of mathematical knowledge in ancient India.

Transmission and Preservation: Mathematical knowledge in ancient India was transmitted orally and through written texts, ensuring its preservation and continuity over generations. Gurukuls, traditional schools of learning, played a crucial role in disseminating mathematical knowledge to students through direct instruction from gurus.

Cultural and Religious Context: Mathematics in ancient India was intertwined with religious, cultural, and practical aspects of daily life, influencing ritualistic practices, architectural designs, astronomical observations, and trade activities. The application of mathematical principles in various domains reflected the holistic worldview and intellectual pursuits of ancient Indian society. The past of Vedic Mathematics is deeply rooted in the intellectual and cultural heritage of ancient India, where mathematical knowledge flourished as an integral part of Vedic literature, religious rituals, and practical applications. Through the contributions of ancient Indian mathematicians and scholars, Vedic Mathematics laid the foundation for the development of mathematical sciences and continues to inspire inquiry, exploration, and appreciation in the modern world. In the present day, Vedic Mathematics continues to be relevant and influential, impacting various aspects of education, research, and practical applications. Here's a glimpse into the present state of Vedic Mathematics.

Education: Vedic Mathematics is taught in schools, educational institutions, and through online platforms worldwide, offering alternative approaches to learning mathematics. Educators integrate Vedic Mathematics principles into curricula, textbooks & teaching methodologies to enhance students' mathematical proficiency, problem-solving skills, and cognitive abilities.

Research: Scholars and researchers explore the mathematical concepts and techniques found in Vedic texts, studying their historical context, mathematical rigor, and practical applications. Interdisciplinary research combines insights from Vedic Mathematics with modern mathematical theories, computational methods, and scientific inquiry, leading to discoveries and innovations.

Practical Applications: Vedic Mathematics principles find applications in various fields such as engineering, computer science, finance, architecture, and decision-making. Algorithms inspired by Vedic Mathematics techniques are developed for optimization, cryptography, data analysis, artificial intelligence, and other computational tasks, contributing to advancements in technology and innovation.

Educational Outreach: Workshops, seminars, and online courses on Vedic Mathematics are conducted to raise awareness, promote learning, and foster interest in mathematical traditions and cultural heritage. Educational initiatives focus on making Vedic Mathematics accessible to diverse audiences, including students, teachers, parents & enthusiasts, through outreach programs and community engagement.

Cultural Revival: Efforts are made to preserve and revive ancient mathematical traditions and cultural heritage associated with Vedic Mathematics. Cultural organizations, institutions, and scholars promote the study and appreciation of Vedic Mathematics as part of India's rich intellectual legacy and global heritage.

Cross-Cultural Exchange: Vedic Mathematics transcends cultural and geographical boundaries, attracting interest & participation from individuals & communities worldwide. Cross-cultural exchange programs, collaborations & academic exchanges facilitate the sharing of knowledge, experiences, and insights related to Vedic Mathematics across different cultures & societies.

Innovation and Entrepreneurship: Entrepreneurs and innovators develop products, services, and applications based on Vedic Mathematics principles, catering to diverse market needs and consumer preferences. Start-ups and businesses leverage Vedic Mathematics techniques for problem-solving, decision-making, and optimization, driving economic growth and social impact. In the present era, Vedic Mathematics continues to thrive as a source of inspiration, exploration, and learning, shaping educational practices, fostering interdisciplinary research, and contributing to practical solutions and innovations in various fields. The future of Vedic Mathematics holds promise in several areas, driven by advancements in education, technology, and interdisciplinary research. Here are some potential directions for Vedic Mathematics in the future.

Integration into Educational Systems: Vedic Mathematics can be integrated into mainstream educational systems worldwide, offering alternative approaches to teaching and learning mathematics. Educators may incorporate Vedic Mathematics principles into school curricula, textbooks, and teaching methodologies, catering to diverse learning styles and fostering mathematical proficiency among students.

Technological Applications: Vedic Mathematics principles can inspire the development of algorithms and computational techniques in various technological domains. Researchers may explore applications of Vedic Mathematics in artificial intelligence, machine learning, optimization algorithms, and other computational fields, leading to innovative solutions and advancements in technology.

Cross-Disciplinary Collaboration: Vedic Mathematics can serve as a bridge between different academic disciplines, fostering interdisciplinary collaboration and research. Mathematicians, scientists, engineers, educators, and practitioners from diverse fields may collaborate to explore the intersections between Vedic Mathematics principles and their respective domains, leading to new insights, methodologies, and applications.

Cognitive Enhancement: Vedic Mathematics techniques can be leveraged for cognitive enhancement and mental agility, benefiting individuals of all ages. Programs and workshops focusing on Vedic Mathematics may be developed to promote cognitive skills, problem-solving abilities, and lifelong learning, contributing to personal development and professional success.

Cultural Preservation and Revival: Vedic Mathematics can play a role in preserving and reviving ancient mathematical traditions and cultural heritage. Efforts to study, document, and disseminate Vedic Mathematics teachings may be undertaken to preserve India's mathematical legacy and promote cross-cultural understanding and appreciation.

Global Outreach and Awareness: Vedic Mathematics can reach a wider audience through global outreach initiatives, educational platforms, and digital media.

Innovation and Entrepreneurship: Vedic Mathematics principles can inspire innovation and entrepreneurship in various sectors, including education, technology, finance, and healthcare. Entrepreneurs and innovators may develop products, services, and applications based on Vedic Mathematics principles, addressing societal challenges and creating new opportunities for economic growth and social impact. The future of Vedic Mathematics holds immense potential for education, technology, interdisciplinary collaboration, cognitive enhancement, cultural preservation, global outreach, and innovation. By embracing and exploring the rich heritage of Vedic Mathematics, individuals and communities can unlock new avenues for intellectual inquiry, creativity, and progress in the years to come. Vedic mathematics is a system of mathematical techniques that originated in ancient India, primarily found in ancient Hindu scriptures called the Vedas. These techniques cover a wide range of mathematical operations and concepts, including arithmetic, algebra, geometry & calculus. The direct application of Vedic mathematics to the golden ratio isn't explicitly discussed in classical Vedic texts.

The golden ratio, often denoted by the Greek letter phi (φ) is an irrational number approximately equal to 1.618033988749895. It has unique mathematical properties such as being the solution to the equation $^{1+\sqrt{5}}{}_{2}$and having a significant presence in various natural phenomena and art forms due to its aesthetic appeal. While Vedic mathematics provides numerous shortcuts and techniques for performing calculations efficiently, it doesn't offer specific methods for directly dealing with the golden ratio. However, one can certainly use Vedic mathematics techniques in conjunction with principles related to the golden ratio in mathematical problem-solving or exploration. Vedic multiplication techniques could be applied to calculate products involving the golden ratio or its powers more efficiently. Additionally, Vedic square techniques might be utilized in geometric constructions or manipulations involving shapes related to the golden ratio.

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Development of the Industrial Complex of Kryvoryzhya: Economic Benefits, Technogenic Consequences and Environmental Problems

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ABSTRACT

The rapid economic development of Kryvyi Rih and large-scale geospatial changes in the territory are associated with the development of the iron ore basin and the development of the mining and industrial complex and ferrous metallurgy enterprises of the city.

The study aims to highlight the positive economic factors of industrial development in the region and to study the whole complex of geospatial changes in the territory. The task of the research is also to understand the negative environmental consequences and ways to solve the problems of environmental pollution.

As a result of studying historical sources and cartographic materials in the study it was possible to understand the patterns of spatial development of the city and the scale of geospatial changes in Kryvyi Rih. In the course of the work, objects of anthropogenic landscapes, water bodies and territories of industrial enterprises were studied and plotted on the city map. This made it possible to understand the peculiarities of the location, the scale of the transformation of the territory and man-made danger.

Keywords: man-made danger, mining industry, anthropogenic landscapes, quarries, stockpiles, karst landscapes, ecological condition.

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RESUME

The rapid economic development of Kryvyi Rih and large-scale geospatial changes in the territory are associated with the development of the iron ore basin and the development of the mining and industrial complex and ferrous metallurgy enterprises of the city.

The study aims to highlight the positive economic factors of industrial development in the region and to study the whole complex of geospatial changes in the territory. The task of the research is also to understand the negative environmental consequences and ways to solve the problems of environmental pollution.

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The city's enterprises have a significant impact on Ukraine's economy. The share of Kryvyi Rih in the total gross domestic product of Ukraine is 9%, national exports - 8%, total industrial production of Dnipropetrovsk region - 42.3%. More than 80% of iron ore is extracted here and 20% of Ukraine's metal is produced. [9]

As a result of open-cast iron ore mining, anthropogenic landscapes have emerged in the city, as a result of mining and quarrying, storage of waste rock and waste processing and beneficiation of minerals, the formation of underground cavities in mines, followed by their redemption and displacement of blocks of the earth's crust. Industrial landscapes occupy huge areas that can be compared with the areas of many large cities in Ukraine.

Also, the development of the industrial complex and the growing population of the city required large reserves of fresh water. And since the territory does not have large natural sources of water supply, to solve this problem, a number of reservoirs were built on the existing river network and the Dnieper-Kryvyi Rih canal was built.

Unfortunately, the development of industry in addition to the clear economic benefits brought the city a number of environmental problems and man-made hazards such as:

- *Concentration of potentially dangerous objects in the city (mines, quarries, dumps, sludge storages, waste cavities, etc.), which require annual discharge of excess return water;*
- *Formation of abysmal landscapes, which is associated with underground mining of iron ores and the displacement of adjacent blocks of native rocks;*

- *The presence of waste from the extractive industry, which is presented in the form of dumps, sludge storages, heaps and landfills, forming zones of man-made desertification, the area of which by the end of the XX century. amounted to about 8% of the total territory of Ukraine;*
- *Emissions of pollutants into the atmosphere by the enterprises of the complex, which annually amount to more than 1.5 million tons, or almost 32% of total emissions in the country;*
- *Soil pollution as a result of industrial enterprises;*
- *Water pollution by heavy metals, which occurs due to discharges of insufficiently treated water by enterprises of the mining, metallurgical and metalworking industries directly into the rivers of the region.*

Keywords: man-made danger, mining industry, anthropogenic landscapes, quarries, stockpiles, karst landscapes, ecological condition.

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I. INTRODUCTION

The beginning of iron ore mining on an industrial scale in Kryvyi Rih almost 150 years ago became the impetus for the rapid industrial development of the region. As a result, only during the period from the 30s to the 90s of the 20th century, Kryvyi Rih turned from a small town into an industrial giant. The Kryvyi Rih region experienced rapid economic development, but at the same time, the industrial complex fundamentally changed the landscape and led to extremely serious environmental problems and man-made hazards. Therefore, it is important to study and research the geospatial changes of the territory, environmental hazards and search for solutions to the problems.

The purpose of this study is to comprehensively highlight the positive economic factors of the development of the industrial complex of Kryvyi Rih and to study the geospatial changes of the territory as a consequence of the development of the mining and industrial complex.

The task of the research is to highlight man-made and ecological problems and the environmental impact of the industrial complex in the city of Kryvyi Rih, associated with the rapid development of the mining and industrial complex of the region.

II. THEORETICAL AND METHODOLOGICAL FOUNDATIONS OF RESEARCH

In the last decade, the interest of scientists in the study of anthropogenic changes in the territory of Kryvyi Rih and the study of mining landscapes has increased. Thus, in the article by Kazakov V.L. "On the way to a complete study of mining landscapes of Kryvbas" presents a database of the studied spatio-temporal structure of mining landscapes of the city and region. The researcher determined the objective of the work to justify the schemes of optimization of mining landscapes and their inclusion in regional eco-networks, taking into account their structure in the development of the general plan of the city of Kryvyi Rih, for the development of various directions of industrial tourism. [2]

Many scientific studies are devoted to the ecological problems of the city, in particular E.V. In the article "Environmental problems of Kryvyi Rih - state and prospects", Chasova highlighted the real state and severity of environmental hazards in the industrial city of Kryvyi Rih. [2, 3, 8]

III. RESEARCH METHODS AND DATA

In the process of this research, a number of methods were used that helped to investigate geospatial changes and the consequences of anthropogenic impact on the environment in the region. Thus, the study of historical cartographic materials and the use of modern satellite images helped to solve one of the main issues of this study - the mapping of territories with anthropogenic landscapes on the city map. In the course of field research, observations were made of a number of industrial facilities: the quarry and museum of the Southern Mining and Processing Plant, the Burshchytsky dump, the quarry dump of the Novokryvorizkiy Iron Ore Enrichment Works, the sinkhole of the mines named after Ordzhonikidze and Ternivska, mine named after Shilman, flooded quarries: № 2 Novokryvorizkiy Iron Ore Enrichment Works, Karachuniv granite quarry, Central Iron Ore Enrichment Works quarry, Hannivskiy quarry. Such observations made it possible to understand the patterns of organization and features of the spatial development of the city's industrial complex.

An important method in the study was the systematic analysis of all economic and ecological aspects of the city's industrial complex, as interconnected systems of factors affecting the territory and the ecosystem as a whole.

Comparative analysis in this study was used to compare the interaction of natural and anthropogenic factors of influence on geospatial changes of the city territory.

The principle of comprehensiveness of research is important for conducting research, which allows to develop recommendations in compliance with the requirement "not to worsen the ecological situation", to investigate the entire system, to identify its problems and to form perspectives for further research.

Mathematical methods make it possible to carry out calculations, forecasting, generalizations, and conclusions in research that cannot be obtained without a mathematical component. In research, these methods, thanks to their objectivity, allow you to compare certain objects with each other, highlight the main thing among a large amount of information, and evaluate the participation of each factor in the total amount of influences.

The method of literary sources was used in the process of collecting reference and historical material. The statistical method is the main one in the process of processing statistical materials of various information resources of the city of Kryvyi Rih and industrial enterprises. It made it possible to compile all data on the current state of the city's industrial complex and all changes in the development process.

IV. RESEARCH RESULTS

The beginning of industrial development of iron ores in 1880 was connected with the organization "Joint-Stock Company of Kryvorizki Iron Ores". Mining operations began in 1881 at the Saksahanskiy mine. In the same year, the construction of the Catherine railway began, which connected the city with the industrial regions of Dnieper and Donbas. She played a huge role in accelerating the development of industry in the region.

At the end of the 19th century the territory around the city of that time was developed extremely intensively. One by one, mines are opened, near which settlements for workers are built. In 1897, Kryvyi Rih iron ore basin took first place in ore mining in the Russian Empire, overtaking the Ural Basin. The first mine in the basin began to operate in 1886. Since then, underground mining of iron ore has continued at an increasing pace. In 1890, there were already 79 mines operating in Kryvyi Rih, and by the end of the 19th century, 266 industrial enterprises.

On June 16, 1931, Hryhoriy Ordzhonikidze, head of the Supreme Soviet of the USSR, signed an order on the construction of the Kryvorizkiy Metallurgical Plant. On August 4, 1934, the first blast furnace was launched. This day is considered the birthday of the Kryvorizhstal plant. In 1936, the construction of the Kryvyi Rih Coke Chemical Plant was completed.

In the post-war period, there was a rapid development of the industrial complex: in 1952, the Kryvyi Rih Cement Plant was created; in 1955, the first stage of the Southern Iron Ore Enrichment Works was put into operation; In 1959, factory № 1 of the Novokryvorizkiy Iron Ore Enrichment Works was put into operation; In 1961, the first stage of the Central Iron Ore Enrichment Works was built; In 1962, blast furnace № 7 (BF №7), equipped with electronic computing equipment, industrial television, was put into operation; In 1964, the first stage of the Northern Iron Ore Enrichment Works was launched; In 1965, 573 enterprises operated in the city. During the years 1960-1985, the industrial potential of the city continued to grow: in 1966, the Inhulets Iron Ore Enrichment Works was created on the basis of the Inhulets deposit of iron quartzite; In 1969, a wagon repair depot was opened; In 1970, the unique "Artem-2" mine complex was launched; after the launch of the blast furnace -8, the blast furnace shop of the Kryvyi Rih Metallurgical Plant became the largest in Europe; 1974 — the launch of the world's largest Blast Furnace-9 took place; In 1975, the "Remgormash" plant was established.

At the end of the 1960s, the city's population exceeded 500,000. The unification of workers' villages in Kryvyi Rih was facilitated by the completion of the construction of a 100-kilometer asphalt highway in 1958, which connected the city with the northern and southern mines and the settlements near them. Also, the city of Inhulets became part of Kryvyi Rih after 1963, and Terny in 1969.

As it becomes clear from the historical excursion, the city experienced rapid development with the growth of the mining industry in the 20th century.

Modern Kryvyi Rih is a large industrial city, the center of the Kryvyi Rih iron ore basin, the most important raw material base of metallurgy in Ukraine. [4]

The Kryvyi Rih industrial region plays a leading role in the economy of Ukraine and is the main raw material base for the development of ferrous metallurgy, is of strategic importance for the economic independence and security of the state. In the total gross domestic product of Ukraine, the share of Kryvyi Rih is 9%, of national exports - 8%, of the total volume of industrial production of Dnipropetrovsk region - 42.3%. [9]

More than 70 million tons of iron ore and concentrates are produced every year by metal ore mining and beneficiation enterprises. Two mines are managed by the "Evraz Sukha Balka" company, four by the Kryvyi Rih iron ore plant. More than 6.0 million tons of steel, as well as more than 5 million tons of cast iron and 5.5 million tons of rolled steel are produced annually at metallurgy and metal processing enterprises.

The construction complex is represented by organizations of various specializations: a cement-mining plant, plants for the production of reinforced concrete, local building materials, and others. The city is one of the three bases of the industrial giant "HeidelbergCement" in Ukraine.

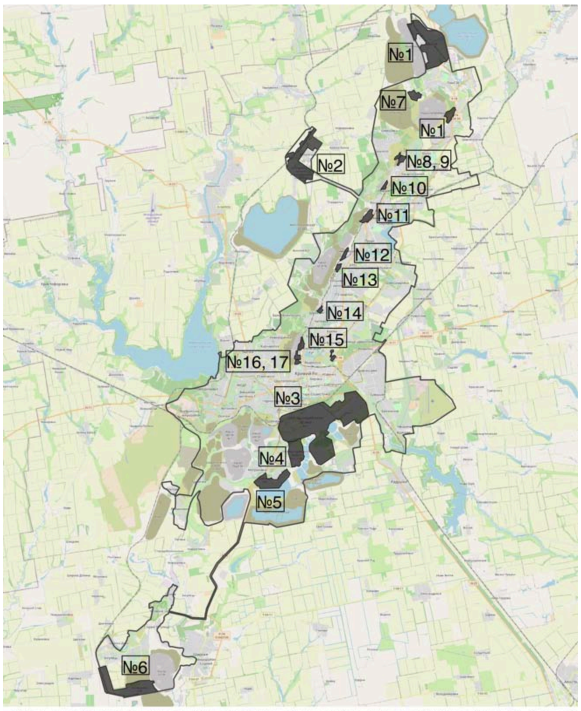
8 out of 11 Ukrainian iron ore mining and processing enterprises, as well as main production service enterprises, are located in the Kryvyi Rih Basin. Therefore, the main city-forming industry that steadily determines the city's profile in the territorial division of labor is ferrous metallurgy.

The Kryvyi Rih iron ore basin is one of the oldest and largest basins in our country. More than 80% of iron ore raw materials are mined here and 20% of Ukraine's metal is produced. Iron ore deposits of Kryvyi Rih are complex in their composition, each of them is composed of two or three types of iron ores and accompanying non-metallic minerals. The specific gravity of the mining and metallurgical complex is 86% of the total volume of industrial production in the city.

Kryvyi Rih is home to one of the world's largest metallurgical plants - "ArcelorMittal Kryvyi Rih", five mining plants - Northern, Southern, Central, Novokryvorizkiy, Inhuletsky with ten quarries with a depth of more than 300 m for open mining, three ore processing plants and other.

Preferred nomenclature: iron ore, concentrate, agglomerate, coils, cast iron, steel, ready-rolled products. The only one in the country, the Kryvyi Rih Surik Factory produces iron surik, which is in demand in Ukraine and beyond. The Kryvorizkiy Mining Equipment Plant and Kryvbasvybuhprom (enterprises engaged in explosive works) also operate in the city. [9]

(See Fig. 1)



1)Northern Iron Ore Enrichment Works; 2)Central Iron Ore Enrichment Works; 3)"ArcelorMittal Kryvyi Rih"; BF - 9; Kryvyi Rih Surik Factory; Kryvyi Rih Cement Plant; Kryvyi Rih Coke Chemical Plant; 4)Novokryvorizkiy Iron Ore Enrichment Works; 5)Southern Iron Ore Enrichment Works; 6)Inhulets Iron Ore Enrichment Works; 7)Pershotravneva Mine Management ("Pershotravneva" Mine); 8)Central Iron Ore Enrichment Works mine named after Ordzhonikidze; 9)Kryvyi Rih Iron Ore Plant mine "Ternivska"; 10)Kryvyi Rih Iron Ore Plant mine "Gvardiyska"; 11)"Evraz Sukha Balka" mine "Yuvileina"; 12)"Evraz Sukha Balka" mine named after M.V. Frunze; 13)Kryvyi Rih Iron Ore Plant mine "Oktyabrska"; 14)Kryvyi Rih Iron Ore Plant mine "Rodina"; 15)"ArcelorMittal Kryvyi Rih" N°1 named after Artema; 16)Kryvyi Rih Iron Ore Plant mine "Saksahan"; 17)Central Iron Ore Enrichment Works mine "Hihant-Hlyboka".

Fig. 1: Map of territories occupied by enterprises.

The city received an impetus for development not only because of its resource potential, but also because of its favorable geographical location. Because it is located in the very center of Ukraine and has approximately the same distance to all economically important regions of the country. This makes it possible to deliver rental cars to Donbas enterprises and ready-made products to Black Sea ports with relatively low costs. That makes it possible to reduce logistics costs in the delivery of industrial goods to the final consumer. Therefore, the city was one of the first in the Russian Empire to receive a railway connection and today has one of the most extensive networks of both passenger and industrial railway infrastructure in Ukraine. The Kryvyi Rih Directorate of Railway Transportation "Ukrzaliznytsia" is located in the city, which serves five directions and annually provides up to 17% of the national volume of all rail freight transportation. In general, the daily volume of cargo transportation is about 200,000 tons.

The city's enterprises have a significant impact on the economy of Ukraine. Thus, ArcelorMittal Kryvyi Rih is the largest exporter, 85% of finished products go abroad. The enterprise employs more than 20,000 workers according to 2019 data. The Southern Iron Ore Enrichment Works produces an average of 34 million tons of ore per year and has the largest open industrial quarry in the country and

Europe (currently the most popular object of industrial tourism in Ukraine), the enterprise employs 7,600 workers. The Novokryvorizkiy Iron Ore Enrichment Works of the deposit produces an average of 15.2 million tons of ore per year. At the Central Iron Ore Enrichment Works, mining is carried out by open-pit and mine methods, the enterprise employs a total of 4,643 workers. The Northern Iron Ore Enrichment Works is the largest mining enterprise in Europe with a complete cycle of blast furnace raw material preparation — iron ore concentrate and coils — where the deposits are mined by the open method and 5,965 workers work. The Inhulets Iron Ore Enrichment Works produces 70 million tons of ore mass annually and produces 14 million tons of iron ore concentrate, and the company also employs 4,931 workers. The Kryvyi Rih Cement Plant specializes in the production of slag types of cement and uses slag and other waste from the metallurgical industry of the Kryvyi Rih region. Sukha Balka (mine) is an enterprise specializing in underground mining of iron ore, the reserves of which have been explored to a depth of 2,060 m in the Yuvileyna mine field and to a depth of 1,500 m in the mine field named after Frunze (both mines have underground bunker-crushing complexes and surface crushing-sorting factories), the enterprise employs 3,000 workers. [9]

Since the Kryvyi Rih region is noted for its industrial component, it becomes obvious that mining activity could not pass without a trace for almost 150 years. Due to the development of open-pit mining of iron ores, today we can see the consequences of this activity in the form of quarries, dumps and sludge storages, which occupy huge areas that can be compared with the areas of many large cities of Ukraine.

In this way, anthropogenic landscapes arise as a result of open-pit and extractive mining operations, storage of empty rock and waste from mineral processing and beneficiation, the formation of underground cavities in mines with their subsequent extinguishment and displacement of forged blocks of the earth's crust. [7]

Because of this, a significant ecological and man-made problem arises in Kryvyi Rih, since the technology for processing spent sludge and waste rock is not implemented in Ukraine today. Therefore, the only way for now is to accumulate these rocks in already existing sludge storages, dumps and occupy more and more new territories with them.

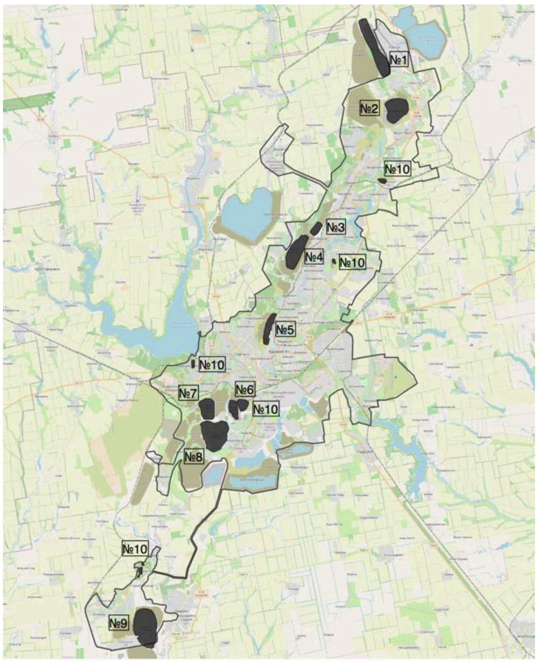
Quarries are a negative form of relief of man-made origin, within which open mining of minerals takes place. There are only 54 quarries (working and decommissioned, with re-operation) on the territory of Kryvyi Rih: 41 iron ore, 4 granite, 6 sand, 3 clay. The main condition for laying quarries is the shallow occurrence of the mineral deposit and the overlap with a small thickness of sedimentary deposits.
(See Fig. 2)

Dump mining landscapes are formed on the basis of man-made formations such as dump. Dumps are one of the main forms of anthropogenic relief, which is formed as a result of the storage of overburden on the earth's surface and the storage on the earth's surface of the by-products of mineral enrichment - slurries in the process of quarrying. Dumps are formed from "empty" and "poor" rocks that cannot be enriched. In turn, sludge occurs as a by-product of ore processing after the selection of the magnetic fraction on magnetic separators, which occurs during ore enrichment at mining and beneficiation plants. After this procedure, the sludge is pumped to sludge storage facilities where it is stored. Landfills are divided by type into sludge storage (hydraulic landfills), loose (loamy, sandy), rocky and mixed. In total, there are 104 landfills in the territory of Kryvyi Rih, ranging from low (up to 20 meters high) to very high (almost all sludge repositories with a height of 110-130 m). Landfills also vary in size from very small (up to 50 hectares) to large ones, where the area is more than 300 hectares (the area of the largest sludge storage facility of the Northern Iron Ore Enrichment Works is 1,840 hectares or 18.4 km^2). *(See Fig. 3)*

After quarries and dumps, failed landscapes represent the third group of mining anthropogenic landscapes, the emergence of which is associated with underground mining of iron ores and displacement of adjacent blocks of native rocks. There are two types of fault landscapes on the territory of Kryvyi Rih: displacement zones and fault zones (zones of the formation of troughs and depressions). There are a total of 26 such zones. *(See Fig. 4)*

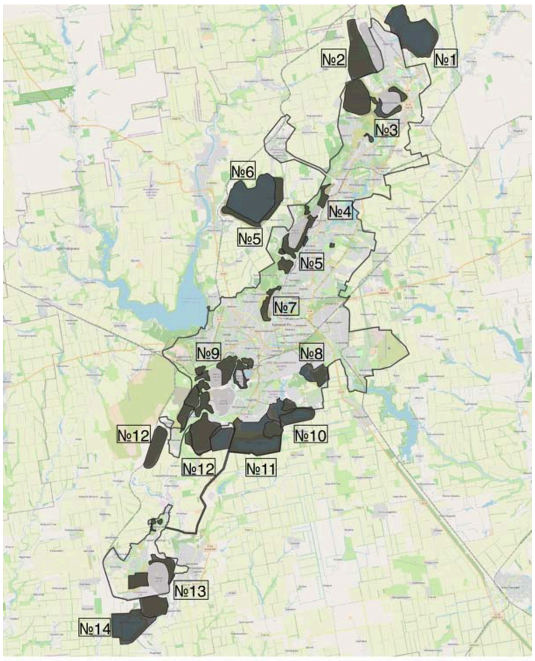
Today, the total area of mining landscapes of Kryvyi Rih is 201 km^2 (which can be compared with the area of the city of Lviv, which is 149 km^2, and the city of Odesa - 162.4 km^2).

The structure of the city's mining landscapes is as follows: the area of quarries is more than 42 km^2; the area of the dumps is 70 km^2; sludge storage area - 55 km^2; the area of mine failures and displacement zones is 34 km^2. The given figures are constantly changing, due to the unceasing continuation and growth of mining operations and dumping. [2, 3] *(See Fig. 5)*



1)Hannivskiy quarry; 2)Pershotravneviy quarry; 3)Novokryvorizkiy Iron Ore Enrichment Works quarry; 4)Hleyvatskiy quarry; 5)Southern and Northern quarries; 6)№ 2 Novokryvorizkiy Iron Ore Enrichment Works quarry; 7)№ 3 Novokryvorizkiy Iron Ore Enrichment Works quarry; 8)Southern Iron Ore Enrichment Works quarry; 9)Inhulets Iron Ore Enrichment Works quarry; 10)Flooded granite quarries.

Fig. 2: Map of quarries.



1)Northern sludge storage; 2)Dump of the Hannivskiy quarry; 3)Dump of the Pershotravneviy quarry; 4) Dump of the Central Iron Ore Enrichment Works quarry; 5)Dump of the Hleyvatskiy quarry; 6)Central Iron Ore Enrichment Works sludge storage; 7)Dump of the Southern and Northern quarries; 8)Kryvyi Rih Cement Plant sludge storage; 9)Dump of the N°2, N°3 Novokryvorizkiy Iron Ore Enrichment Works quarries; 10)Novokryvorizkiy Iron Ore Enrichment Works sludge storage; 11)Southern Iron Ore Enrichment Works sludge storage; 12)Dump of the Southern Iron Ore Enrichment Works quarry; 13)Dump of the Inhulets Iron Ore Enrichment Works quarry; 14)Inhulets Iron Ore Enrichment Works sludge storage.

Fig. 3: Map of industrial dumps.

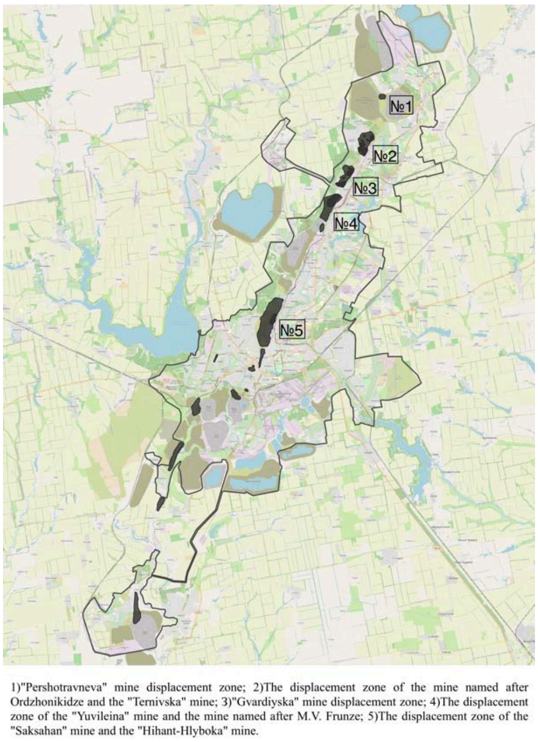


Fig. 4: Map of failed landscapes.

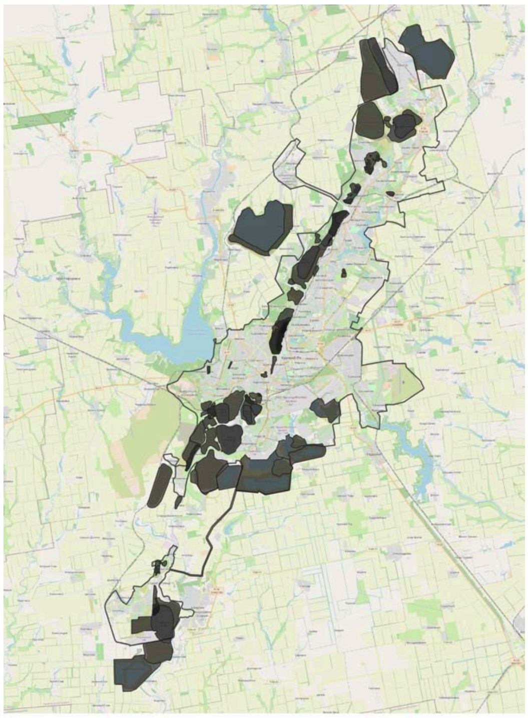


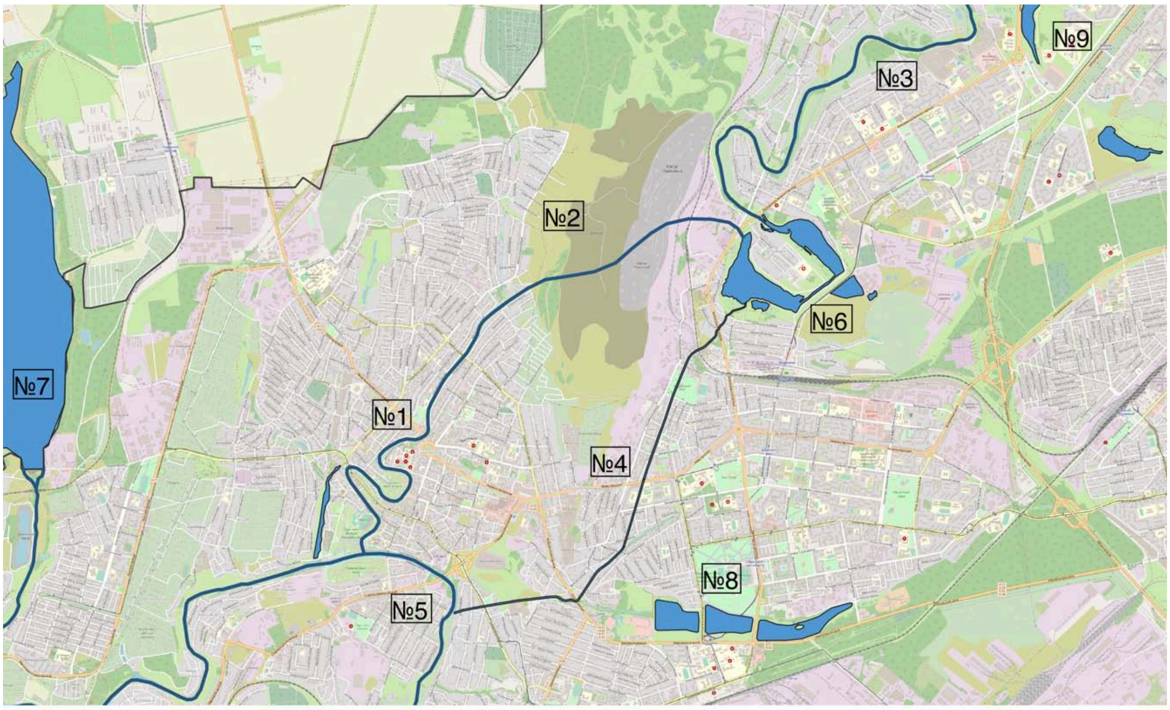
Fig. 5: Map of mining landscapes.

In order to understand the entire complex of geospatial changes of the territory of the city and the region, the issue of geographical features of Kryvyi Rih is important. The territory is located in the steppe zone and does not have large natural sources of water supply. And the development of the city's industrial complex was directly related to the creation of the necessary reserves of high-quality fresh water. This task was solved by the construction of a number of reservoirs on the existing river network and the construction of the Dnipro - Kryvyi Rih canal with a length of 41.3 km. Large-scale construction made it possible to ensure the supply of huge volumes of water for the needs of industry and the city's population.

Water supply to the city and the Kryvyi Rih region is carried out from two main sources: the Karachuniv reservoir and the Southern reservoir. There are a total of 5 reservoirs near the city, which perform different functions:

- The Karachuniv reservoir (area reaches over 36 km²) on the Inhulets river (the largest and oldest - 90 years) is used as a source of water intake, a recreation area, for fish farming, land irrigation and flood water level regulation. It was laid in 1930 in connection with the construction of the Kryvyi Rih Metallurgical Plant (now ArcelorMittal Kryvyi Rih).
- The southern reservoir was artificially created in the Taranova and Chebanka streams (the basin of the Kamianka river). It was built in 1961 to store Dnipro water, which is supplied to it by the Dnipro-Kryvyi Rih canal and is intended for drinking and domestic purposes, irrigation of agricultural land.
- The Iskriv reservoir was built in 1958. Length 35 km, width up to 1.7 km. The reservoir was built for the technical water supply of the Kryvyi Rih basin and the city of Yellow Waters, as well as for irrigation.
- The Kresiv reservoir was created on the Saksahan river at the beginning of the 20th century for a hydroelectric power plant. Water can be used only for technical purposes.
- Makortov reservoir on the Saksahan river 25 km from the town of Zhovti Vody, created in 1958. The reservoir is the first of the cascades of Saksahan reservoirs and accumulates Saksahan river runoff.

The water is used for industrial water supply of the Kryvyi Rih iron ore basin, irrigation of agricultural lands. [5]. *(See Fig. 6)*



1)The old channel of the Saksahan river; 2)Path of the Saksahan river before the construction of the South and North quarries; 3)Saksahan river; 4)Saksahansky derivation tunnel; 5)Inhulets river; 6)Saksahan reservoir; 7)Karachuniv reservoir; 8)"ArcelorMittal Kryvyi Rih" settling ponds; 9)Ponds of "Sonyachny" and "Hirnytskyi" microdistricts.

[Fig. 6]

The Saksahansky derivation tunnel was built in 1957, simultaneously with the Saksahansky reservoir. The construction of the tunnel was due to the availability of rich iron ores in the Saksahan river valley, after the diversion of the river, iron ore mining began in the newly established "Pivdenniy" quarry, located in the mine field of the mine Kirova.

The tunnel, 5.3 km long, at depths from the day surface of 24-65 m, from the Saksahan reservoir to the exit portal on the Inhulets river. The exit portal, i.e. the present-day mouth of the Saksahan river, is located 1.5 km downstream of the Inhulets river than the historical mouth.

Unfortunately, the industrial development of the region, in addition to economic and social benefits and geospatial changes of the territory, led to serious environmental consequences. Kryvyi Rih is one of the most ecologically dangerous cities in Ukraine. Mining and processing enterprises, to which the city owes its development, are also its biggest problem. The volume of products produced at the enterprises of the complex reaches 33% of the total volume of production in Ukraine, and emissions of pollutants into the air by the enterprises of the complex, according to unofficial data, annually amount to more than 1.5 million tons, or almost 32% of the total emissions in the country. From these data, it becomes clear what an extraordinary environmental load the 600,000-strong population of the industrial city and the environment receives.

Atmospheric air experiences the greatest negative impact from the activities of enterprises in Kryvyi Rih. The main pollutants are carbon monoxide (73%), dust (15%), sulfur dioxide (3%) and other harmful substances (hydrogen sulfide, ammonia, phenol, formaldehyde and others). Although official statistics emphasize the annual reduction of emissions into the atmosphere and the improvement of cleaning technologies at the enterprises of the region, in reality, public activists and independent environmentalists record repeated unauthorized emissions of harmful substances into the atmosphere and significantly higher emission rates. [8]

In July 2019, the government created the "Office of Control of Emissions into the Atmosphere" in Kryvyi Rih. The main task of this inspection is to control emissions of polluting enterprises. After all, the network of control points is located in the system of the enterprises themselves, so the real state of emissions and even the access of independent ecologists to the enterprises is extremely complicated.

The low level of efficiency in the use of subsoil and raw materials with significant volumes of its extraction led to large losses of minerals in the subsoil and the accumulation of a large amount of production waste in the form of dumps and sludges.

One of the problems is soil pollution as a result of the activities of industrial enterprises. Polluting substances enter the atmospheric air, and then settle on the ground and are washed away by precipitation within a radius of up to 5 km from a stationary source of emissions.

One of the objects of the environment, the most important for humans and at the same time the most susceptible to the influence of heavy metals, is natural water. Their contamination with heavy metals occurs due to the discharge of insufficiently purified water by enterprises of the mining, metallurgical and metalworking industries directly into the rivers of the region. Approximately half of city wastewater is discharged into water bodies insufficiently treated, of which about 15% - without treatment at all. Up to 70% of industrial wastewater is discharged without any treatment.

The Inhulets river should be noted among the most polluted rivers. The Saksahan river also suffered an irreversible negative impact. The natural regime of the river has been greatly changed by the regulatory influence of dams, the discharge of mine and industrial waters, as well as the withdrawal of water for technical needs. Also, the transfer of a large section of the river into a derivation channel led to waterlogging of the old part of the channel. Attempts to artificially feed the old channel with a pipeline from the Karachuniv reservoir did not give the desired result. Therefore, a large section of the river on the territory of the city is actually gradually becoming swampy.

A significant concentration of potentially dangerous objects on the territory of the city (mines, quarries, landfills, sludge storage facilities, spent voids, etc.), which, if groundwater pumping is stopped or reservoirs overflow, will inevitably become a source of emergency situations and man-made disasters. The lack of a real alternative to the full use or disposal of excess return water dictates the need for annual measures to discharge excess return water from Kryvyi Rih mining and ore enterprises.

The disposal of industrial and household waste is a big problem in the cities of Ukraine. The complexity of the problem is proportional to the population and industrial potential of the city. In metallurgy and thermal energy, up to 40% of the enterprise's territory is used for waste storage. As a result, unique anthropogenic landscapes are formed in close proximity to human habitation. They are due to the presence of waste from the mining industry, which is presented in the form of dumps, sludge storages, terricones and landfills, which form zones of man-made desertification, the area of which by the end of the 20th century. was about 8% of the total territory of Ukraine. Even according to official statistics, emissions of harmful substances amount to more than 395,000 tons - 590 kg per person. But independent experts talk about exceeding these data several times. Also, almost 9 billion tons of industrial waste have accumulated at the enterprises of the region, which causes the clogging of huge areas of fertile land.

In the process of production activities of Kryvyi Rih enterprises, more than 169 million m3 of industrial waste is generated annually, which is taken to landfills and sludge storage facilities, where more than 2.5 billion m3 of enrichment waste is already stored; they cover an area of about 16,000 hectares. This means that huge areas of fertile land are lost forever, and the area of these objects will increase every year. It should be noted that these objects also have a negative impact on the environment, as they pollute huge areas of agricultural land and residential areas. [8]

The main polluting enterprises are located in the immediate vicinity of residential areas, since historically urban residential buildings were formed for the needs of each enterprise.

Mining of ore in the subsoil, pumping of underground water, a huge amount of artificial sediments created by man - cause changes in the geological structure, which cause an increase in the man-made crisis.

The city's environmental program provides for industrial enterprises to modernize existing production facilities and dust and gas treatment plants, build new efficient dust and gas collection systems, as well as a set of dust suppression measures at landfills, sludge storage facilities, product warehouses, industrial sites, highways, streets of residential areas in the area of industrial activity including the use of binders, as well as cooperation with specialized scientific organizations on the development, review and implementation of new technologies for dust suppression, including "green technologies". But all the measures envisaged by the program require constant state control. [1].

The city experienced rapid economic development in the 20th century. from a town of 20,000 people, it grew into a large city, which at the beginning of independence reached almost a million people. Industrial development became the impetus for the development of residential construction and the unification of many towns of Kryvyi Rih agglomeration into a large city, which is the longest in Ukraine and Europe.

During the Soviet era, all giant enterprises such as "ArcelorMittal Kryvyi Rih" and 5 Iron Ore Enrichment Works emerged, which became the largest mining and metallurgical enterprises of Ukraine. This led to the development of railways, road and air routes.

What became a decisive factor for the rapid development of the city. Today, Kryvyi Rih is the "metallurgical capital of Ukraine", one of the largest cities and has great prospects for development and improvement of the standard of living. The city has one of the lowest unemployment rates.

But at the same time, the city's enterprises are among the biggest air polluters in Ukraine, which have a negative impact on the air, rivers and fertile soils of the region. Due to the unsatisfactory condition of the components of the natural environment, the incidence of lung diseases and cancer in Kryvyi Rih residents is very high.

The industrial landscapes formed as a result of iron ore mining and processing carry a potential man-made danger and require a constant search for solutions for their reclamation, conservation and disposal of production waste.

Although dust and gas capture systems have been used in recent decades, and the rates of extraction and processing have decreased, thereby reducing the impact on the environment, the ecological situation in the city is very complex and requires constant monitoring by state environmental inspections and the public.

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Contradiction to Neutralization Reactions

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ABSTRACT

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ABSTRACT

This article contradicts Neutralization reactions by considering the real-life examples of the three most common Neutralization Reactions.

Keywords: neutralization reactions, gases, unbalanced equations, contradiction.

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I. INTRODUCTION

Neutralization reactions are defined as "when an acid reacts with an alkali it results in Salt and Water" today. This research article contradicts the Neutralization equations by stating that the result of the reaction of an acid with an alkali not only results in salt and water but also gas. So the general Neutralization reaction is not.

$$\text{Acid} + \text{Akali} \rightarrow \text{Salt} + \text{Water}$$

But in the corrected form it should be

$$\text{Acid} + \text{Akali} \rightarrow \text{Salt} + \text{Water} + \text{Gas}$$

And this is a contradiction to the current Neutralization reactions.

II. MAIN METHODS, RESULTS, AND DISCUSSION

Let us consider the three most common Neutralization reactions that are commonly encountered today.

$$2NaOH+H_2SO_4 \rightarrow Na_2SO_4+2H_2O \quad (1)$$

$$HCL + NAOH \rightarrow NACL + H_2O \quad (2)$$

$$HNO_3 + KOH \rightarrow KNO_3 + H_2O \quad (3)$$

The first reaction whereby Sodium Hydroxide reacts with Sulphuric acid results in Sodium Sulphate and water. This reaction also releases Sulphur dioxide gas. The second reaction whereby Hydrochloric acid reacts with Sodium Hydroxide results in Sodium Chloride and water. This reaction also releases Chlorine gas The third reaction whereby Nitric acid reacts with Potassium hydroxide results in Potassium nitrate and water. This reaction also releases Nitrous Oxide gas.

As we see the above reactions will change with Sulphur dioxide, Chlorine, and Nitrous Oxide gases on the right side of the equations (1), (2), and (3) respectively, thereby contradicting Neutralization reactions.

From the above discussion, we note that a Neutralization reaction whereby when an acid reacts with an alkali it results not just in Salt and water but also in a gas which is unaccounted in the present three neutralization reactions. Hence Neutralization reactions are contradicted as the reactions need to be re-balanced.

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III. CONCLUSION

The Neutralization reactions are contradicted.

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