Slovak international scientific journal

№88, 2024
Slovak international scientific journal

The journal has a certificate of registration at the International Centre in Paris – ISSN 5782-5319.
The frequency of publication – 12 times per year.
Reception of articles in the journal – on the daily basis.
The output of journal is monthly scheduled.
Languages: all articles are published in the language of writing by the author.
The format of the journal is A4, coated paper, matte laminated cover.
Articles published in the journal have the status of international publication.

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Slovak international scientific journal
Partizanska, 1248/2
Bratislava, Slovakia 811 03
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BOTANY

РАЗМНОЖЕНИЕ НЕКОТОРЫХ ПРЕДСТАВИТЕЛЕЙ СЕМЕЙСТВА FAGACEAE, РАСПРОСТРАНЕННЫХ В ГУБИНСКОМ РАЙОНЕ, В УСЛОВИЯХ АБШЕРОНА (АЗЕРБАЙДЖАН)

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REPRODUCTION OF SOME REPRESENTATIVES OF THE FAGACEAE FAMILY, COMMON IN THE GUBA REGION, IN THE CONDITIONS OF ABSHERON (AZERBAİJAN)

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Аннотация

Представители семейства арахисовых (*Fagaceae* Dumort.) сформировались в середине мелового периода мезозойской эры и имели широкий ареал в третьем периоде кайнозоя. Раскопанные останки были найдены в Европе, Азии и Северной Америке. Находки в Арктике показывают, что эти представители гораздо старше. Виды, относящиеся к современному семейству фисташковых, самостоятельно появились на земле в конце эоцена — начале олигоцена. Ископаемые фисташки на Кавказе были найдены в плиоценовых отложениях кайнозойской эры в Западном Закавказье.

На Кавказе и в Азербайджане широко распространены представители 3 родов, принадлежащих к семейству Фисташковых, - дуба (*Quercus* L.), бука (*Fagus* L.) и каштана (*Castanea* Mill.).

На территории Губы представители арахиса широко распространены и образуют лесные массивы. Буковые и дубовые леса занимают большую площадь в Губинском, Гусарском и Девечинском районах.

Для изучения вопросов интродукции фисташек, распространенных на северо-востоке Большого Кавказа, в условиях Абшерона особое значение имеет размножение их семенами в новых экологических условиях.

Abstract

Representatives of the peanut family (*Fagaceae* Dumort.) formed in the middle of the Cretaceous period of the Mesozoic era and had a wide range in the third period of the Cenozoic. Excavated remains were found in Europe, Asia and North America. Finds in the Arctic show that these representatives are much older. Species belonging to the modern pistachio family independently appeared on earth at the end of the Eocene - beginning of the Oligocene. Fossil pistachios in the Caucasus were found in Pliocene deposits of the Cenozoic era in Western Transcaucasia.

Representatives of 3 genera belonging to the Pistachio family are widespread in the Caucasus and Azerbaijan: oak (*Quercus* L.), beech (*Fagus* L.) and chestnut (*Castanea* Mill.).

In the territory of Guba, representatives of peanuts are widespread and form forest areas. Beech and oak forests occupy a large area in the Guba, Gusar and Devechi districts.

To study the issues of introducing pistachios, common in the northeast of the Greater Caucasus, in the conditions of Absheron, their reproduction by seeds in new ecological conditions is of particular importance.

Ключевые слова: дуб, бук, интродукция, семя, Апшерон.

Keywords: oak, beech, introduction, seed, Absheron.

Семя — самостоятельный организм, образующийся после процессов опыления и оплодотворения в пестике, и составляет эмбриональную стадию растения в его онтогенетическом развитии. Онтогенез семени начинается с периода покоя. Покой и прорастание являются альтернативными состояниями семени и неотделимы друг от друга. Физиологический покой начинается только в условиях прорастания семян. К физиологическому покою относятся все процессы, подавляющие прорастание и устраняющие покой [14, 15, 19].

В литературе он встречается в работах многих исследователей по размножению деревьев и кустарников арахиса семенами [10, 23,5, 7, 18, 10, 23, 18, 10).

Размножение представителей арахиса исследуемого региона в природных и культурных условиях сравнительно мало изучено. С этой точки зрения большое значение имеет изучение размножения арахиса в условиях Апшерона.

МАТЕРИАЛЫ И МЕТОДИКА

В 2023-2024 гг. распространились 5 видов (Fagus orientalis Lipsky, Quercus pedunculiflora C

Koch, Quercus pedunculiflora C Koch, Q macranthera Fisch et Mey ex Hohen), принадлежащих к двум родам (Quercus L, Fagus L) семейства буковых (Fagaceae Dumort). на территории Губы Q pubescens Willd, Q iberica Srev) изучено размножение в условиях Абшерона.

Научно-исследовательская работа проводилась в Центральном ботаническом саду НАНА. Семенное размножение изучаемых растений проводили по методу М.К. Фирсова, В.В. Огиевского и др. [20], П.Е. Левиной [14], П.С. Левиной [15], а также методом загонного размножения по Т.В. Хромовой, С.С. Плотниковой и Т.В. Хромовой [21]. Семена для опыта были собраны в лесах Губы.

РЕЗУЛЬТАТЫ И ИХ ОБСУЖДЕНИЕ.

В проведенных исследованиях семена сортов бука восточного и дуба высевали на грядках из почвы, песка, навоза (1:1:1) осенью (октябрь-ноябрь) и весной (март) на опытном поле. Семена изучаемых видов при осеннем и весеннем посеве дали в 1-й год массивные всходы. В зависимости от сроков посева отдельные всходы наблюдались в третьей декаде марта, массовые – во второй декаде апреля. При весеннем посеве отдельные ростки образовывались в третьей декаде апреля и первой декаде мая, массовые - во второй и третьей декаде мая.

Семена дубовых пород, посеянных осенью, проросли через 140-157 дней после посева, а у бука восточного - через 155 дней после посева. Продолжительность прорастания семян у пород дуба варьировала от 35 до 57 дней. Для прорастания семян требуется 20 дней. Он длится 35 дней у Q. macranthera, 42 дня у *Q. iberica, Q. pedunculiflora* и 57 дней у *Q. pubescens*. Всхожесть семян дуба при осеннем посеве составила 68-100%, а виды Q. macranthera отличались высоким процентом всхожести (98-100%). У *Q. iberica* этот показатель был несколько ниже (68%). Семена *Fagus orientalis* дали всхожесть 62%. Всхожесть семян дуба при весеннем посеве повышается до 75-95%.

Несколько выше этот показатель был у видов *Q. pedunculiflora* и *Q. macranthera* (91-95%). Продолжительность прорастания семян дуба летом колеблется в пределах 32-61 дня. Прорастание длится 32 дня у Quecus pedunculiflora, 43 дня у *Q. pubescens*, 50 дней у *Q. macranthera*, 61 день у *Q. iberica*.

Результаты, полученные при размножении изучаемых растений в естественных условиях семенами осенью и весной, оказались близкими. Многим растениям, которые растут естественным путем, требуется период покоя после того, как их семена созреют. Покой семян играет ключевую роль в их дальнейшем развитии. Такие семена не прорастают при посеве в поле весной. Этой особенностью характеризуются и семена бука восточного. Семена Fagus orientalis подвергались длительной стратификации (90 дней) для получения большого количества всходов при весеннем посеве. В наших исследованиях стратифицированные семена бука восточного дали всхожесть 67%.

По результатам проведенных исследований можно отметить оптимальные сроки посева видов дуба (*Q.pedunculiflora* C.Koch, *Q.macranthera* Fisch. et Mey. ex Hohen., *Q.pubescens* Willd., *Q.iberica* срев.) в условиях Апшерона приходится на осень октябрь-ноябрь, весна - на март. При осеннем посеве проросло 68-100% семян дуба, при весеннем - 76-95%. Семена арахиса восточного прорастали на 62% при осеннем посеве, а всхожесть увеличивалась до 67% при 90-дневной стратификации семян. Прорастание семян при осеннем посеве у бука восточного продолжалось 20 дней, а у дуба колебалось в пределах 35-57 дней. При весеннем посеве этот показатель сохранялся от 32 до 61 дня. Чтобы сохранить важные формы растений ценных сортов, их размножают вегетативно. Сохранение ценных хозяйственных признаков и особенностей растений определяет большое значение и роль вегетативного размножения. В то же время при вегетативном размножении растения в первые 2-3 года растут быстрее, раньше начинают фазу цветения и плодоношения. В работах различных исследователей имеется достаточно сведений о размножении растений зимними и летними загонами.

Нами были проведены опыты по размножению представителей арахиса в закрытых условиях в зимних и летних загонах. Для укоренения карандашей использовали 0,005% раствор ЙТ. Зимние и летние загоны изучаемых видов обрабатывались в течение 24 часов.

Несмотря на приложенные в ходе исследования усилия, положительных результатов получено не было. Причина этого в том, что черенки, взятые со старых дубов, не могут прижиться. Таким образом, на основании проведенных экспериментов был сделан вывод, что изученные растения нормально размножаются в условиях Абшерона.

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СУЧАСНІ РІШЕННЯ ТА ПІДХОДИ ДО МАСШТАБУВАННЯ ДОДАТКІВ

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MODERN SOLUTIONS AND APPROACHES TO APPLICATION SCALING

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DOI: 10.5281/zenodo.13926460

Анотація

Стаття присвячена сучасним рішенням та підходам до масштабування додатків в умовах високих навантажень. Розглядаються приклади провідних компаній, таких як Netflix та Meta, які використовують власні системи для ефективного управління ресурсами, прогнозування та балансування навантаження. Обговорюються технології контейнеризації, оркестрації, оптимізація баз даних та мікросервісна архітектура, що дозволяють адаптувати інфраструктуру до змінних вимог і забезпечувати стабільну роботу сервісів.

Abstract

The article explores modern solutions and approaches to scaling applications under high load conditions. It examines examples from leading companies such as Netflix and Meta, which use custom systems for efficient resource management, load prediction, and balancing. The discussion covers technologies like containerization, orchestration, database optimization, and microservice architecture, which enable adapting infrastructure to changing demands and ensure stable service operation.

Ключові слова: горизонтальне масштабування, вертикальне масштабування, мікросервісна архітектура, масштабування баз даних, масштабування у хмарі.

Keywords: horizontal scaling, vertical scaling, microservices architecture, database scaling, cloud scaling.

Понад 5 мільярдів людей користуються Інтернетом, що означає зростання на 1392% з 2000 року [1]. Глобальні онлайн-платформи, такі як Instagram і Uber, щодня обробляють величезні обсяги даних, і кількість їхніх користувачів продовжує зростати. Наприклад, Instagram має понад 2 мільярди активних користувачів щомісяця [2], а Uber обслуговує 131 мільйон користувачів щомісяця [4]. Щодня у Twitter надсилаються сотні мільйонів твітів [3]. Щоденно Google обробляє понад 8,5 мільярда пошукових запитів, що підкреслює обсяги даних, з якими працюють сучасні онлайн-сервіси [5].

Таке стрімке зростання кількості користувачів і даних вимагає високої масштабованості систем, яка дозволяє додаткам ефективно адаптуватися до змін навантаження. За даними Gartner, понад 60% компаній стикаються з проблемами продуктивності через недостатнє масштабування [6]. Масштабованість стає ключовим фактором успіху для сучасних платформ, оскільки вона допомагає ефективно відповідати на виклики зростання обсягів даних і трафіку та забезпечує стабільну роботу навіть під час пікових навантажень. Якщо масштабованість не була врахована під час проектування системи, це може призвести до мільярдних втрат [7].

Основні поняття масштабування

Масштабованість (scalability) визначає здатність системи вміщувати постійно зростаючу кількість елементів або об'єктів, без проблем опрацьо-

вувати зростаючі обсяги роботи та/або адаптуватися до зростання [8]. У контексті програмного забезпечення масштабованість визначається за такими параметрами:

- Кількість одночасних запитів користувачів (або зовнішніх), які система може обробити.
- Обсяг даних, що може бути ефективно оброблений.
- Цінність даних у системі, яку можна отримати за допомогою прогнозної аналітики.
- Здатність підтримувати стабільний і постійний час відгуку при зростанні навантаження запитів [9].

Масштабованість досягається за допомогою двох підходів, а саме збільшення ємності (capacity) системи та оптимізація її компонентів.

У свою чергу, збільшення ємності системи може бути досягнуто також двома методами:

- вертикальне масштабування (vertical scaling / scaling up);
- горизонтальне *масштабування* (horizontal scaling / scaling out).

При цьому, найчастіше не менш важливою є можливість динамічно зменшити ємність системи для зменшення витрат.

Вертикальне масштабування позначає додавання ресурсів до окремого вузла системи, що зазвичай залучає додавання процесорів або пам'яті до окремого комп'ютера. Такий підхід дозволяє швидко підвищити продуктивність без змін в архітектурі додатка, але має обмеження через фізичні межі апаратного забезпечення.

Google Cloud Platform (GCP) пропонує інстанси типу n1-highmem-96 з 96 віртуальними процесорами і 624 GB оперативної пам'яті [10], що є прикладом вертикального масштабування, оскільки ресурси додаються на одному сервері.

Подібний підхід використовує Amazon Web Services із серією інстансів типу R5, які мають до 96 vCPU та до 768 GB оперативної пам'яті. Це дозволяє працювати з великими обсягами даних та виконувати обчислення, які вимагають великої потужності. Microsoft Azure пропонує серію M-віртуальних машин, спеціально розроблених для критично важливих завдань з високими вимогами до пам'яті, де інстанси можуть мати до 128 ядер і до 3.8 TB оперативної пам'яті.

Усі три платформи мають свої сильні сторони у вертикальному масштабуванні, але обмеження зростання одного вузла спільне для всіх: у певний момент фізичні межі інстансів досягаються, і подальше масштабування стає неможливим без переходу до горизонтального підходу. Тому вертикальне масштабування часто використовується як перший етап масштабування перед переходом до більш гнучкого горизонтального підходу.

Вертикальне масштабування БД може бути ефективним для додатків з обмеженою кількістю користувачів. Окрім цього, одним із підходів є зменшення обсягу запитів до бази даних. Це можна досягти за допомогою використання розподіленого кешу (distributed cache). Тоді при запиті від зовнішніх сервісів спочатку перевіряється кеш, і тільки у випадку відсутності відповідних даних у ньому робиться запит до бази даних.

Обмеження вертикального масштабування. Однак багато систем вимагають доступу до дуже великих обсягів даних, що робить використання однієї БД практично неможливим. Додатково, згідно з законом Амдала [11], ефективність додавання процесорів до окремого вузла сильно залежить від того, яка частина програми, у процентах, виконується паралельно. Наприклад, якщо 50% програми виконується послідовно, то додавання більше 8 ядер не надає майже ніякого ефекту. У таких випадках існує два варіанти вирішення цієї проблеми: оптимізація коду та використання розподілених БД.

Горизонтальне масштабування — це додавання нових вузлів до системи, наприклад, додаткових серверів до розподіленого додатку [12]. Горизонтальне масштабування дозволяє реплікувати сервіси та розміщувати їх на різних вузлах, що забезпечує гнучкість і стійкість до збоїв.. Зазвичай, цей підхід вимагає наявності двох ключових компонентів: балансиру навантажень (load balancer, що перенаправляє запити до відповідних сервісів і повертає результати клієнтам) та безстанових сервісів (stateless services, які не зберігають даних про окремі клієнтські сесії).

Приклади використання горизонтального масштабування:

- **Amazon.com та мікросервісна архітектура:** Amazon.com використовує мікросервісну архітектуру, розділяючи додаток на понад 100 мікросервісів [13].
- **Розподілені бази даних:** Розподілені бази даних покращують доступність системи, підтримуючи реплікацію вузлів, які зберігають дані. Це дозволяє доступ до даних навіть при проблемах із початковим вузлом.
- **Бази даних у хмарі:** Питання масштабованості, еластичності та автономності баз даних у хмарі можна розглядати, використовуючи два підходи [12]: злиття даних (Data Fusion) і поділ даних (Data Fission), прикладами яких є MegaStore від Google та MS SQL Azure.
- **Модифікації для високонавантажених систем:** Facebook використовує модифікації Apache Hadoop, зокрема Hadoop Distributed File System (HDFS), а також власні системи автоматичного масштабування, які дозволяють ефективно управляти ресурсами у горизонтально масштабованих середовищах з високим навантаженням, як-от Facebook Messages.

Усі ці приклади ілюструють важливість горизонтального масштабування для сучасних високонавантажених систем, нижче будуть розглянуті детальніше. Вони показують, як поділ обчислень між декількома вузлами або сервісами допомагає уникнути вузьких місць, підвищує надійність системи та дозволяє ефективно обробляти значні обсяги запитів навіть під час пікових навантажень. Горизонтальне масштабування не лише покращує продуктивність, але й забезпечує стійкість до збоїв, гнучкість і адаптивність, що є критичними факторами успіху

для великих компаній, таких як Amazon та Facebook.

Вищезазначені компоненти системи можуть бути організовані у різні шари, кожний з яких включає свій балансир навантажень, системи кешування та інші сервіси, які спілкуються між собою через визначені API. Таке розміщення в шарах дозволяє ізолювати різні аспекти додатку, забезпечуючи тим самим більшу модульність та незалежність компонентів. Наприклад, мікросервісна архітектура дозволяє кожному сервісу функціонувати незалежно, спрощуючи процеси розробки, тестування та впровадження змін. Кожен шар може бути масштабований незалежно від інших, що є особливо корисним у системах з великим навантаженням або коли потрібно швидко реагувати на зміни у вимогах до системи.

Мікросервісна архітектура дозволяє додатку розділятися на менші компоненти, кожен з яких може масштабуватися незалежно, забезпечуючи гнучкість і швидку реакцію на зміни навантаження. Втім, слід ретельно планувати взаємодію між ними, щоб уникнути затримок у роботі.

Зі збільшенням бази користувачів і запропонованих сервісів веб-додатків спостерігається стрімке зростання різноманітності та складності серверних служб, з яких вони складаються [14]. Наразі є тенденція використання мікросервісних моделей [15] [16] [17], у яких програма розділяється на окремі мікросервіси [18], кожен з яких виконує спеціалізовані функції, такі як управління HTTP-підключенням, маршрутизація протоколів [19], подача реклами [20]. Такі моделі забезпечують незалежну масштабованість компонентів за допомогою адаптації кількості фізичних серверів або потужностей, призначених для кожного мікросервісу, у залежності від щоденних та довгострокових тенденцій навантаження [17].

При великій кількості користувачів монолітна архітектура може бути менш ефективною порівняно з мікросервісною архітектурою. При порівнянні монолітної та мікросервісної архітектури у хмарних веб-додатках [17] зазначається, що для додатків з невеликою кількістю користувачів (сотні або тисячі) використання монолітного підходу може бути більш практичним.

Приклади використання мікросервісної архітектури:

- **Amazon.com** використовує понад 100 сервісів для повернення однієї сторінки користувачу. Кожен мікросервіс може бути незалежно розгорнутий на окремих серверах чи контейнерах і масштабований залежно від потреби у ресурсах. Взаємодія між мікросервісами здійснюється через легкі протоколи обміну даними, що забезпечує швидку відповідь і високу доступність сервісу, особливо при збоях одного чи декількох сервісів. Це дозволяє, у випадку збою одного сервісу, іншим сервісам перейняти його функції, забезпечуючи безперервність обслуговування та високу доступність. Ця модель також підвищує стійкість системи до відмов [13]. Впровадження мікросервісів у Amazon показує, як поділ додатку на незалежні сервіси допомагає легше керувати ресурсами та підвищувати стійкість до збоїв.
- **Google Cloud Platform (GCP)** пропонує інстанси типу n1-highmem-96, які мають 96 віртуальних процесорів і 624 GB оперативної пам'яті, що дозволяє значно знизити навантаження на бази даних за рахунок використання розподіленого кешування. Така стратегія допомагає зменшити кількість запитів до бази даних, знижуючи час відгуку і підвищуючи загальну продуктивність системи [10].

Технологічні аспекти: Мікросервісна архітектура вимагає впровадження балансувальників навантаження та безстанових сервісів, які не зберігають інформацію про стан клієнтських сесій, дозволяючи розподіляти запити між вузлами динамічно і ефективно. Це підтримує рівномірне розподілення навантаження і дозволяє системі ефективно масштабуватися.

Такий підхід дозволяє компаніям розробляти та впроваджувати нові функціональні можливості швидко і з меншими затратами, адаптуючи кожен сервіс незалежно до змін у бізнес-вимогах або навантаженні без ризику для цілісності загальної системи.

Масштабування баз даних:

Розподілені бази даних (Data Sharding):

Розподілені БД можна поділити на дві основні категорії:

- Розподілені SQL (structured query language) БД, які представляють собою єдину логічну БД, яка розподілена по декількох фізичних вузлах. До них також відносяться NewSQL БД.
- Розподілені NoSQL (not only SQL) БД, що використовують різноманітні моделі та мови запитів та зберігають дані на окремих вузлах, доступ до яких можливий окремо.

Розподілені бази даних покращують доступність системи. Вони підтримують реплікацію вузлів, які зберігають дані, що дозволяє отримувати доступ до даних навіть у випадку проблем з основним вузлом. Хоча розподілені бази даних мають багато переваг, вони, як і інші компоненти масштабованих систем, вимагають компромісів. Основним компромісом для баз даних є узгодженість (consistency).

Для масштабування розподілених баз даних зі спільним доступом до даних автори [21] пропонують альтернативну архітектуру для розподілених БД, яка базується на двох принципах, а саме відділення обробки запитів від сховища даних, та спільне використання даних вузлами (sharing data), що оброблюють запити. Дані зберігаються у розподіленому менеджері записів, який складається з множини вузлів-сховищ. Шар обробки складається з множини вузлів обробки, які мають доступ до спільної системи сховища (storage system). Пропонується механізм вилучення даних безпосередньо з вузла, у якому вони знаходяться. Вузли обробки та сховища можуть масштабуватися окремо, у залежності від конкретних вимог. Архітектура підтримує як OLTP (Online Transaction Processing / онлайнова обробка транзакцій), так і OLAP (Online Analytical

Processing / аналітична обробка у реальному часі) навантаження. Запропонована архітектура найкраще підходить для локальних мереж (LAN – local area network), т.я. вона покладається на низьку латентність, інтенсивний обмін даними, обмежену буферізацію та синхронну реплікацію для запобігання втрати даних у випадку аварії.

NoSQL та модифікації HBase: Масштабованість можна покращити за допомогою модифікацій до розподіленої бази даних типу NoSQL HBase [22]:

- Підтримка гарантованих мультиколонкових транзакцій.
- Можливість оновлення програмного забезпечення кластерів без призупинення роботи бази даних.
- Оптимізація пошуку.
- Новий формат файлів бази даних – HFile V2, який підтримує багаторівневі індекси.
- Оптимізація ущільнення (compaction).
- Підтримка розподіленого поділу логів по різних серверах та інші.

Варто зазначити, що через декілька років ця система була мігрована до MyRocks – MySQL підсистеми зберігання (storage engine), оптимізованої щодо розміру даних та швидкості запису [23] [24]. Ця міграція дозволила спростити схему БД, зменшити фактор реплікації даних з 6 до 3, використовувати алгоритм компресії Zstandard [25], та у цілому зменшити розмір даних на 90%. Інші переваги нової системи включають спрощення відновлення сервісу у випадку аварії, оптимізація використання флеш-пам’яті, яка призвела до зменшення латентності читання (read latency) у 50 разів, та ін.

DBX – резидентна база даних: Іншим прикладом створення масштабованої бази даних була розробка DBX – резидентної БД [26], яка використовує обмежену транзакційну пам'ять Intel RTM (Restricted Transactional Memory, технологія для роботи з транзакціями в оперативній пам'яті). Авторам вдалося досягти 506817 транзакцій за секунду на 8-поточному Haswell ЦП.

Масштабування баз даних є критичним аспектом для підтримки продуктивності сучасних додатків з великим навантаженням. Розподілені бази даних дозволяють системам ефективно розподіляти дані між декількома вузлами, що підвищує доступність, надійність і стійкість до збоїв. Оптимізація NoSQL баз даних, таких як MongoDB, Cassandra та Redis, забезпечує гнучкість у роботі з нереляційними даними та значно покращує продуктивність завдяки можливостям горизонтального масштабування. Використання цих підходів дозволяє зменшити навантаження на окремі вузли, забезпечити стабільний доступ до даних навіть у пікові моменти і підтримувати високий рівень обслуговування користувачів.

Питання масштабованості, еластичності та автономності баз даних у хмарі можна розглядати, використовуючи два підходи [12]:

- **Злиття даних (Data Fusion)** передбачає використання сховищ ключ-значення та подальше групування елементів, що забезпечує багатоключовий доступ до даних. Прикладом такої системи є MegaStore від Google.
- **Поділ даних (Data Fission)** полягає в розділенні великої бази даних на осколки (shards). До таких систем належать MS SQL Azure, ElasTraS та інші.

Бази даних у хмарі надають еластичність, дозволяючи компаніям гнучко масштабувати ресурси. Контейнеризація та оркестрація, наприклад через Docker та Kubernetes, полегшують розгортання, масштабування та управління контейнеризованими додатками. NoSQL бази даних та розподілені системи, такі як Cassandra, MongoDB і Redis, підтримують горизонтальне масштабування і високу продуктивність при роботі з великими даними.

Розподілене кешування і системи управління чергами повідомлень, такі як Apache Kafka та RabbitMQ, забезпечують асинхронну комунікацію між сервісами, підвищуючи рівень відмовостійкості та масштабованості.

Масштабування веб-додатків і баз даних у хмарі охоплює кілька напрямків, включаючи використання мікросервісів, оптимізацію серверів та обчислювальних ресурсів залежно від навантаження. Це особливо важливо для високонавантажених систем, таких як Facebook Messages, де застосовуються спеціалізовані модифікації Apache Hadoop [21]. Зміни в Hadoop Distributed File System (HDFS) підвищують ефективність роботи та забезпечують горизонтальне масштабування.

У Facebook Messages використовуються такі модифікації до Hadoop:

- **AvatarNode**: Використання двох AvatarNode — активного і пасивного (standby) замість одного головного (master) NameNode. Обидва AvatarNode отримують дані від DataNodes, що дозволяє пасивному вузлу швидко стати активним при збоях, на відміну від BackupNode, для якого цей процес може тривати до 20 хвилин [21].
- **DistributedAvatarFileSystem (DAFS)**: Система забезпечує прозорий доступ до HDFS і покращує аварійну заміну головного вузла для клієнтів, завдяки оновленому Hadoop RPC, який автоматично підбирає відповідний протокол, залежно від версії ПЗ [21].
- **Модифікація розміщення блоків**: Зміни в методі розміщення блоків по серверах знижують ймовірність втрати даних у 100 разів порівняно з початковим випадковим методом [21].
- **Реальна обробка даних**: Поліпшення в обробці даних включають використання тайм-аутів у Hadoop RPCs, зчитування даних з локальних реплік і прискорений доступ до файлів, завершення запису яких відбулося некоректно [21].

Модифікації до Hadoop є частиною стратегії Facebook щодо горизонтального масштабування, яка передбачає адаптацію системи до зростання навантаження за допомогою додавання нових ресурсів. Система автоматичного масштабування Facebook, описана в [27], визначає необхідну кіль-

кість серверів на основі аналізу роботи, яку потрібно виконати серверам у будь-який момент часу, і включає такі ключові компоненти:

1. **Історичні дані**: використання історичних даних для тренування моделей машинного навчання, які виявляють закономірності в навантаженні на сервери.
2. **Моделювання ємності**: використання прогнозів моделей для визначення необхідної кількості серверів, з урахуванням поточного та прогнозованого попиту.
3. **Аварійний попит**: система враховує можливий попит у разі виходу з ладу великого центру даних.
4. **Система Watchdog**: додатковий сервіс, що забезпечує безпечне масштабування, контролюючи систему та автоматично коригуючи ресурси до рівня, визнаного безпечним (зазвичай максимальний рівень за останні сім днів).

Цей підхід до масштабування дозволяє Facebook ефективно керувати ресурсами серверів, адаптуватися до змін у навантаженні та забезпечувати надійну роботу сервісів навіть у критичних умовах.

Система Scryer від Netflix — це приклад горизонтального масштабування. Netflix ефективно управляє масштабуванням своїх сервісів, прогнозуючи навантаження та адаптуючи обчислювальні потужності для підтримки оптимальної продуктивності та мінімізації витрат за допомогою системи Scryer [28]. Система складається з чотирьох модулів: Data Collector, Predictor, Action Plan Generator і Scaler. Data Collector збирає дані з різних джерел, очищує та трансформує їх для передачі до наступного модуля. Predictor генерує прогнози на основі обраного алгоритму; використовуються два алгоритми — лінійна регресія та швидке перетворення Фур'є. Action Plan Generator застосовує прогнози разом з іншими параметрами, такими як пропускна здатність серверів, для створення плану автоматичного масштабування. План оптимізується з метою мінімізації кількості подій масштабування при збереженні оптимального розміру наступної партії. Scaler виконує згенерований план, у тому числі складає розклад масштабування за допомогою AWS API. Такий підхід допомагає Netflix не тільки знизити витрати, але й підтримувати стабільну роботу сервісу під час пікових навантажень.

Після розширення системи горизонтально (додаванням серверів) або вертикально (посиленням існуючих серверів), **балансування навантажень** забезпечує ефективний розподіл вхідних запитів між усіма доступними ресурсами. Це досягається за допомогою спеціального обладнання або програмного забезпечення, таких як балансувальники навантаження, які аналізують поточне навантаження на сервери і розподіляють запити, щоб жоден сервер не був перевантажений, забезпечуючи оптимальну продуктивність та доступність сервісів.

Для балансування навантажень існують різні підходи, включаючи еволюційні алгоритми (генетичний, мурашиний), мультиагентні системи, імовірнісні розподіли та інші. Наприклад, у [29] описано багатоступеневий процес, де спочатку використовується алгоритм машинного навчання на основі Гауссівського процесу для прогнозування динамічного навантаження, а потім застосовується кластеризація методом k-середніх для аналізу взаємодії робочих навантажень.

Балансування навантажень також можна досягти шляхом горизонтального та вертикального масштабування додатків у контейнерах, які дозволяють динамічно адаптувати ресурси, змінюючи кількість контейнерів або їх потужності залежно від поточних потреб. Серед методів, що використовуються, — Q-learning, Dyna-Q learning і навчання, засноване на моделі (Model-Based Reinforcement Learning).

Подібно до Netflix, компанія Meta (Facebook) також стикається з викликами управління високими навантаженнями на свої сервіси, але підходить до цього з іншого боку. Їхня система Taiji [30] фокусується на балансуванні навантаження між центрами даних і мінімізації затримок користувацьких запитів. Система розподіляє навантаження між центрами даних і мінімізує затримки запитів, контролюючи маршрутизацію між датацентрами та кордонними вузлами, які слугують для кешування та розповсюдження статичного контенту. Taiji складається з Runtime, який формує таблицю маршрутизації на основі політики сервісу, і Traffic Pipeline, який генерує налаштування для кожного вузла, що знижує навантаження на back-end на 17% порівняно з попередньою системою Social Hash. Цей підхід дозволяє Meta ефективно керувати користувацьким трафіком і забезпечувати безперебійну роботу своїх сервісів, зменшуючи навантаження на back-end.

Обидві системи, Scryer і Taiji, мають спільну мету — забезпечити стабільну роботу та демонструють різні підходи до управління масштабуванням і балансуванням навантаження у високонавантажених середовищах. Netflix робить акцент на прогнозуванні навантаження та динамічному масштабуванні, тоді як Meta зосереджується на оптимізації трафіку між центрами даних. Обидва підходи показують, як сучасні технологічні гіганти адаптуються до вимог постійного зростання користувацької бази та трафіку, використовуючи інноваційні рішення для забезпечення стабільної роботи своїх сервісів.

Система Kraken, хоч і не є класичним балансувальником навантаження, також сприяє ефективному управлінню ресурсами. Kraken — це відкритий P2P Docker-реєстр для масштабованої доставки контейнерних образів [31]. Він використовує пірінгову мережу для швидкої передачі даних між хостами, що знижує навантаження на центральні сервери і прискорює доставку образів у великих системах. Система підтримує горизонтальне масштабування, додаючи нові вузли, що підвищує її продуктивність і надійність, на відміну від вертикального масштабування, яке збільшує потужність окремих серверів.

Механізм узгодженого кешування впроваджений Netflix у Titus Gateway — системі управління

контейнерами, яка забезпечує ефективне керування контейнерними робочими навантаженнями, підвищуючи швидкість обробки запитів і знижуючи навантаження на основні системи [32]. Titus Gateway діє як API-шлюз, через який проходять запити на дані, і для оптимізації роботи використовується кешування. Механізм кешування зберігає часто запитувані дані, щоб зменшити час доступу до них і знизити навантаження на основні системи. Узгоджене кешування забезпечується спеціальним протоколом синхронізації, який використовує монотонні джерела часу, що дозволяє кожному запиту отримувати актуальні дані на момент запиту. Оптимізації включають групування запитів перед синхронізацією і подання даних із кінцевою узгодженістю, що підвищує продуктивність і надійність системи, особливо в розподілених середовищах, як у Netflix.

Можна відмітити, що багато компаній покладаються на готові хмарні рішення від AWS та Microsoft, проте найбільші гравці, такі як Meta (ex. Facebook), Netflix та Uber, розробляють власні системи залежно від конкретних потреб. Деякі з цих систем повністю опубліковані у вільному доступі, інші — частково розкриті через описи принципів роботи, але ще більша кількість залишаються пропрієтарними та відомі лише розробникам.

Таким чином, масштабування додатків є складною та багатошаровою проблемою, яка залишається актуальною і широко обговорюється у сучасних дослідженнях. Існує безліч підходів до масштабування, які можна поділити на категорії, як-от:

1. **Масштабування СУБД (систем управління базами даних) та БД (баз даних):** Включає оптимізацію роботи баз даних для підтримки великої кількості запитів і даних.
2. **Масштабування за допомогою мікросервісної архітектури:** Дозволяє розділяти додаток на менші, незалежні сервіси, які можна масштабувати окремо.
3. **Масштабування у хмарі:** Використання хмарних рішень для динамічного розподілу обчислювальних ресурсів, що дозволяє масштабувати системи в залежності від навантаження.
4. **Оптимізація балансувальників навантаження:** Вдосконалення механізмів розподілу запитів між серверами для забезпечення рівномірного навантаження і мінімізації затримок.
5. **Системи прогнозування навантаження:** Використання алгоритмів прогнозування для передбачення майбутніх навантажень і завчасного масштабування ресурсів.
6. **Різноманітні комбінації вищенаведених підходів:** Багато сучасних рішень включають комбінацію кількох підходів для досягнення найкращих результатів.

Масштабування додатків — це складний і багатошаровий процес, що потребує подальших досліджень для подолання поточних викликів. Незважаючи на досягнення в оптимізації ресурсів, залишаються питання ефективності та стійкості, які потребують розв'язання для забезпечення стабільної роботи великих систем.

Таким чином, подальший розвиток масштабування додатків є не лише технічною необхідністю, але й ключовою вимогою для підтримки конкурентоспроможності та надійності сучасних цифрових платформ. Глибоке вивчення існуючих рішень та створення нових технологій - основа для майбутнього розвитку інфраструктури, що відповідає вимогам стрімко зростаючих обсягів даних і користувацьких запитів.

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CONSTRUCTION AND ARCHITECTURE

ДІАЛЕКТИКА ФОРМУЛЮВАННЯ ОРГАНІЗАЦІЙНО-ТЕХНОЛОГІЧНИХ СТРУКТУР ТА КЛАСИФІКАЦІЙ МЕТОДІВ МОНТАЖУ БУДІВЕЛЬНИХ КОНСТРУКЦІЙ

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DIALECTICS OF THE FORMULATION OF ORGANIZATIONAL AND TECHNOLOGICAL STRUCTURES AND CLASSIFICATION OF METHODS FOR INSTALLATION OF BUILDING STRUCTURES

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Анотація

В статті представлений аналіз відомих варіантів визначення основних складових технологічних процесів в будівництві, відображена діалектика формулювання організаційно-технологічної структури та класифікації методів монтажу будівельних конструкцій. Детально описані відмінності та характерні властивості вільних та примусових методів монтажу. Вказані напрямки ефективного використання інформаційної бази даних особливостей відомих методів монтажу для розробки архітектурних концептів та конструктивно-технологічних рішень майбутнього будівництва.

Abstract

The article presents an analysis of known options for determining the main components of technological processes in construction, displayed the dialectics of the formulation of the organizational and technological structure and classification of methods for installation building structures. Differences and characteristic properties of free and forced installation methods are described in detail. The directions of effective use of the information database of features of known installation methods for the development of architectural concepts and structural and technological solutions of future construction are indicated.

Ключові слова: зведення великопрогонових покриттів, підйомні модулів, методи підтягування та виштовхування конструкций.

Keywords: erection of large-span coatings, lifting modules, methods of pulling up and pushing out of constructions.

Актуальність проблеми

Період з 50-х років минулого століття до сьогодення характеризується сталим збільшенням кількості побудованих великопрогонових залізобетонних та металевих об’єктів промислового та громадського призначення. Концепція утворення великопрогонових покриттів (ВП) , як складових великорозмірних будівель (ВБ), поступово змінюється від монтажних операцій по переміщенню окремих конструкцій покриттів кранами на проектні висоти до зведення блоків габаритних покриттів індустріальними методами. Характерною ознакою індустріальних технологій в будівельній галузі стають процеси, передбачаючи попереднє укрупнення конструктивно-технологічних блоків ВП на стендах з використанням кранів та наступне переміщення просторових покрівельних блоків на проектні висоти з залученням в монтажні процеси гідравлічних підйомників. Систематизація даних по висвітленню технологічних процесів, характеризуючих перебіг будівництва різноманітних об’єктів за період с 50-х років минулого сторіччя до сьогодення та відбір формулювань, які найбільш коректні в висвітленні організаційно-технологічних структур та можливих методів монтажу будівельних конструкцій є актуальною задачею досліджень.

Аналіз публікацій

Технологічні особливості зведення залізобетонних та металевих ВБ, в першу чергу ВП, побудованих в період з 1950 по 2024 роки, знаходять своє відображення в багаточисельних працях вчених, проектантів та виробничників.

1950 – 1981 роки. В наукових роботах Фокова Р.І. [1], Тейлора Р. [2], Швіденка В.І. [3], Завадскаса Є.К. [4], Ровінского Л. [5], Таукача Г.Л. [6], Зіолька Ж. [7] детально описуються і аналізуються технологічні особливості процесів будівництва конкретних об’єктів. Приводяться характеристики та принципи роботи кранів, щоглів, стріл, порталів, лебідок. Робляться перші спроби визначення і узагальнення монтажних процесів прийомів та операцій, в яких задіяні монтажники, такелажники, кранів-

ники. Напрацювання вчених і виробничників знаходять своє відображення у багаточисельних посібниках та підручниках.

1982–2000 роки. В роботах науковців та практиків Черненка В.К. [8], Федоренка П.П. [9], Колесніченка В.Г. [10], Літвінова О.О. [11], Ругла Х. [12], Торкатюка В.І. [13], Гребінника Р.А. [14] детально представлені наукові напрацювання та описаний виробничий досвід по проектуванню та зведенню промислових та громадських об'єктів. В підручниках та посібниках по монтажу будівельних конструкцій, монографіях, наукових роботах приділяється увага розгляду багаточисленних монтажних процесів пов'язаних з укрупненням конструкцій великопрогонових покриттів (КВП) на стелажах, процесу підніманням, тимчасовому та остаточному закріпленню в проектному положені.

2001 – 2024 роки. Наукові розробки в галузі промислового та цивільного будівництва, публікації з хронометричним відображенням процесів зведення різноманітних об'єктів стають фундаментом для формування ознак, які б відповідали загальним принципам технологічного процесу зведення будівель, типовим рисам побудови організаційно-технологічних рішень у кожному окремому монтажному процесі. Найбільшу увагу в питаннях наукового формулювання організаційно-технологічної структури будівельних процесів, аналізу та визначенню багаторівневих складових методів монтажу приділяли науковці Черненко В.К., Тонкачеєв Г.М. та Осипов О.Ф. [15].

Мета роботи

На закладі аналізу відомих формулювань організаційно-технологічних структур та класифікацій методів монтажу будівельних конструкцій визначити найбільш придатні структури та класифікації, дозволяючи враховувати технологічні особливості відомих методів монтажу ще на стадії архітектурно-конструкторського проектування та розробці технологічних карт зведення, в першу чергу великопрогонових, промислових та цивільних обєктів.

Виклад основного матеріалу досліджень

Визначення та формулювання організаційно-технологічної структури та класифікації методів монтажу будівельних конструкцій найбільш виразно відображене в наукових роботах Гребінника Р.А, Ровінского Л., Черненка В.К.

Так, Гребінник Р.А. формулює монтаж конструкцій, як комплексний процес зведення будівель і споруд з фрагментів чи цілих конструкцій, який складається з транспортних, підготовчих і монтажних робіт (Рис.1).

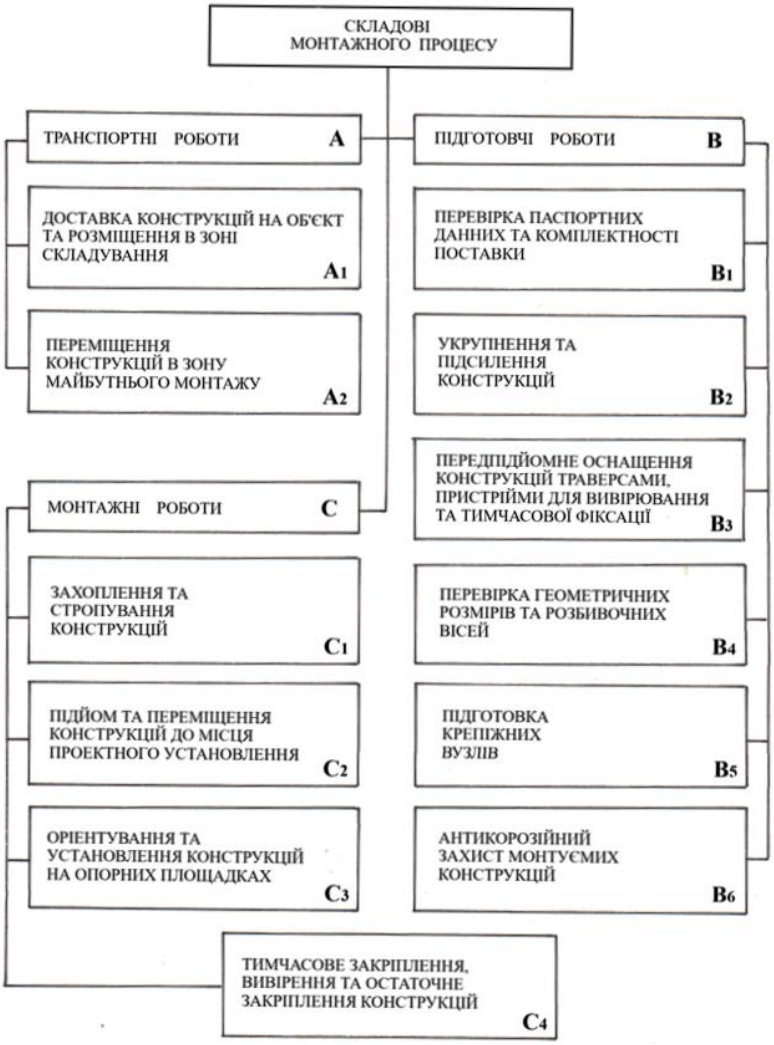

Рис.1 Класифікація складових монтажного процесу, впроваджена Гребінником Р.А. (опрацювання автора)

Монтажний процес (МП) може бути представлений в сукупності складових А , В, С

ММ = { А, В, С } (1)

де А – транспортні *роботи*. до переліку яких входять доставка конструкцій на будівельний майданчик (А1), складування та переміщення конструкцій в зону майбутнього монтажу (А2);

В - *підготовчі роботи*, це перевірка паспортних даних та комплектації конструкцій, які поступили на будівельний майданчик (В1), укрупнення та підсилення конструктивних елементів (В2), оснащення конструкцій траверсами та пристріями для вивірювання та тимчасової фіксації (В3), перевірка геометричних розмірів та розбивочних вісей(В4), перевірка вузлів кріплення, антикорозійний захист поверхонь конструкцій (В5);

С - *монтажні роботи*, захоплення та стропування конструкцій (С1), первинний підйом та переміщення конструкцій до місця проектного установлення (С2), орієнтування та установлення конструктивних елементів на опорних площадках(С3), тимчасове закріплення, вивірення та остаточне закріплення конструкцій в проектному положенні (С4).

Заслуговують на увагу визначення способів підйому та переміщення будівельних конструкцій, які запровадив Ровінский Л. При розгляданні варіантів зведення інтегрованих покрівельних конструкцій були сформульовані два основних способи, якими переміщуються конструкції в зоні монтажу, в саме:

- *піднімання (переміщення) підтягуванням*, при якому монтажний елемент розміщений під механізмом підйому і виконує переміщення в трьох вимірному просторі в напрямку механізму, який виконуючого підйом (Рис.2, а);

- піднімання (*переміщення) виштовхуванням*, при якому монтуємий елемент переміщується в напрямку від механізму, задіяного в виштовхуванні (Рис.2, б).

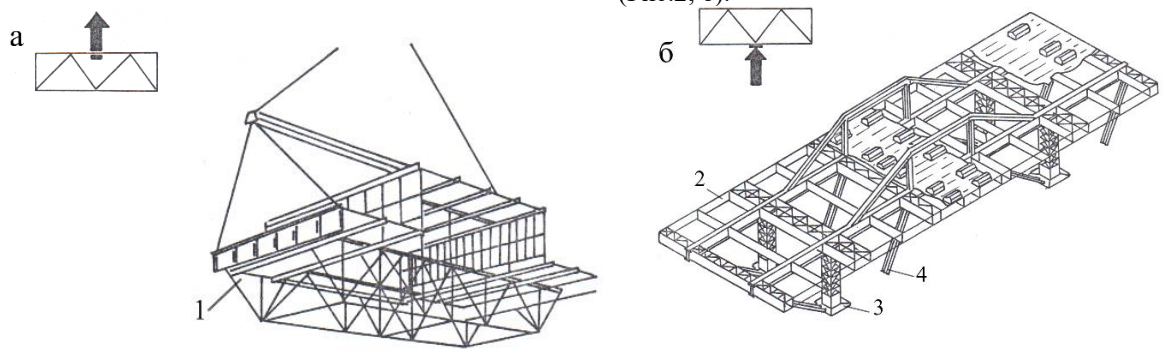

Рис.2 Класифікація способів переміщення конструкцій Ровінского Л.: а – піднімання (переміщення) підтягуванням, б – переміщення виштовхуванням, 1 – укрупнений покрівельний блок, 2 – конструктивно-технологічний блок покриття, 3 – підрощувальний стовп підйомника, 4 – проектна колона

Найбільш детально організаційно-технологічна структура (ОТС) будь-яких будівельних процесів і класифікація методів монтажу представлена в роботах Черненка В.К. Для отримання уявлення про загальну ОТС виконання різноманітних будівельних процесів, приводиться визначення «технології процесу праці», яке базується на методі праці. До складу методу праці входять прийоми виконання відповідної операції, простого або комплексного процесу та виробничого потоку і демонструється порядок перетворення безлічі складових для досягнення поставленої мети. Відповідні операції, при цьому, виконуються за умови взаємодії засобів праці (виробництва) та предметів праці. Нарівні з ОТС визначеного процесу будівництва виділяється структура методу її виконання, яка розкриває безпосередній процес і може бути представлена у вигляді моделі цього процесу. Завдяки структурі методу виконання визначеного процесу будівництва, в відповідних наукових і проектних напрацюваннях, спочатку формується багатоваріантна множина можливих рішень. На наступному етапі з множини можливих рішень, з урахуванням вхідних проектних завдань та технічних умов, виділяються найбільш раціональні проектні рішення з переважними техніко-економічними показниками, які і рекомендуються для впровадження в будівельні процеси. Загальній ОТС методу виконання будь-якого процесу будівництва, в т.ч. і монтажного, притаманні чотири обов'язкові складові, а саме: *1) організація* фронту робіт, послідовність (черговість) і режими виконання робіт, укрупнення деталей та виробів, подачі (переміщення) елементів; *2) механізація* окремих операцій, цілого комплексу операцій і процесів; 3) *виконання* операцій, підготовка фронту робіт, приймання та складування матеріалів, деталей, конструктивних елементів, переміщення, укладання або встановлення, вивіряння, тимчасова та остаточна фіксація і закріплення виробів; 4) *керування* перебігом сукупності операцій, виконавцями, механізованими процесами та розвиток різноманітних виробничих процесів.

За умови відображення і розкриття структурою методу монтажу відповідної ОТС монтажного процесу, метод монтажу може бути представлений сукупністю складових і структурних елементів, характеризуючих *організацію, механізацію, прийоми здійснення та керування монтажними операціями*. Сам метод монтажу (ММ), при цьому, визначається взаємодією засобів виробництва з предметами праці, і являє собою чітке відображенням основних шляхів перебігу процесу монтажу. ОТС методів монтажу конструкцій може бути представлена , як

принципова сукупність складових множин О, М, П, К :

$$ММ = \{О, М, П, К\} \quad (1.2)$$

де О – організація монтажу, М – механізація монтажу, П – прийоми виконання монтажних операцій, К – керування монтажними операціями. Кожна із базових складових методу монтажу формується з множини структурних елементів:

$$О = \{О_1, О_2, О_3, О_4\} \quad (1.3)$$

$$М = \{М_1, М_2, М_3, М_4\} \quad (1.4)$$

$$П = \{П_1, П_2, П_3, П_4, П_5, П_6,\} \quad (1.5)$$

$$К = \{ К_1, К_2 \} \quad (1.6)$$

Найменування множин структурних елементів принципової сукупності складових «О», «М», «П», «К» відображене на загальній схемі організаційно-технологічної структури методу монтажу конструкцій (Рис. 3) .

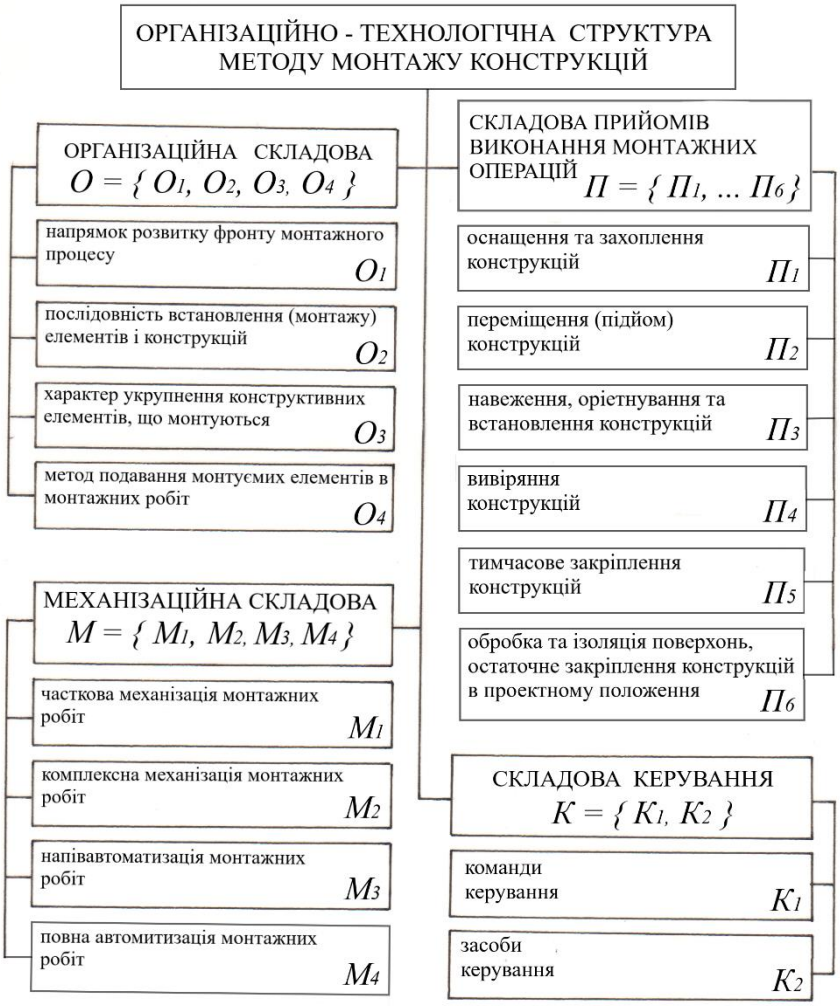

Рис. 3 Загальна схема ОТС методу монтажу конструкцій, впроваджена Черненко В.К. (опрацювання автора)

Для кожного структурного елементу відповідної складової ОТС методу монтажу, в свою чергу, характерна множина можливих рішень. Так, наприклад, для складової організації О:

$$О_1 = \{О_{11}, О_{12}, О_{13}, О_{14}, О_{15}\} \quad (1.7)$$

$$О_2 = \{ О_{21}, О_{22}, О_{23} \} \quad (1.8)$$

$$О_3 = \{О_{31}, О_{32}, О_{33}, О_{34}, О_{15}\} \quad (1.9)$$

$$О_4 = \{О_{41}, О_{42}, О_{43} \} \quad (1.10)$$

Найменування множин можливих рішень $\{ О_{11} \div О_{33} \}$ для структурних елементів $(О_1 \div О_4)$ організаційної складової «О» та множин можливих рішень для структурних елементів складових «М», «П» та «К» представлені на розгорнутій схемі організаційно-технологічної структури методу монтажу конструкцій (Рис. 4).

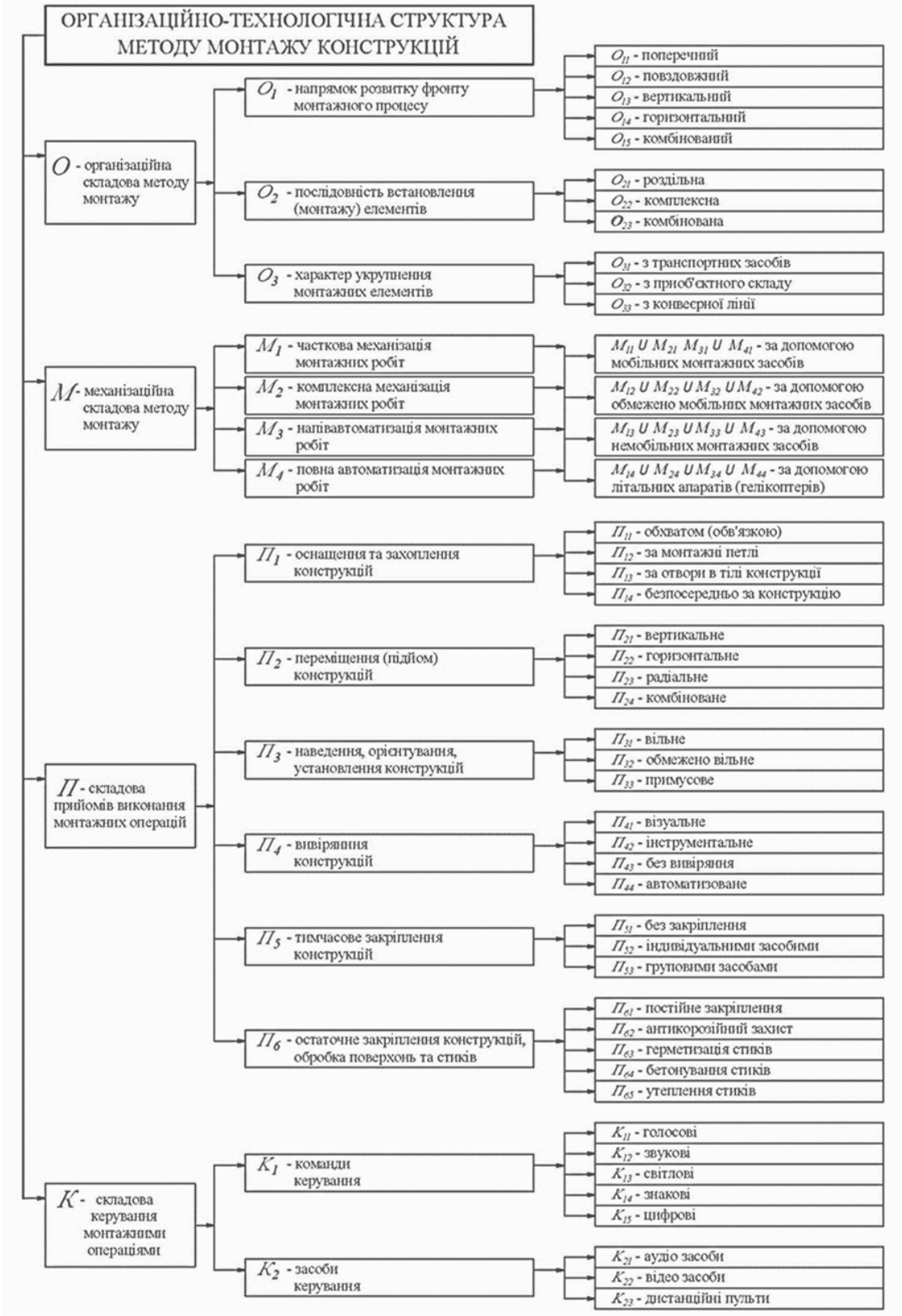

Рис. 4 Розгорнута схема ОТС методу монтажу конструкцій, впроваджена Черненко В.К. (опрацювання автора)

Класифікаційне структурування ММ сформулювалось на закладі глибокого та усестороннього аналізу вченими кафедри Будівельних технологій Київського національного університету будівництва і архітектури Черненком В.К., Тонкачеєвим Г.М., та Осиповим О.Ф. характеристик множин можливих рішень структурних елементів відповідних складових ОТС ММ та технологічних особливостей відповідних монтажних процесів, розкриваючих властивості і закономірності різноманітних варіантів зведення будівельних конструкцій. Зміна характеристик відповідних складових ОТС та технологічних особливостей ММ призвело до утворення багатоваріантних комбінацій монтажного

процесу. Назва створюваного ММ, таким чином, приймалась в залежності від переважного впливу властивостей однієї або декількох складових, притаманних ОТС та технологічним особливостям методу монтажу, що створювався. Для класифікаційного структурованого представлення можливих варіантів ММ були послідовно відібрані та детально сформульовані *п'ять відмінних властивостей*.

Перша відмінна властивість методів монтажу – це *вид підйому (переміщення конструкцій).* Визначаються два основних види підйому (переміщення) – *вільний підйом*, при якому матеріали та конструкції переміщуються підйомними механізмами в тривимірному просторі без обмежень, та *примусовий підйом (переміщення)*, при якому переміщення конструкцій виконується по напрямних або з використанням системи шарнірів.

Друга властивість – *напрямок переміщення конструкцій.* Акцептуються напрямки переміщення – горизонтальній, вертикальний, похилий, радіальний.

Третя властивість – *спосіб переміщення конструкцій.* Визначаються способи - підтягуванням, виштовхуванням, переносом, поворотом і опусканням.

Четверта властивість – *спосіб формування конструкцій.* Можливі варіанти: - *нарощування* конструктивних елементів у вертикальній площині;

- *приєднання* конструктивних елементів у горизонтальній площині;

- *переміщення та наступне приєднання* однієї чи декількох конструкцій у вертикальній, горизонтальній чи похилій площинах;

- *підрощування* конструктивних елементів та повнозбірних просторових конструкційних блоків;

- *поворотом у вертикальній площині* просторових фрагментів чи повністю зібраних конструкцій.

П'ята властивість - *область застосування,* яка охоплює всі архітектурно-конструктивні варіанти рішень збірних, монолітних, збірно-монолітних об'єктів промислового та цивільного призначення, де знаходять своє застосування ММ.

Спільні властивості та ознаки, характерні для можливих варіантів ММ будівельних конструкцій, стали підґрунтям для формування шістьох основних груп ММ. Кожна з груп ММ має, тільки їй притаманні, технологічні особливості. Так, *група ММ1* – методи монтажу з використанням вільного підйому підтягуванням з нарощуванням конструкцій у вертикальній площині.

Група ММ2 – методи монтажу з використанням вільного підйому підтягуванням з приєднанням конструкцій до раніш змонтованих елементів у горизонтальній площині. Схематично класифікація груп ММ1 та ММ2 представлена на Рис. 5.

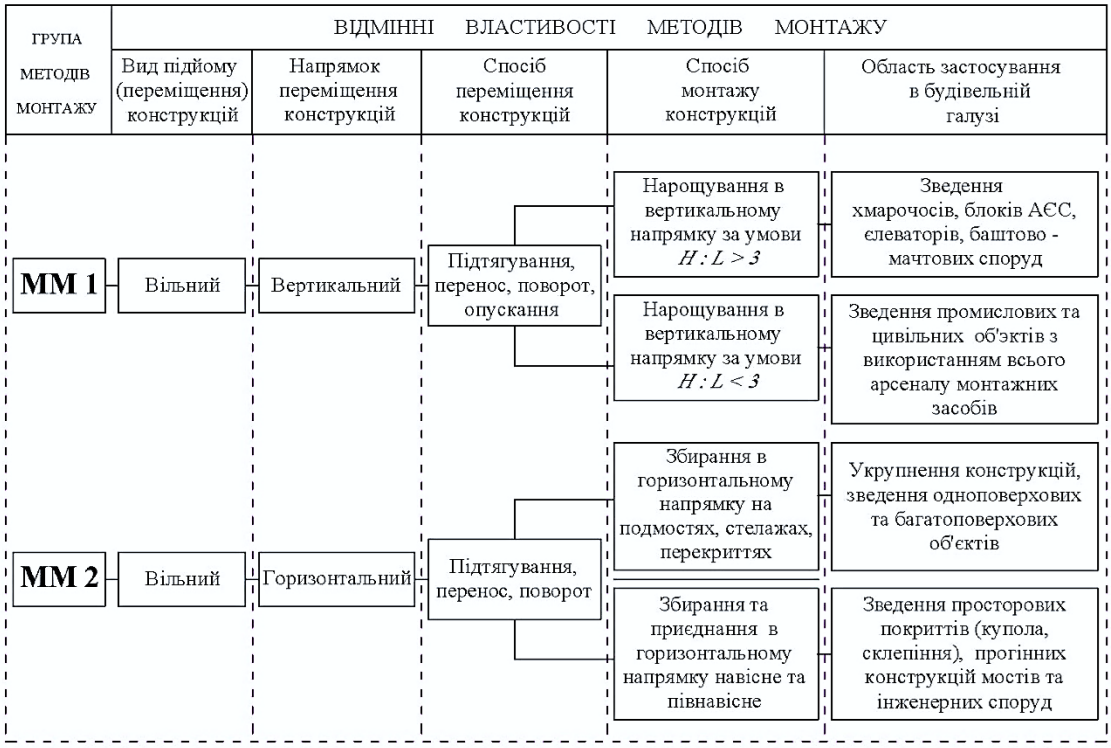

Рис.5 Структурна класифікація груп ММ1 та ММ2, впроваджена Черненко В.К. (опрацювання автора)

Група ММ3 – методи монтажу з використанням примусового переміщення (підйому) підтягуванням конструкцій тільки по вертикальним напрямним.

Група ММ4 - методи монтажу з використанням примусового вертикального переміщення виштовхуванням з підрощуванням елементів конструкцій.

Схематично класифікація третьої та четвертої груп ММ представлена на Рис. 6.

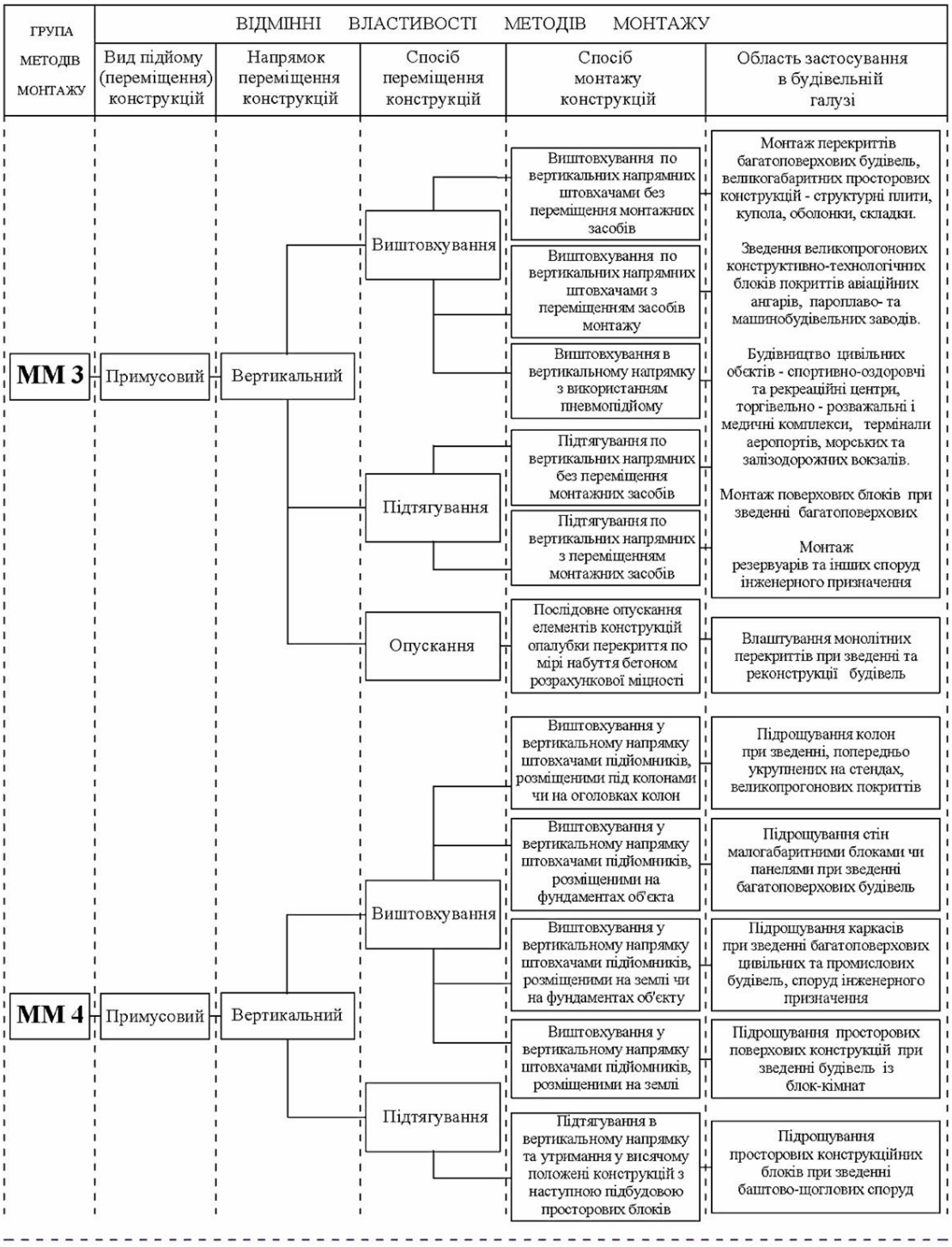

Рис.6 Структурна класифікація груп ММ3 та ММ4, впроваджена Черненко В.К. (опрацювання автора)

Група ММ5 - методи монтажу з використанням примусового переміщення підтягуванням конструкцій по горизонтальним або похилим напрямним.

Група ММ6 – методи монтажу з використанням примусового переміщення підтягуванням чи виштовхуванням вертикальним поворотом навколо шарнірів.

Схематично класифікація п’ятої та шостої груп ММ представлена на Рис.7.

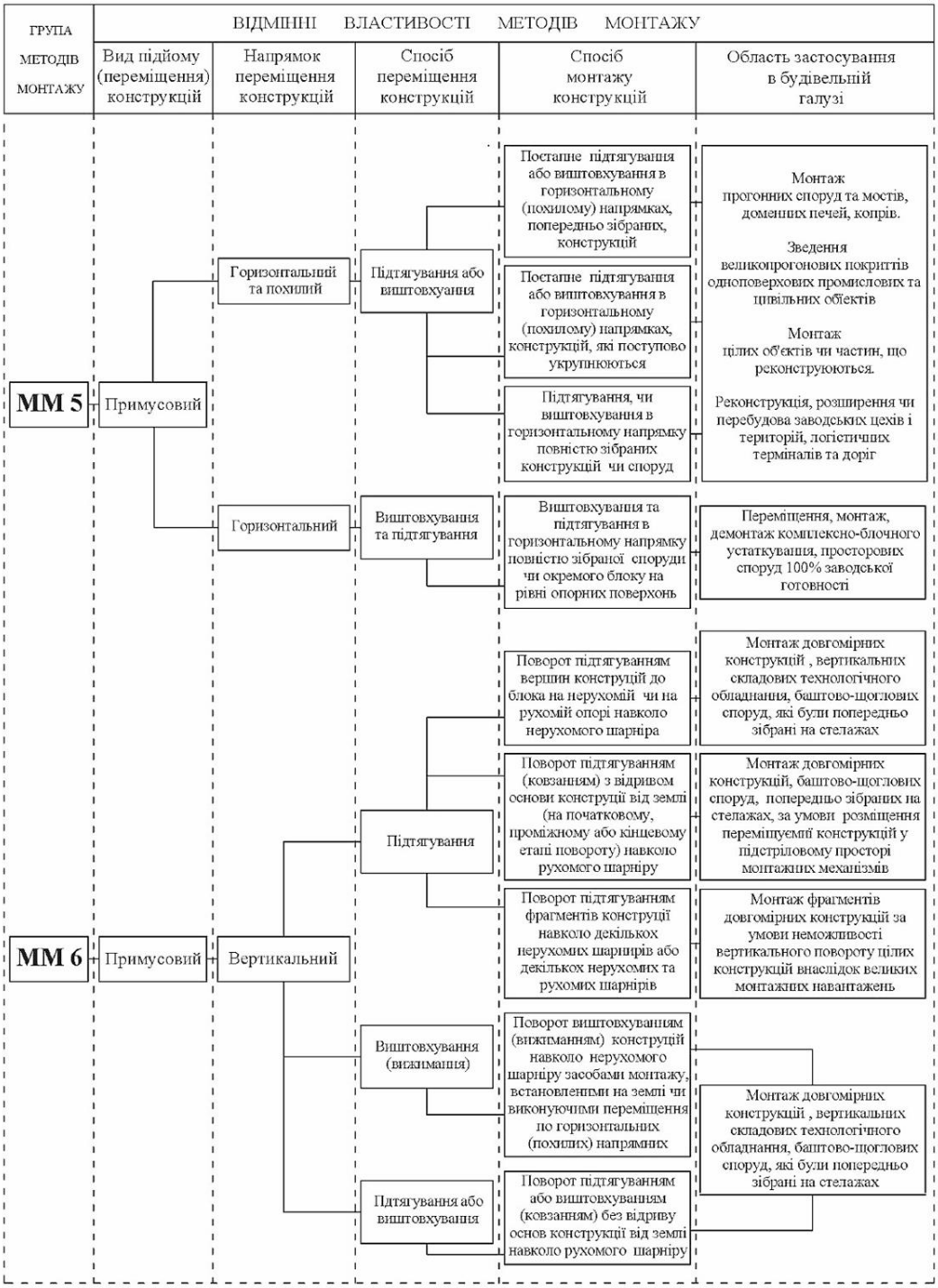

Рис.7 Структурна класифікація груп ММ5 та ММ6, впроваджена Черненко В.К. (опрацювання автора)

Технологічний процес зведення будівель, зазвичай, складається з декількох монтажних процесів, які відносяться до різних груп ММ. При цьому, кількість та взаємозв'язок між ММ залежать від конструктивно-технічних особливостей об'єкта будівництва і умов виконання монтажних робіт. Серед переліку ММ, використання яких передбачається при зведенні будівель і споруд, виділяється ММ, який є, найскладнішим та найбільш трудомістким. Вибраний ММ визначається, як основний, і на закладі вибраного ММ формується загальна організаційно-технологічне структура стратегічна послідовність будівництва.

Висновки

Детальна інформаційна база даних критеріальних особливостей ОТС та класифікації методів монтажу, розроблена та сформульована групою вчених на чолі з Черненко В.К., дозволяє використовувати всю палітру властивостей відомих ММ ще на етапі архітектурно-конструкторського проектування. Технологічні вимоги, характерні для ММ з використанням примусового підйому (переміщення) разом з конкретними технічними умовами будівництва можуть бути акцептовані при розробці архітектурних та конструкторських рішень майбутніх обєктів, в першу чергу, великопрогонових просторових покриттів, та випрацювані інноваційних

конструктивно-технологічних рішень для зведення великопрогонових будівель багатофункціональними підйомними модулями.

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EARTH SCIENCES

THE FEATURES OF THE TOURIST SEASON 2022 AND THE PROSPECTS FOR THE DEVELOPMENT OF TOURISM IN UKRAINE

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DOI: 10.5281/zenodo.13926498

Abstract

The article analyzes the current state of tourism development in Ukraine, particularly during wartime and post-war periods. The article aims to outline the features of the development of the national tourism industry during war, taking into account the european integration process and internal organizational and managerial decisions and to present the prospects and trends of the industry's development in the post-war period. The research methods used include statistics, analysis, synthesis, comparison, interpretation, and forecasting. The results. The study discusses the fluctuating state of the tourism business during wartime, considering both objective and subjective factors. It also analyzes data from the State statistics service of Ukraine from 2000 to 2022, highlighting the progressive development of tourism in peacetime and the regressive development during the period of full-scale russian invasion of Ukraine. The article presents the realities of the tourism business in 2022, taking into account the economic, financial, military, and demographic situations. The challenges and risks that the post-war period may bring to the development of the tourism industry are also identified. The study notes that the industry is currently adapting to societal instability and responding to various types of risks. The article identifies the main promising directions for the development of tourism in the coming years and emphasizes the importance of international agreements regarding transport logistics for its successful development. The novelty of the research lies in the fact that it characterizes for the first time the changes in national tourism during the war period, in particular, changes in the geography of tourist destinations and the transition of the industry to the information-digital era. It is determined that changes in the tourism industry of Ukraine are related to the decline in economic activity, security, and demographic situation. New promising directions in tourism are presented: military-patriotic and natural-rehabilitation. It is noted that international and domestic tourism in the post-war period may be subject to sanitary-epidemiological, ecological, and technological risks. It is predicted that the spiritual component of the ukrainian people will serve as a tourist magnet, which will be manifested in the export of cultural and tourist heritage through its identification and development of cross-border and national tourist products. Transport logistics, thanks to agreements with carriers on «open skies» and rail connections with EU countries, will also contribute to the development of tourism.

Keywords: tourist destination, tourism in the post-war period, military-patriotic, natural-rehabilitation.

Importance and relevance of the research topic. Today Ukraine lacks a developed strategy or program for the development and organization of tourism during wartime and the post-war period, which has led and will lead to significant changes in the tourism industry. Currently, it is necessary to plan a national tourism business based on the experience of countries that have experienced wartime aggression, as well as an objective assessment of current realities. Therefore, an analysis of the development of the tourism business during the wartime period, as well as the identification of new tourism directions, prospects for the development of tourist destinations, potential consumer groups of tourist products after its completion, is timely and has led to the relevance of the chosen topic.

The current state of the researched issue. The collapse caused by the massive invasion of russian forces into Ukraine has led to significant changes in the country as a whole, including the economy and consequently, in the national and international tourism industry. The focus on the state of this industry is due to the significant gap between its level of development before and during the war. One of the notable drivers for research in this context has been the rapid reorientation of tourist flows, changes in countries and regions that are donors of tourists, and the formation of new types and directions of tourism. The basis for recovery has been the experience of restoring the tourism industry in countries such as Slovenia, Croatia, Egypt, etc. One of the main key positions for the restoration of the national tourism business has been the need to fill the state and local budgets. Special attention has also been given to

changes in the socio-cultural environment and the export of cultural heritage.

The article aims to outline the features of the development of the national tourism industry during war, taking into account the European integration process and internal organizational and managerial decisions and to present the prospects and trends of the industry's development in the post-war period. It also presents directions and ways of tourism development, as well as highlighting the priority tourist destinations as a condition for the development of infrastructure-sustaining regions, which will contribute to the development of territorial communities.

The analysis of the features of tourism development and the experience of countries that have experienced wartime and restored domestic and international tourism were borrowed from works of both foreign and ukrainian scientists. For example, David Currie's work [1] occupies a significant place in the world scientific heritage. The work of Dedylova T., Nosyryev O., and Osipova S. [2] is dedicated to the development of conceptual principles for the restoration of Ukraine's tourism potential in the post-war period from 2022-2030 based on strategic management. N. Barvinok studied and justified war tourism as an important factor in tourism development in Ukraine during the post-war period and identified the tourist resources that will serve as the basis for its organization [3]. L. Bozhko and V. Kholodok studied the impact of wartime on tourism development and analyzed the experience of restoring tourism in countries affected by the armed conflict [4]. L. Kovalska's works include several publications dedicated to the aggression and annexation of Ukrainian territories by russia [5], the impact of migration processes on tourism development in Ukraine during the period of russia's aggression [6], and more. However, the reality of the tourism industry during russia's massive invasion into Ukraine in 2022 remains a white spot.

Research methods. In the analysis of the national tourist market, we used the following methods of scientific research: statistics and comparison – with a determined number of tourists served by tour operators and travel agents over a 22-year period, analysis and synthesis – with a determined state of the tourist market during the war period in Ukraine, forecasting – taking taking into account the experience of the countries of Georgia and Moldova, the interpretation of the development of tourist transport logistics in Ukraine was carried out, and taking into account the objective and subjective factors that affect the development of the tourism industry, the main tourist destinations in the post-war period were indicated.

The main material. The tourist industry during the war between russia and Ukraine is in a state of stagnation. This full-scale war has defined the course of negative processes, including mass migration processes: emigration, re-emigration, forced internal displacement, as well as the decline of the economy, the manifestation of hatred towards anything russian, looting both by local residents invaders and others. All of these processes undoubtedly affect and determine social relations between people, including consumers of tourist services.

The national tourism market during the war is volatile and is influenced by both objective and subjective factors. Among the objective factors are the state of the tourist infrastructure, the qualifications of professionals in the service industry, the availability of information about tourist attractions, and so on. Subjective factors include political and economic conditions, annexation of territories, the pandemic, and so on. However, despite all these factors, the tourism industry in Ukraine is still functioning.

To determine the real state of the national tourism market, we will analyze it before the annexation of ukrainian territories by russia, during the pandemic, and during the mass military invasion of russians into ukrainian lands. Analyzing State Statistics data from 2000 to 2022, it was determined that the boom of tourists served by tour operators and travel agents (by types of tourism) fell on 2019 (excluding the temporarily occupied territory of the Autonomous Republic of Crimea, Sevastopol, and temporarily occupied territories in Donetsk and Luhansk regions) and amounted to 6,132,097 people (fig. 1). Of these, outbound tourists accounted for 5,524,866 people, domestic tourists 520,391 people, inbound (foreign) tourists – 86,840 people.

According to the Ministry of Infrastructure of Ukraine, the peak of inbound (foreign) tourists was observed in 2003 and amounted to 590,641 people out of a total of 2,856,983 people served by tour operators and travel agents (by types of tourism). Of these, 344,332 were outbound tourists and 1,922,010 were domestic tourists [7].

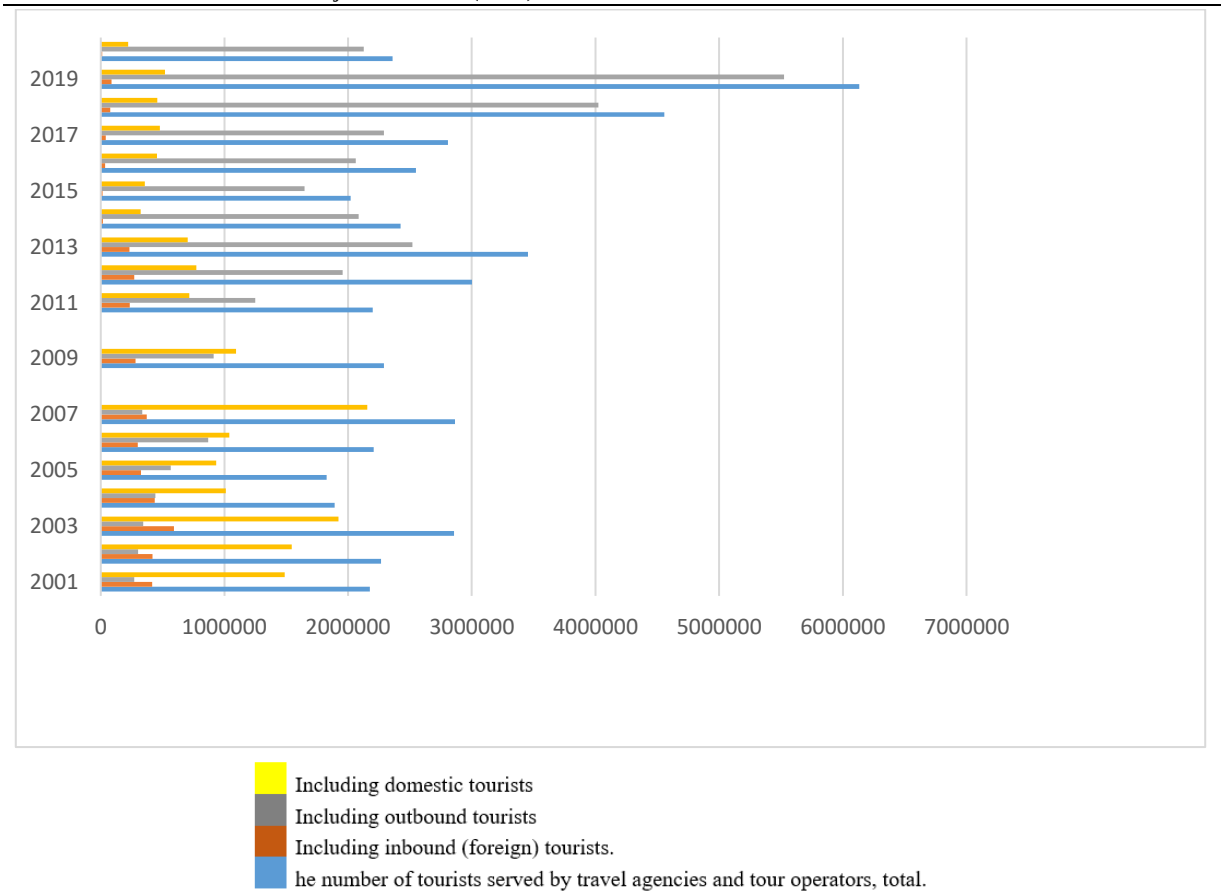

Fig. 1. Number of tourists in Ukraine served by tour operators and travel agents, by types of tourism.

Since 2014, the number of foreign tourists has sharply decreased due to Ukraine's image as a country at war. Since 2016, the flow of international tourists, including outbound tourists, has increased due to the visa-free regime with EU countries. This process was also facilitated by equal prices for tourist products on both international and national markets. During 2020, the number of both outbound and inbound tourists, taking into account quarantine measures related to the Covid-19 pandemic, also significantly decreased.

The realities of the tourism business in 2022 also turned out to be unpromising, particularly in terms of infrastructure (destruction and failure of tourist service establishments and facilities), financial (reduction of wages, inflation of the hryvnia, increase in the exchange rate of currencies, bankruptcy of tourist firms), military (full-scale hostilities of russia in tourist destinations, for example, along the Black and Azov Seas coasts), and demographic (reduction in the number of potential consumers of tourist services, orientation of services to a certain age category – children's tourism, etc.) situations, which did not contribute to people traveling for recreation. However, despite such radical changes, the tourism industry replenished the state budget, albeit to a lesser extent.

According to the State Tourism Agency, 33.34% less taxes were paid to the state budget in 9 months of 2022 than in the same period in 2021. A significant decline in financial revenues was recorded in the Capital region, particularly in Kyiv – by 43 %, in the Black Sea (southern), namely in the Odesa region – by 78 %. Partial cessation of revenues to the state budget was observed in the Sumy and Chernihiv regions, and complete cessation – in the Kharkiv, Luhansk, Donetsk, and Kherson regions. During 2022, the number of taxpayers also decreased by 28 % [8].

The national tourism market, during 2022, acquired a unique character, which was manifested in: the locality of its manifestation and the displacement of the geography of tourist destinations, the suspension of international inbound and partially outbound tourism, changes in the geography of tourist donor regions and the behavior of consumers and tourism sector workers, differentiation and stratification of the tourism product, and the formation of new tourism directions.

The local nature of tourism and the shift in the geography of tourist destinations. During 2022, the national tourism market in Ukraine exhibited a particular character, which was manifested in the localization of its development and the shift in the geography of tourist destinations. Despite the state of war in Ukraine, the tourism industry continued to operate in the relatively peaceful western part of the country. However, the development of tourism had a local character, primarily focused on mountainous areas and resort destinations within the Carpathian tourist destination. This shift in focus was caused by the war, which led to the occupation of most of the coastal resorts by russia, the destruction of infrastructure in most regional centers and cities on the left bank of Ukraine, as well as in some administrative centers on the right bank, and damage to transport logistics and critical infrastructure centers across the country.

According to the State Agency for the development of tourism (DART) the tourism industry grew by almost 130% in Carpathian destinations compared to last year, namely, positive dynamics of tax collection was observed in Ivano-Frankivsk and Lviv regions [9].

The increase in such a fee is driven by the growing number of visitors, although it had varying levels throughout 2022. In the spring of 2022, within the Carpathian tourist destination, tourists self-organized in small groups, with most choosing to travel on foot. Bicycles and/or quad bikes were rarely rented from rental points. Accommodation was mainly organized in rural green estates or hotels. The prices of tourist products decreased by almost half compared to the previous year [10]. Prices also decreased in accommodation establishments, for example, at the Bukovel tourist complex, the cost of a room in a hotel with a pool was 600 UAH, and in Yaremche city – 300 UAH.

During the summer of 2022, the development of domestic tourism was activated. Using the example of the tourist company «Edelweiss» in Yaremche, Ivano-Frankivsk region, excursion services were the most popular among tourists. Excursions were mainly organized on weekends. Among the popular tourist tours were climbing mountain peaks (Mt. Sivulya, Pip-Ivan, Dovbushanka, etc.). Free introductory tours to the Carpathian living heritage sites were organized for internally displaced persons.

In the autumn and during the 2022–2023 New Year and Christmas holidays, the tourist season in the Carpathian destination resumed. For example, in the cottage town of Phoenix relax park, located in the territory of Polyanitska TG in Ivano-Frankivsk region, 500 tourists stayed at the same time. Financial receipts of the tourist town for july amounted to 6.1 millions UAH, august – 10.6 millions UAH, september – 6.4 millions UAH, october – 7.9 millions UAH, november – 4.7 millions UAH, december – 9.1 millions UAH (according to the establishment's reception data, not including revenues from other services, including food establishments). In total, over 16,000 tourists visited Phoenix relax park during this period.

Suspension of international inbound and partially outbound tourism. Safety of tourists is a priority and a guarantee for the development of international and domestic tourism. Ensuring safety, both within the Carpathian destination and during logistical transportation in a country that has declared martial law, is inappropriate. Therefore, during the war, mainly Ukrainians, who made up 95 % of tourists, and only 5 % were visitors, took part in tourism. International tourists preferred cultural and educational tourism. To achieve this goal, they chose tourist complexes such as Bukovel, Dragobrat, as well as regional centers: Lviv, Uzhhorod, Chernivtsi and Ivano-Frankivsk, and for business trips – Kyiv and Lviv.

Among outbound tourism, the backbone was made up of children, women, and people over 60 years old. According to the tourism company «Apelsin» (Ivano-Frankivsk), the main regions where requests from Ukraine for tourist services were directed in the summer season were: 75 % – Turkey, 12 % – Greece, 13 % – other countries (Spain, Bulgaria, Croatia, Montenegro), and in the winter season: Egypt – 78 %, UAE – 11 %, Dominican Republic – 8 %, other exotic countries (Mexico, Tanzania) – 3 %. In the second half of 2022, pilgrimage tours to Montenegro resumed, and children's tourism gained a new direction – to Poland, the Baltic countries, England, and so on. Overall, the number of outbound tourists decreased by almost 70 % in 2022.

Change in the geography of tourist donor regions. In the Carpathian tourist destination, prior to russia's full-scale invasion, the capital and central regions served as donor regions for domestic tourism. Today, the guest geography consists of residents from the city of Kyiv, as well as the Kharkiv, Kherson, Mykolaiv, and Odesa regions. The geography of incoming tourists is close to foreign countries such as Moldova, Hungary, and Romania. Tourists from these countries have long-standing family relations, which also encouraged them to travel to visit their loved ones.

Change in the behavior of tourists and employees in the tourism sector. During the war, there was a change in tourist behavior, including perceptions of their surroundings and their attitudes towards themselves. These changes were driven by a noticeable convergence between consumers and employees in the tourism sector and the middle class of the information-digital era, which was shaped by the expansion of higher education, technological skills, and globalization. Representatives of this group have higher education, possess digital technologies, social networking communications, and postmodern self-expression values. Under the influence of the development of information technology, war, and the spread of the COVID-19 pandemic, a new type of tourism has emerged – virtual tourism. Virtual travels contribute to the contemplation of «masterpieces of contemporary world art, raising their patriotic consciousness...». [11].

Changes in communication methods have been accompanied by an improvement in the quality of services and goods, which has facilitated the reallocation of opportunities for those employed in tourism. Promotional functions of the tourism destination are placed on them.

Differentiation and stratification of the tourist product and formation of new tourism directions. Differentiation of the tourism product in the national tourism market is carried out due to changes in the structure of population distribution, labor market, demand for professional competencies, employment and production structure. All these processes are caused by demographic collapse due to a prolonged demographic crisis (the predominance of deaths over births for almost 10 years, until 2013 and in 2022), mass emigration from Ukraine (according to the UN, the number of refugees exceeded 7.9 million people in 2022, although a significant number of them are returning), strengthening of gender imbalance (significant advantage of women over men due to irreparable losses on the front), sharp increase in mortality (particularly in the 20–35 age group) and decrease in the birth rate, depopulation of eastern and southern territories, sharp increase in the population in western and northwestern regions of

Ukraine, etc. According to the report on internal displacement in Ukraine, as of August 1, the number of officially registered persons in the Transcarpathian region was 125.8 thousand, in Lviv region –106.6 thousand, and in Ivano-Frankivsk region – 94.9 thousand [12].

In 2022, the stratification of the tourist product in Ukraine was observed in several initiatives. The Kosiv painted ceramics were included in the Council of Europe's cultural route «European Route of Ceramics», which connects Germany, Spain, France, Italy, the Netherlands, Portugal, the UK, Turkey, and now Ukraine [13]. The project «52 Lifestyles in the Carpathians: Revival of Traditional Cultures of Work» was implemented with co-financing from the European Union [14]. In Dolyna, Ivano-Frankivsk Oblast, a tourist route to the natural monument «Kamin Kolybach» was presented as part of the project «Creating a system of comprehensive measures for tourism development in Dolyna united territorial community» [15], in Lviv, the National Museum named after Andriy Sheptytskyi hosted a virtual exhibition «Alternative Dimensions», and two new virtual museums: the «Museum of Modernism» and the «Museum of Science» were opened [16].

During the war, the formation of the tourism product was accompanied by changes in ukrainian society, namely a significant increase in identification with being ukrainian, which led to the development of patriotic tourism. There was a transformation of the tourism product towards promoting national identity, a desire to stay in Ukraine and consume ukrainian products. The development of the main types and directions of tourism, and therefore the tourism product, in the context of decentralization of power, was carried out taking into account the public opinion of the local population. Such a trend, namely, the demonstration of high civic activity of local communities and society as a whole during and in the immediate aftermath of the war, will serve as the basis for the formation and development of the tourism industry.

Today, tourism is adapting to social instability and responding to various dangers. This adaptation is reflected in the extension of logistics transportation by the InterCity train from Kyiv to Lviv, the additional launch of a new route from Zaporizhzhia to Uzhhorod via Lviv, as well as the resumption by Ukrainian railways from August 5 of the train No.55/56 «Kyiv-Yasinya (Transcarpathian region)» with stops in Yaremche, Tatariv-Bukovel, and Vorokhta [17]. Thus, the development of tourism «...depends on tourism logistics, the development of information and communication sphere...» [18].

In 2022, the most important things for most consumers of tourism services in Ukraine will be their health status, psychological comfort, interpersonal relationships, personal freedom, morality, and home comfort. Therefore, in the post-war period, considerable attention will be given to family and family values, and most consumers of tourism services will choose family vacations. Natural destinations with a focus on recreational (e.g. beach) and family vacations in nature, including ecotourism, will be preferred.

The development of medical and health tourism will also play a leading role in domestic tourism. Sanatorium and resort complexes will serve as the main facilities for physical and spiritual rehabilitation. A large portion of consumers of these services will be veterans, war children, and civilian victims in Ukraine. The development of medical and health tourism will center on the Transcarpathian, Odessa, Ivano-Frankivsk, and Volyn regions. A nature-rehabilitation direction of tourism will develop by combining medical and health tourism with ecotourism.

The Carpathian tourist destination, as the most surviving infrastructure, will restore the flow of tourists from the UAE and Kuwait. The favorable climate, hospitality of the local population, development of tourist infrastructure, and affordability of the tourist product for the middle class from Arab countries will make it possible to activate the tourist season from may to september. The main centers of rest will be tourist complexes such as «Bukovel», «Dragobrat», «Skhidnytsia», and others, as well as the city of Yaremche, the village of Tatariw, and other tourist-attractive settlements. The city of Lviv will be the center of cultural and tourist destinations, and the holding of various thematic mass events will attract the attention not only of tourists from Poland but also from other countries in Europe. The likelihood of the development of new international events and cross-border tourist routes will be significant. The development of cultural and cognitive tourism will also take place in the Kyiv and Odessa regions. The development of gastronomic tourism will flourish in Transcarpathian regions in combination with ethnic cuisines.

The recovery of Ukraine and its tourism industry, as well as its recognition in the international market, is possible through the export of ukrainian culture. With the increasing number of destroyed, damaged, or stolen cultural heritage sites in Ukraine (according to the Ministry of Culture and Information Policy of Ukraine, as of July 6, 2022, russians committed 407 crimes against ukrainian cultural heritage, and as of July 17, 2022, the number has already reached 423, totaling approximately 5–6 billion euros), there is a question of their preservation. One alternative approach is their digitization [19].

The development of international inbound tourism to Ukraine is being intensified, especially from western, northern, and central Europe. The spiritual component of the ukrainian people, including their indomitability and love for freedom, will be a tourist magnet. The military-patriotic direction of tourism will be based on these components, with the main tourist attractions being places of military glory (Chornobaivka), hero cities (Kharkiv, Mykolaiv, Chernihiv, etc.), military-historical sites such as Donetsk airport, Ilovaisk (Ilovaisk Cauldron), Zmiyev Fortifications (Kyiv region), Azovstal (Mariupol), and fortifications, and so on.

Taking into account the experiences of countries such as Georgia and Moldova, the increase in the number of railway routes and flights was carried out based on agreements with EU countries [20]. Similarly, the «open sky» agreements, which helped overcome aviation monopolies by increasing the number of airlines

and reducing competition on routes, should be relied upon in Ukraine's post-war period. As a result, prices for passengers have decreased, and passenger traffic at airports has increased. Other challenges in the post-war period are likely to be related to sanitary-epidemiological, ecological, and technogenic risks that will affect international and domestic tourism. Among the sanitary-epidemiological risks are the Covid-19 pandemic, the spread of epidemics such as cholera and monkeypox. Ecological risks include soil pollution, the likelihood of radiation contamination, and the destruction of biodiversity. Technogenic risks include damage and destruction of dams, which in turn will lead to the flooding of significant areas, transportation routes, and so on.

Conclusions. The russian–ukrainian war has caused significant changes in the development of tourism in Ukraine both «pre-war» (before 2014) and «during the war» (2022–2023). These changes were caused by both objective and subjective factors and manifested themselves in the boom of inbound international tourists in 2003 and its sharp decrease in 2022, the peak of outbound and domestic tourists in 2019 and its minimum in 2001 and 2020 respectively. During the war, the tourism industry adapted to social instability and various risks. In particular, there was a redirection of tourist flows, mainly: international outbound to Turkey, Egypt, inbound from Moldova, Belarus, Hungary, domestic from southern and eastern regions of the country to the west. The Carpathian tourist destination became the center of national tourism development. There was a change in consumer and tourism sector behavior due to their identification with the middle class of the information and digital age, as well as self-identification as «Ukrainians», and changes in communication methods, etc. As a result of the differentiation and stratification of the tourism product, Kosiv's picturesque ceramics joined the transborder tourist route «European Route of Ceramics» and a number of projects such as «52 lifestyles in the Carpathians: reviving traditional work cultures», «To the Stone of Kolibach», etc. have been implemented. There is a continuation of the implementation of new transport and logistics routes both national and international.

During the post-war period, the image and promotion of Ukraine as a tourist destination will be established on the international tourism market. The development of domestic tourism will be intensified and will present such main directions as military-patriotic and natural-rehabilitation. In the near future, the Carpathian and central-capital destinations will be the epicenters of tourism development. The main international tourist flows will be formed, including inbound tourism from arab countries, western and central Europe, and outbound tourism directed towards friendly countries that provided assistance during the war, as well as countries with an affordable price policy for tourism products such as Egypt, Bulgaria, etc.

Research novelty. For the first time, changes in national tourism during russia's mass military invasion of Ukraine on February 24, 2022 are characterized, specifically in terms of tourism destinations and the transition to the information-digital era of tourism. It is determined that changes in Ukraine's tourism industry are associated with economic stagnation, demographic situations, and institutional components in the context of decentralization of power. A forecast is made for the post-war period, including new directions in tourism: military-patriotic and natural-rehabilitation. It is noted that the spiritual component of the ukrainian people will serve as a tourist magnet for international inbound tourists, which will be manifested in the export of cultural heritage through the identification and development of cross-border and national tourism products. Transport logistics, due to agreements with carriers on «open skies» and railway connections with EU countries, will also contribute to the development of tourism. It is noted that domestic tourism in the post-war period may be subject to sanitary-epidemiological, ecological, and technological risks.

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HISTORY

ЖИТТЯ ПІД РАДЯНСЬКИМИ РЕПРЕСІЯМИ. ДОСВІД УЧАСНИЦЬ УКРАЇНСЬКОГО ДИСИДЕНТСЬКОГО РУХУ

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LIFE UNDER SOVIET REPRESSION. THE EXPERIENCE OF PARTICIPANTS OF THE UKRAINIAN DISSIDENT MOVEMENT

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Анотація

У статті розглянуто діяльність учасниць українського дисидентського русу під тиском радянських репресій, виокремлено їхню діяльність в національно-визвольній боротьбі українців та повернення до опозиційної діяльності після ув'язнення. Охарактеризовано нормативно-правову базу яку радянська тоталітарна влада використовувала для обмеження та залякування будь-яких проявів інакомислення. Визначено основні етапи радянської репресивної політики та її зміни щодо суспільства загалом. Наголошено на важливості співпраці українських політв'язнів, як в ув'язненні, так і після звільнення для боротьби проти тоталітарної влади, а також на важливості такої комунікації для розвитку дисидентського руху в цілому.

Abstract

The article examines the activities of the participants of the Ukrainian dissident movement under the pressure of Soviet repression, highlights their activities in the national liberation struggle of Ukrainians and their return to opposition activities after imprisonment. The legal framework used by the Soviet totalitarian government to limit and intimidate any manifestations of dissent is characterized. The main stages of the Soviet repressive policy and its changes in relation to society in general are determined. The importance of the cooperation of Ukrainian political prisoners, both in prison and after release, for the struggle against the totalitarian government, as well as the importance of such communication for the development of the dissident movement as a whole, is emphasized.

Ключові слова: дисидентство, жінки, національно-визвольний рух, репресії, боротьба.

Keywords: dissidence, women, national liberation movement, repression, struggle.

Актуальність дослідження. Історія українського дисидентського руху є досить важливою, особливо враховуючи сучасні події в Україні та обмеження доступу щодо інформації про українських опозиціонерів в радянський час. Важливим є й те, що чимало учасників дисидентського руху почали свою протидію тоталітарній владі, ще в юному віці, а тому змушені були пережити різні етапи діяльності радянської репресивної машини. Розгляд їхньої багаторічної діяльності є цікавим та важливим для дослідження Історії України XX століття, історії УРСР, характеристики радянських репресій проти українців та особливостей життя того часу загалом.

Аналіз публікацій. Дослідженню дисидентства присвятили свої праці чимало істориків та й власне самих опозиціонерів, зокрема Василь Овсієнко, який був учасником правозахисного руху та політв'язнем, а згодом активно досліджував історію руху спротиву в Україні (15, 21). Цікавими є власні інтерв'ю учасниць національно-визвольної боротьби (12, 14, 19), а також енциклопедичні видання з їх загальною біографією, зазначенням термінів та місця їх ув'язнення (3, 27, 34). Окремо варто виділити праці, що стосуються характеристики тоталітарної репресивної політики (1, 5, 9), адже завдяки таким дослідженням можна виокремити основні елементи діяльності влади та схожість чи відмінність в різні періоди історії. Також можна зрозуміти вплив репресивної політики на активізацію руху спротиву, адже чим сильніший був тиск влади, тим сильнішою ставала й протидія.

Виклад основного матеріалу дослідження. «Горе тій країні, де цькують людей…» знаходимо на сторінках першого номеру «Українського вісника» (32, с. 18). Коротка цитата характеризує причину багаторічного протистояння між тоталітарною радянською владою та людьми що стали в опозицію до неї. Історія України XX століття нерозривно пов'язана з репресіями в різних їх проявах – від доган і звільнень з роботи, до багаторічних ув'язнень і смертей у виправних таборах.

Політичні репресії в Україні, беруть свій початок ще з 1918 року, а саме від першої спроби встановлення радянської влади. Можна було б сказати, що закінчуються ці репресії у другій половині 1980-х рр., щоправда тінь тієї репресивної політики відчувалася і в роки незалежності, і навіть сьогодні.

Терор мав на меті уразив практично всі верстви суспільства.

Згідно архівних матеріалів СБ України, протягом 1927-1990 р. в Україні було заарештовано понад мільйон осіб (з них понад 50% – українці), 545 тис. з них засуджені, у т. ч. – щонайменше 140 тис. розстріляно (4).

Діяльність каральних органів була досить прагматичною, використовуючи до різних людей, різний тиск. Зазвичай щоб не знищити відразу, а залякати чи використати для «потреб батьківщини». Навіть величезна система ГУЛАГу, окрім покарання незгодних і залякування інших їх прикладом, діяла з практичною метою - максимальне використання праці в'язнів. Перебування у радянських концтаборах перетворювало тисячі бранців на «сновид з мутними очима бездушних людей» за словами Оксани Мешко (14, с. 33).

На основі попередньої політики, але зі змінами була побудована й система репресій направлена проти дисидентів. Вона включала передусім масштабне використання обшуків, допитів та звільнень, а також арешти та ув'язнень до найбільш незгодних. Також щодо учасників опозиційного руху активніше застосовували каральну психіатрію.

Варто зауважити, що вся репресивна діяльність державних органів Радянського Союзу опиралася на підлаштовану нормативну базу. Одним з найважчих та найжорстокіших періодів радянського тиску, був час правління державою Й. Сталіна. В цей час чимало людей були засуджені за статтею КК УРСР 54 (пункти 1-14). Комплекс складу злочинів, що передбачали відповідальність за «контрреволюційну діяльність», «зраду батьківщини», був введений у КК УРСР у 1927 р (29). Перша редакція закону не містила чіткого врегулювання поняття «зрада батьківщини». Проте у 1930-х роках, суспільно-політична ситуація в країні та схильність комуністичного керівництва до репресій, призвела до доповнення КК УРСР статтею про цей злочин. В статті 54 ч.1 («а», «б», «в», «г») прописувалося покарання за державну зраду, а за підпункти «а» та «б» передбачалася найвища міра покарання (розстріл, який згодом замінили на 25 років ув'язнення). При пом'якшуючих обставинах до 10 р. ув'язнення (10, с. 56).

Чимало арештантів перебували в ув'язненні саме через цю статтю КК УРСР. Зокрема станом на 01.01.1951 в ГУЛАГу, трудових поселеннях та місцях ув'язнення перебувало 579 918 засуджених за контрреволюційні злочини, з яких 334 538 (57,7%) відбували покарання за «зраду батьківщині», 3 256 осіб (0,6%) – члени сімей «зрадників батьківщині» (11, с. 24).

У 1958 році ч.10 тієї ж статті 54 КК УРСР, яка передбачала звинувачення «в пропаганді або агітації, яка полягає в заклику до повалення, підриву або послаблення радянської влади чи до вчинення окремих контрреволюційних злочинів, а також за розповсюдження чи виготовлення або зберігання літератури того самого змісту», була замінена. Нове формулювання статті було введене «Законом СРСР «Про кримінальну відповідальність за державні злочини». До 1961 судове переслідування у всіх республіках СРСР здійснювалося безпосередньо на підставі цього закону, потім цей склад злочинів був включений у нові кримінальні кодекси всіх союзних республік. Фактично нововведення були направлені проти проявів інакомислення. Таким чином репресії проти дисидентів спиралися на відповідну законодавчу й нормативну базу, зроблену для нових потреб. У 1961–1966 саме реформована стаття, в новій редакції вже під номером 62 КК УРСР служила основним кримінально-правовим інструментом для переслідування за практично всі види проявів протесту (30). Окрім неї діяли численні інструкції та рекомендації КДБ при Раді Міністрів СРСР, Верховного Суду СРСР, інших республіканських органів (1, с. 230).

Також з метою придушення громадської активності та критики влади до статті було додано розділ «Особливо небезпечні державні злочинці», що суперечив конституційним правам громадян, адже згідно з радянською конституцією громадяни мали право критикувати тогочасний політикум, а за КК УРСР такі люди піддавалися репресіям, засланням у табори суворого режиму (33, с. 83).

В'ячеслав Чорновіл у документально-публіцистичній збірці «Правосуддя чи рецидиви терору?», зазначив, що судді буквально «розтягують гумову статтю Кодексу, як гармошку», тлумачачи по-різному поняття «антирадянської діяльності». Таким чином, окрім покарання найбільш активних опозиціонерів, стаття була спрямована й на залякування суспільства (33, с. 83).

У 1966 році було запроваджено також статтю 187 КК УРСР, яка передбачала покарання за «Поширювання завідомо неправдивих вигадок, що порочать радянський державний і суспільний лад». Метою її створення було спрощення процедури обвинувачення, адже за звинуваченням в «антирадянській агітації і пропаганді» потрібно було довести наявність мети «підриву або ослаблення» радянської влади. А обвинуватити за статтею 187, до якої не належали «особливо небезпечні державні злочини», було легше. Ця стаття була спрямована проти авторів і розповсюджувачів самвидаву та тамвидаву. Одним з перших під обвинувачення цієї статті потрапив В'ячеслав Чорновіл (31).

Таким чином нормативна база радянських репресій змінювалася залежно від потреб керівного апарату та проти тих, хто найбільше «дошкуляв» системі. Для прикладу протягом 1967–1971 рр. за ст. 62 КК УРСР до кримінальної відповідальності було притягнуто 87 осіб, а в 1972–1973 рр. – близько 70 (9. с. 503).

Частині учасників дисидентського довелося пережити різні віхи радянської репресивної політики та навіть повторно бути засудженими. Наприклад дисидентки – Ірина Сеник, Ольга Горинь, Оксана Попович, Оксана Мешко, Стефанія Петрашсічко та Ніна Вірченко пережили ув'язнення в таборах ГУЛАГу в 1940-1950-х роках, а після продовжили діяльність в дисидентському русі, пережившу нову хвилю тиску.

Масові репресії в Західній Україні 1939-1941 та 1944-1953 рр. (упродовж 1944–1953 рр. за участь у русі ОУН та УПА, або за його підтримку засуджено близька 87 тис. та понад 200 тис. громадян депортовано) стали однією з відчутних частин сталінського терору (4). Метою цієї політики була нейтралізації будь-яких загроз із боку реальних та уявних ворогів (1, с. 156).

Однією з тих хто потрапив під репресії радянської влади у 1940-х роках була Оксана Попович. Майбутня учасниця опозиційного руху з юного віку мала чіткі патріотичні погляди, причиною стала сім'я. Батько – колишній вояк Української Галицької Армії, учасник Листопадового зриву у Львові 1918 року, за патріотичну позицію протягом шести місяців утримували у польській в'язниці, матір – директорка однієї зі шкіл в м. Городенка. З ранніх років оточення визначило майбутній шлях Оксани. Її вуйко Гнат Стефанів був очільником Начальної команди УГА, батькова сестра Клементина Боярська-Попович - українська письменниця та громадська діячка (18).

Під час навчання в гімназії в м. Городенка Оксана вступила до Юнацтва ОУН, обрала для себе псевдо «Маруся» (3, с. 352). В Юнацтві пройшла військовий, ідеологічний та санітарний вишколи. Згодом виконувала обов'язки кур'єра окружного проводу ОУН (27, с. 511).

У лютому 1944 року Оксану Попович заарештували в с. Іспас (нині Спас) на Коломийщині з підпільною літературою під вигаданим іменем Варвари Петрущак. Під час етапування до Коломиї здійснила спробу втечі, але була поранена ногу та спіймана охоронцями. В липні 1945 року військовий трибунал військ НКВС Станіславської (нині Івано-Франківської) області засудив Оксану Попович за ст. 54 на 10 років позбавлення волі та 3 роки обмеження прав (3, с. 352).

Таких як Оксана, засуджених військовим трибуналом було чимало, адже до сфери впливу цих судових органів відносили переважно злочини, спрямовані проти оборони, громадського порядку, державної безпеки, тощо. Ще частина «державних злочинів» розглядалася Особливою нарадою при НКВС СРСР. Тобто цивільне населення на той час опинилося в полі зору спецсудів та позасудового органу – Особливої наради. Ці інституції виносили вироки за найвищим рівнем суворості (5, с. 119). Крім того ці органи могли засуджувати навіть заочно, що було ще однією відмінною рисою радянського терору (1, с. 223).

У перші повоєнні та подальші роки військові трибунали військ НКВС–МВС виносили найжорстокіші вироки не лише учасникам повстанського руху, а й непричетним до нього громадянам. Для прикладу за період із 1 листопада 1946 до 1 квітня 1947 рр. у Львівській, Дрогобицькій, Тернопільській, Волинській, Чернівецькій, Закарпатській, Рівненській областях було засуджено 1036 «бандпособників» і 145 «недоносителів». Серед них – 160 осіб віком до 18 років (5, с. 125).

Після засуду 19-річна Оксана Попович була етапована до м. Воркути в Республіці Комі. Працювала на будівельних роботах, що було дуже важко враховуючи попереднє поранення в ногу. Звільнитися змогла тільки після смерті Сталіна у 1955 році, потрапивши під амністію, як інвалід (14).

З групою інвалідності у 1956 р. повернулася зі заслання ще одна учасниця дисидентського руху Ірина Сеник. Її історія трохи схожа до попередньої, народилася у 1926 р. у Львові, батько належав до Легіону УСС, після працював завідувачем Маслосоюзу. Матір Марія (хоча в кримінальній справі зазначається, як Франциска (2, с. 305)), походила з німецького роду Уберле (19). В сім'ї було троє дітей – найстарша Леоніда (1924 р. н.) була членкинею ОУН і померла на засланні у віддалених районах РР ФСР, менший брат Роман (1931 р. н.), разом з сім'єю був виселений на спецпоселення, як «член сім'ї ОУН-УПА» (28, арк. 1). Таким чином вся сім'я Ірини зазнала репресій, доля батька залишилася невідомо, сестра померла на засланні, матір на спецпоселенні (19).

Ірина Сеник приєдналася до Юнацтва ОУН у 1938 р., під псевдо «Леся» (2, с. 301). До цього до організації вже належала її сестра Леоніда. Свою діяльність Ірина почала під час навчання в гімназії Кокорудзів у Львові та під керівництвом старшої гімназистки Наталії Винників. Від неї отримала перший ідеологічний вишкіл. Доля, чи історія, часто поєднувала між собою українських патріотів, адже боротьба тривала десятиліттями.

У 1941 р. Наталія Винників потрапила під судилище радянської влади під назвою «процес 59». 59 юнаків і юначок було взято під варту та звинувачено в антирадянських злочинах через причетність до ОУН. Маріонетковий суд засудив 42 українців до розстрілу (25). Наталію Винників було розстріляно у 1942 р. в Бабиному Яру, таким чином Ірина Сеник втратила вірну соратницю

У 1944 р. Ірина вступила на факультет англійської філології Львівського університету. Тут продовжила свою підпільну діяльність (28, арк. 1). В післявоєнні роки студентський рух опору був важливою складовою національно-визвольної боротьби українців. Чимало студентів, що розвивали мережу підпільних організацій вже мали попередній досвід діяльності в рамка ОУН (6, с. 98).

Формами діяльності студентських підпільних організацій було поширення та читання літератури національного змісту, агітація проти русифікації та створення пропагандистських текстів (6, с. 98). Доєднання нових членів до ОУН в межах студентських колективів з однієї сторони сприяло швидкому розширенню мережі з іншої - несло небезпеку постійного стеженні викладачами, іншими студентами чи представниками влади.

У 1945 р. Ірина Сеник (в тому ж році і її сестра Леоніда), була заарештована. На допитах не видавала жодних імен, розповідаючи що знала інших членів тільки про псевдо. Своїми завданнями визначала розповсюдження літератури та стеження на вулицях Львова (2, с. 305). Під час інтерв'ю вже в

часі незалежності Ірина Сеник зазначала, що належала до крайового відділу пропаганди, який знаходився в так званому «Зеленому Гаї» на Бібреччині, точніше в Дев'ятники (16).

Після утримання та допитів у слідчому ізоляторі у Львові («Тюрма на Лонцького») у 1946 р. Ірина Сеник була засуджена військовим трибуналом військ НКВС на 10 р. утримання у виправних таборах, 5 років обмеження прав та довічне спецпоселення за ст. 54 ч. 1 «а» та 54 ч.11. Також на 10 років ув'язнення за тими ж статтями була засуджена й Леоніда Сеник, її звинувачували в заготівлі медикаментів для УПА та розповсюдження підпільної кореспонденції (2, с. 310).

Етапована Ірина Сеник до виправного табору в м. Тайшет, згодом переведена до особливого табору № 7 (Озерний), в якому окремо утримувалися політв'язні (19). Після арешту в Ірини почалися проблеми зі здоров'ям, через тортури під час слідства. В таборі пережила кілька операцій, проте полегшення умов утримання не було, доводилося працювати на каторжних роботах (19).

У 1955 р. Ірину Сеник було переведено на спецпоселення в Анджеро-Судженськ Кемеровської області, РРФСР. Тут на засланні перебувало чимало українських політв'язнів та власне родичі Ірини. І тільки у 1968 році змогла повернутися в Україну та оселитися в м. Станіслав (нині Івано-Франківськ) (19).

В таборі Ірина Сеник познайомилася з різними політв'язнями, а також майбутніми представницями дисидентського руху – Оксаною Мешко та Ніною Вірченко (26).

Ніна Вірченко утримувалася з Іриною Сеник в «Озерлагу». 18-річну студентку механіко-математично факультету Київського університету арештували у 1948 р. за звинуваченням у «таємній політичній змові, заколоті» (27, с. 113). Основою звинувачення Ніни став щоденник, який вела з 15 років. А також свідчення близької подруги з якою Ніна Вірченко ділилася своїми думками. Студентка захоплювалася історією України та ідеями національно-визвольної боротьби, розповсюджувала рукописні агітаційні листівки. Про це було відомо товаришці Ніни, яка й доповіла про це (16).

Ніна Вірченко теж виховувалася в патріотичному дусі. Батько – колишній офіцер армії УНР. Мати – фельдшер, знала напам'ять чи не всього «Кобзаря». Змалку Ніна виявляла здібність до математики. У підліткового віці мала гасло життя «Моя любов – Україна і Математика». Придумала собі псевдонім УЖМА: Українка – Жінка – Математик – Астроном» (16).

Після арешту Ніна Вірченко утримувалася у Лук'янівській в'язниці, а згодом була засуджена Особливою Нарадою МДБ СРСР на 10 років ув'язнена, знову ж таки за статтею 54. ч. 1 «а» 54. ч. 11. Етапована до до Озерного ВТТ в Тайшеті, де й познайомилася з іншими політв'язнями. Працювала на лісоповалі та в каменоломні. Звільнитися теж після смерті Сталіна, у 1954 р., потрапивши під амністію, як неповнолітня засуджена (16).

Ще одна співарештантку Ніни Вірченко та Ірини Сеник Оксану Мешко заарештували у 1947 р. Офіційним приводом був начебто «намір вчинити замах на першого секретаря ЦК КП(б)У Микиту Хрущова» (24).

Оксана Мешко народилася 30 січня 1905 року в селі Старі Санжари. Її сім'я походила з козацького роду. Багато родичів Оксани Мешко були втягнуті в перипетії української історії: члени політичних партій, Центральної Ради, Директорії, ОУН, УПА, дисидентського руху, науковці, меценати, депутати. За свою патріотичну діяльність вони зазнавали утисків (24).

Зі спогадів Оксани Мешко вона була заарештована, просто на вулиці біля жінки зупинилося авто і четверо чоловіків силою затягли в середину і привезли у відділення НКВС (14, с. 5). Під час слідства було висунуто обвинувачення про підготовку разом із сестрою Вірою замаху на першого секретаря ЦК КП(б)У Микиту Хрущова (15, с. 17). А згодом присуд – 10 років ув'язнення. Покарання відбувала в Ухті, Комі АРСР.

В тому ж 1947 році було заарештовано й Стефанію Петраш-Січко, за приналежність до українського націоналістичного підпілля. Історія Стефанії Січко схожа до історій інших політув'язнених. Виховання в патріотичній сім'ї, де батько в минулому належав до Легіону УСС, приналежність старшої сестри Омеляни до ОУН, патріотичне виховання в межах читальні «Просвіти». У 1941 р. батько розповів Стефанії та її братам і сестрам про побачені тіла замордованих українців у в'язниці Івано-Франківська, які залишилися після відступу радянських військ. «За ці жертви ви, молоді, повинні пімстити. Бо ми хто зна чи доживемо до тих днів розплати», сказав після тих подій батько своїм дітям. Надалі вся їх діяльність відбувалася в межах національно визвольного руху. Стефанія Петраш-Січко стала чотаркою «Дорасту» ОУН, вела «Доріст» під час акту проголошення відновлення Української Держави у Львові. Деякий час працювала під командуванням підпільника на псевдо «Крига», рідного брата Зиновія Красівського. У 1944 році Стефанія змушена перейти у підпілля через часті облави та переслідування сестри Омеляни. А в 1947 р. переховуючись в помешканні брата була заарештована (21, с. 29-30).

В тому ж році майбутню учасницю дисидентського руху Військовий трибунал військ МВС Станіславської області засудив за ст. 54 ч.1 «а», 54 ч.11 КК УРСР на 10 р. позбавлення волі та 3 р. поразки в правах (17).

Дехто з майбутніх дисиденток потрапив в ув'язнення у 1950-х роках. Зокрема Ольга Горинь (в дівоцтві Мацелюх). У 1951 році майбутня дружина Михайла Гориня вступила на відділ логіки, психології, української мови та літератури Львівського університету. Ту власне й почала активну діяльність в ОУН(27, с. 162) .

Виникнення молодіжних груп, здебільшого серед студентства, формувалося по мірі згасання збройного націоналістичного руху, коли керівництво ОУН взяло курс на посилення організованості й

конспірації серед юнацтва і молоді. Студентські патріотичні організації мали спільні риси, зокрема ідеологічне забезпечення на основі морально-політичних засад українського націоналізму і ОУН; орієнтація на методи політично-пропагандивної боротьби, при наявності незначної кількості зброї (6, с. 99).

Ольга Мацелюх теж примкнула до студентського руху. У 1949 році за зв'язки з оунівським підпіллям було заарештовано брата Ольги Богдана Мацелюха, студента Львівського державного медичного інституту. Разом з іншими студентами з яким разом винаймали помешкання Богдан розповсюджував підпільну літературу. Проте, за доносом свідка був арештований і на суді взяв всю провину на себе, щоб врятувати друзів. Зокрема Романа Василька, студента Львівського політехнічного інституту з яким співпрацював (7, с. 240).

Після арешту Богдана Мацелюха його товариш і співмешканець Роман Василько переселився до свого одногрупника Богдана Бубняка і на початку 1950 р. вони вирішили створити підпільну групу пропаганди національних цінностей. До цієї групи увійшли: студенти фізико-математичного факультету Львівського університету Роман Василько, Богдан Стефанюк і Богдан Бубняк, студентка філологічного факультету Ольга Мацелюх та ще одна студентка Ярослава Терлецька. Основним видом боротьби групи було розповсюдження серед студентів листівок та літератури антибільшовицького спрямування.

Попри чітку конспірацію, групі не вдалося уникнути арешту. Ольга Мацелюх організувала підпільну зустріч з членами ОУН, через яких отримувала літературу, але на цю зустріч прийшов засланий шпигун. З 9 по 11 квітня 1952 р. відбулися арешти членів групи, на суді через зібрану доказову базу заперечувати обвинувачення було даремно. Богдана Стефанюка та Ольгу Мацелюх за ст. 54 ч.1 «а» КК УРСР було засуджено на 25 років виправно-трудових таборів ГУЛАГу. Романа Василька, Богдана Бубніка та Оксану Терлецьку - на 10 років ув'язнення (7, с. 242).

Ольгу Мацелюх було етаповано до Інти, Комі АРСР. Тут працювала на будівниці дороги через лісотундру, згодом переведена в селище Абезь поблизу Інти, а потім в с. Коксунь Карагандинської області, Казахської РСР. У 1956 році після смерті Сталіна Ольга Мацелюх змогла потрапити під амністію та звільнитися (27, с. 162).

Історії практично всіх цих репресованих жінок були схожі. Народжені в міжвоєнний час та вихована в патріотичних сім'ях, вони не хотіли миритися з життям під тиском влади. Жінки втрачали рідних і близьких у цій боротьбі та роки своєї молодості в виправних таборах та в'язницях.

Практично однаковими були й спогади про ув'язнення, нестача їжі, важкі кліматичні умови, непосильна праця та знущання табірної адміністрації. Іноді ці розповіді безкомпромісні - з бійцівським гартом відповідала Оксана Попович: «Совєцька власть погано працювала, що мене не розкрила», міліціянтам після того, як відбула покарання під вигаданим прізвищем і не була розконспірована (18). Іноді незвично теплі, здавалося для ув'язнення це неможливо, але Оксана Мешко зазначала: «В нас продовжувала діяти внутрішня сила збереження жіночого біологічного індивіда– схильність і відчуття тонкого та прекрасного в природі й людях. Молоді дівчата писали вірші, укладали пісні… Вишивали, плели художні речі... Нарешті, співали пісні з такою тугою і задушевністю, що їх не описати моїм старечим недолугим пером» (15, с. 41).

Навіть після звільнення життя не стало легшим. За колишніми політув'язненими слідкували каральні органи, свобода була штучною, адже піти далі встановлених владою кордонів не можна було. Крім того дітей політв'язнів обмежували, створювали перешкоди для навчання, стежили. В таких умовах влада сама підштовхувала до опору. «Стало легше на душі. Хоч нас переслідували сильніше, але ми знали, що ми не одні», зазначала Стефанія Петраш-Січко про свою мотивацію приєднатися до дисидентського руху (21, с. 76) . Схожа мотивація була і в інших.

Кільком колишнім арештанткам вдалося оселитися в Івано-Франківську і поступово перетворити місто в один з осередків дисидентського руху. Після звільнення з табору у 1956 р. Оксана Попович теж оселилася в цьому місті. Тут затоваришувала з Любов'ю Возняк-Лемик, дружиною Миколи Лемика та теж колишньою арештанткою радянських виправних таборів. Разом з нею приєдналася до розповсюдження самвидаву - праць Валентина Мороза, Бориса Антоненка-Давидовича, Івана Дзюби. Крім того жінки активно допомагали політв'язням, керувала всім цим процесом Оксана Мешко (18).

За таку діяльність у 1975 році Оксану Попович засуджують вдруге, за звинуваченням в «антирадянській агітації та пропаганді з метою ослаблення радянської влади» та відправляють до в'язниці в Мордовській АРСР. Тут вона зустрічає інших арештанток - Ірину Сеник, Ірину Калинець, Надію Світличну, Стефанію Шабатуру, Дарію Гусяк та Марію Пальчак. В ув'язненні в колі однодумців Оксана продовжує свою боротьбу, голодує в знак протесту проти сваволі влади і неналежних умов утриманні, вступає до Української Гельсінської групи і її підписи з'являються під низкою опозиційної документації. З ув'язнення і заслання звільняється лише в 1987 році, сумарно відбувши 24 роки радянських таборів і в'язниць (18).

У тому ж Івано-Франківську після ув'язнення оселилася й майбутня співкамерниця Оксани Попович Ірина Сеник, яка повернулася в Україну у 1968 році (2, с. 312). Тут вона налагодила зв'язки з колишніми членами ОУН та учасниками опозиційного руху – Любов'ю Возняк-Лемик, Оксаною Попович, Валентином Морозом, Раїсою Мороз, Опанасом Заливахою, Оксаною Мешко, Ніною Вірченко тощо. Жінка увійшла до Івано-Франківського та Львівського осередків захисту прав політв'язнів, писала скарги та протести на захист ув'язнених. За таку діяльність у 1973 р. Ірина Сеник була засуджена за тією ж статтею 62 КК УРСР за «антирадянську агітацію та пропаганду» та ув'язнена у в'язниці ЖХ-

385/3 в с. Барашево в Мордовській АРСР. Тут як і ув'язнені соратниці голодувала проти порушення прав ув'язнених та проти заборони вишивати, адже своєю творчістю намагалася розбавити важке життя у в'язниці. У 1979 році перебуваючи на засланні , стала учасницею УГГ і її підписи почали з'являтися під важливими документами організації, де повідомлялося про терор влади. Звільнитися змогла лише у 1983, відбувши 33 роки ув'язнення та заслання (34, с. 684).

У 1956 р. зі спецпоселення до Києва повернулася і Оксана Мешко. В часі ув'язнення радянська влада була досить пильною до сина Оксани Мешко, Олеся Сергієнка. У 1953 р., за показами товариша його вперше було затримано МГБ в справі гуртка студентів-філологів, і тільки смерть Сталіна врятувала його від неминучого арешту (35). Практично перед самим поверненням матері у травні 1956 Сергієнко був викликаний у КГБ з приводу провокаційного листа з ув'язнення від шкільного товариша під назвою «Що робити?». Після ХХ з'їзду КПРС притягти його до відповідальності не було можливості, але сесія була зірвана і він змушений був після 4-го курсу залишити навчання (20).

У 1963 р. О. Сергієнко поступив у Київський мединститут. Це був початок і розквіт руху шістдесятників, в якому Олесь Сергієнко взяв найактивнішу участь (35). 28 травня 1966 року його арештували на 15 діб за те, що був на вечорі пам'яті Івана Франка. Наслідки не забарилися: відрахували з мединституту. Для чоловіка почалася своя боротьба з системою.

Після виступу на похороні Алли Горської 1970 року його звільнили з роботи, але Сергієнко продовжував брати участь в акціях проти переслідувань діячів української культури. У 1972 році його засудили на 7 років ув'язнення у виправному таборі в Пермській області та 3 роки заслання за ст. 62 КК. Через рік – ще на 3-річне ув'язнення у Володимирській в'язниці (24).

Починаючи з 1965 року Оксана Мешко теж активно підтримувала опозиційний рух, у зв'язку з чим тиск влади на сім'ю посилювався слідкуванням та обшуками. У 1970 р. Оксана Мешко стала активною учасницею боротьби за звільнення Валентина Мороза (15, С. 71). Все більш зрозумілим ставало, що тиск влади на дисидентів посилюється, проте Оксана Мешко не задавалася. Частішими ставали обшуки та допит.

У 1976 році Оксана Мешко стала однією з трьох перших членів-засновників знаменитої Української Гельсінкської Групи. А залишившись на свободі після арештів голови УГГ Миколи Руденка та члена-засновника Олекси Тихого (невдовзі й усього первинного складу групи), 72-річна жінка змушена була керувати УГГ протягом 4 років, аж до нового арешту в 1980 р.

На час її арешту УГГ, після розгрому або саморозпуску під тиском репресій у 1977 – 1978 рр. всіх інших гельсінських груп – Московської, Литовської, Грузинської та Вірменської, – залишалася чи не єдиною діючою правозахисною організацією в СРСР. Попри репресії проти групи – з 42-х членів УГГ було заарештовано 35 (15, С. 5). Курувати всіма протестними проектами УГГ, підтримувати політв'язнів, спілкуватися з ними, підписувати важливі документи за збереження прав людини в тоталітарній системі, крім того бути в поважному віці, після довгих років ув'язнення та арешту сина було важкою справою. Але «козацька матір», як називали Оксану Яківну інші учасники опозиційного руху була борцем. Свою боротьбу продовжувала і під час 8-річного заслання до якутського селища Аян Хабаровського краю. Туди потрапила 76-річною. Навіть після звільнення у 1988 р. Оксана Мешко сприяла звільненню з таборів інших політв'язнів, серед них – Левка Лук'яненка (24).

У 1956 році з табору звільнилася й Ольга Мацелюх. Вона змогла відновити навчання в університеті. Із Михайлом Горинем вона познайомилася 1961 року (23). Після одруження почалася нова хвиля репресій, здавалося цього разу основний тягар впав на плечі Михайла Гориня, проте бути дружиною дисидента в УРСР, до того допомагати в його діяльності було складною справою. Після арешту Михайла Гориня у 1965 році Ольга, на той час художній керівник Львівського будинку вчителя, була звільнена з роботи (27 , с.162). Здавалося б такий вид репресій, не були такими складними, як попередні, проте радянська влада тиснула на дружин дисидентів, найпоширенішими були звільнення, стеження, залякування, допити, тиск на дітей, створення перепон в їхньому навчанні.

В часі ув'язнення чоловіка Ольга передавала йому заборонену літературу (12). Під час однієї із зустрічей у валізі з подвійним дном Ольга привезла працю «Інтернаціоналізм чи русифікація» Івана Дзюби. Іншого разу Ольга передала чоловікові книжку Фройда, а в листі вказала: «Уважно прочитай ту книжку – то дуже цікава книжка!» Михайло зрозумів натяк і знайшов у корінці вклеєну статтю самвидаву. «Оля – унікальна жінка, я вам скажу», – говорив Михайло Горинь, пригадуючи ті передачі від дружини (23).

Практично до прийняття Незалежності був відчутний тиск влади, проте Ольга Горинь продовжувала активну діяльність - долучилася до боротьби за відновлення УГКЦ та УАПЦ, писала статті та репортажі, за що отримувала адміністративні стягнення.

Учасницею того ж релігійного дисидентства стала й Стефанія Петраш-Січко. У 1954 році, ще перебуваючи на засланні Стефанія познайомилася з майбутнім чоловіком, Петром Січком, членом українського націоналістичного підпілля, засудженим на 25 років ув'язнення. У 1956 р. вони одружилися, згодом народилося двоє синів та дочка. У 1957 р. сім'ї вдалося повернутися в Україну.

Новий етап боротьби почався для родини у 1970-ті. Після того як старшого сина Василя відрахували з Київського університету, фактично через минуле батьків. Будь-які спроби добитися правди були марними, тому Василь пішов до паспортного столу й написав заяву: «Здаю свій паспорт у зв'язку з незаконним виключенням мене з університету і

вимагаю видати мені закордонний паспорт для виїзду з СРСР і продовження навчання в будь-якій країні світу» (23).

Тиск влади на Василя Січка ставав все відчутнішим і юнак вирішив приєднатися до дисидентського руху та вступити в УГГ, через місяць приєднався і батько Петро. Підписи Петра і Василя з'являлися під протестними документами, а згодом Петро Січко оприлюднив заяву про порушення прав людини в СРСР – на прикладі своєї сім'ї. У квітні 1979 року подав заяву до Президій Верховної Ради СРСР та УРСР про геноцид українського народу, у ній же зрікся радянського громадянства.

У грудні 1979 року Січків засудили: батькові – три роки суворого режиму, а синові – три роки посиленого режиму. Невдовзі засудили й молодшого сина Володимира, який теж відмовився від радянського громадянства (21, с. 10-11).

Через ув'язнення рідних, заборону побачень, передач і побиття у в'язниці Стефанія неодноразово зверталася до влади із заявами, які періодично передавалися за кордон. (23). Окрім боротьби за рідних, Стефанія вступила до «Ініціативної групи для захисту прав віруючих та церкви в Україні». Влада не хотіла відновлення УГКЦ та УАПЦ, тому проти членів групи почалися репресії, голову групи Йосипа Терелю було заарештовано. Стефанія продовжувала діяльність за відновлення конфесій, незважаючи на арешти рідних, близьких та постійні обшуки та залякування (22, с. 147). Коли 1983 року звільнили Володимира, а 1985-го – Петра і Василя, вони теж приєдналися до релігійного дисидентства(23). «Коли не страшна смерть, то перед чим і чого лякатись?», зазначала дисидентка (21, с. 123).

Їхня боротьба була тривалістю в життя, адже навіть після звільнення із таборів комуністичний режим всіляко ускладнював життя «ворогів народу», намагався зробити його якомога нестерпнішим: труднощі із пропискою, неможливість здобути освіту та фах, мати належне місце праці, зрештою, постійні цькування та тавро «зрадників батьківщини» (13. с. 7-8). Їхні історії про те як навіть найжорсткіша тоталітарна політика не в змозі зупинити силу єдності і протидії. «Страждання в'язнів не тільки вилилися сльозами, вони стали джерелом високих поривань, свободи та віри в прогрес», зазначала Ірина Сеник (8, с. 11). Ця цитата чудово підсумовує суть діяльності дисидентів, борців за права і свободи.

Висновки. Підсумовуючи все вище викладене, варто зазначити що діяльність українських дисидентів в рамках радянської держави була складною, враховуючи постійне переслідування та небезпеки. Часто учасники опозиційного руху об'єднувалися не просто в колі однодумців, а в середовищі людей, які також зазнали репресій в тій чи іншій формі. Адже одного разу потрапивши в поле зору радянських спецслужб, чи більше, отримавши тавро «зрадника батьківщини», людина постійно перебувала під тиском влади і переслідуваннями. А отже об'єднуватися з такими ж репресованими людьми і продовжувати рух спротиву було чи не єдиним рішенням.

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MATHEMATICS

FROM THE EXPERIMENTALLY PROVED PRINCIPLE OF THE PHYSICAL REALITY OF IMAGINARY NUMBERS IT FOLLOWS THAT THE INVISIBLE AFTERLIFE WORLD, WHERE GODS AND SOULS OF THE DEAD DWEL, REALLY EXISTS [1]

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DOI: 10.5281/zenodo.13926511

Abstract

Rightly recognized as a great scientific achievement of physics of the XX century, the special theory of relativity (SRT), however, turned out to be incorrect, because at that time there was no experimental knowledge necessary for its creation, which had to be replaced by postulates. But not everything was guessed. And this is quite natural. All new theories are always subsequently refined and corrected. However, none of the many subsequent corrections and experimental refutations of SRT was not accounted for and still is not taken into account. As a result, SRT has remained uncorrected.

It is in this form that SRT is now studied in all physics textbooks, used in the educational process even in the most prestigious universities.

However, a corrected version of SRT has already been created, in which instead of the in-correct principle of non-exceeding the speed of light, the experimentally proven principle of physical reality of imaginary numbers, which refuted this postulate, is used. The corrected version of SRT has allowed to solve many unsolved in the noncorrected version of SRT problems. And from relativistic formulas of the corrected version of SRT follows the existence of numerous mutually invisible parallel universes. In the corrected version of SRT also it is explained that these invisible universes about which it is spoken in all religions, and are invisible afterlife world in which Gods and souls of dead dwell.

Keywords: imaginary numbers; complex numbers, hypercomplex numbers, WMAP, Planck, special theory of relativity, invisible parallel universes and antiuniverses, Multiverse, Hyperverse, portals, Gods, invisible afterlife world, souls of dead.

Introduction

Created in the twentieth century by the works of Joseph Larmor [1], Nobel Prize winner Hendrik Anton Lorenz [2], Jules Henri Poincaré [3], Nobel Prize winner Albert Einstein [4] and other outstanding scientists, the special theory of relativity (SRT) [5]-[7] because of its use of the principle of relativity is rightly considered a very great scientific achievement. However, in the XXI century it was proved that this theory is incorrect, because:

- the relativistic formulas obtained in it are not correct;
- they've been incorrectly explained using the wrong principle of light speed non-exceedance;
- from them were made incorrect conclusions about physical unreality of discovered 400 years before creation of SRT by Scipione Del Ferro, Niccolo Fontana Tartaglia, Gerolamo Cardano, Lodovico Ferrari and Rafael Bombelli[2] [8] imaginary numbers and the existence in nature of our only visible universe, in which all measurements are carried out only using real numbers.

As can be seen from the graphs (see Fig. 1a,b,c) of relativistic formulas of this version of SRT

$$m = m_0 / \sqrt{1 - (\frac{v}{c})^2} \quad (1)$$

$$\Delta t = \Delta t_0 \sqrt{1 - (\frac{v}{c})^2} \quad (2)$$

$$l = l_0 \sqrt{1 - (\frac{v}{c})^2} \quad (3)$$

where m_0 is the rest mass of the moving body;

m - relativistic mass of the moving body;

Δt_0 - rest time of a moving body;

Δt - relativistic time of a moving body;

l_0 - rest length of a moving body;

l - relativistic length of a moving body;

v is the velocity of the moving body;

c - speed of light;

in the range of pre-light speeds $v<c$ all these quantities take values measured by real numbers, in the range of superluminal speeds $v>c$ take values measured by imaginary numbers, and at the speed equal to the speed of light $v=c$, the function $m(v)$ has a gap. Therefore, in the pre-light speed range formulas (1)-(3) have been explained. And in the superluminal range of

[1] This is a reprint of the author's article "It follows from the experimentally proven principle of the physical reality of imaginary numbers that the invisible afterlife mentioned in all religions really exists" published in the Norwegian Journal for the Development of International Sciences No 138.

[2] And perhaps even before them imaginary numbers were discovered by Paolo Valmes [9], who was burned alive at the stake by the Spanish Inquisitor Tomas de Torquemada.

speeds the results of calculations in the form of imaginary numbers the creators of SRT could not explain. And in modern textbooks of physics they are not explained till now. After all, what is 5 meters, 6 grams and 7 seconds is clear to everyone, but what is 5*i* meters, 6*i* grams and 7*i* seconds, where $i=\sqrt{-1}$, and now no one can explain.

Moreover, as can be seen from the graphs of formulas (1)-(3), in the superluminal range of velocities v>c (see Fig. 1a,b,c) these formulas correspond to physically unstable processes that cannot exist in nature at all.

Indeed, let us assume that the material body in the range $V>C$ for some reason began to move faster. Then its mass according to the function graph $m(v)$ in Fig. 1a will decrease. But because of this lighter body will move faster. This, according to the graph of the function, will lead to a further decrease in the mass $m(v)$ of the moving body. And this will again lead to an increase in the velocity *v*

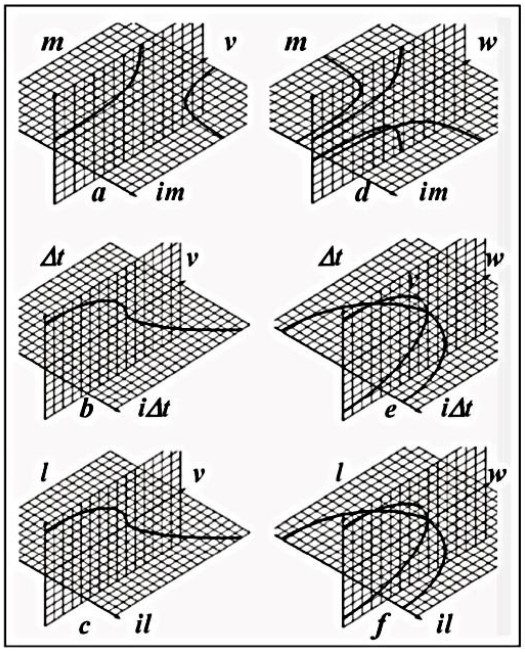

Fig. 1. Graphs of functions $m(v)$, $\Delta t(v)$ *and* $l(v)$ *corresponding to the existing and the corrected versions of the STR in the subluminal* $V<C$ *and superluminal* $V>C$ *ranges*

of the material body. And so on. Therefore, in the end this material body with zero mass and infinitely high speed flies to 'nowhere'.

And assuming that the material body on the graph of the function $m(v)$ in the range $V<C$ for some reason began to move slower and reasoning in a similar way, we will come to the conclusion that this material body moving slower and slower, will overcome the point of astrophysical singularity ***v=c*** and, being in the range ***v<c*** will, stop.

So, at any point in the range $V>C$ on the graph of the function $m(v)$ the ongoing process will indeed be unstable and therefore cannot exist.

And so the fate of SRT hung in the balance. After all, no one would not need a theory that even its authors could not explain. But SRT was saved by the fact that in it introduced a postulate called the principle of non-exceeding the speed of light, the meaning of which is clear from its name. And from this postulate followed that the formulas (1)-(3) in the superluminal range of speeds $V>C$ do not need to be explained, since imaginary numbers allegedly do not describe any processes that do not exist in nature.

So the fate of the SRT hung in the balance. After all, no one would not need a theory that even its authors could not explain. But SRT was saved by the fact that it introduced a postulate called the principle of non-exceeding the speed of light, the meaning of which is clear from its name. And from this postulate followed that formulas (1)-(3) in the superluminal range of speeds could not be explained, as imaginary numbers no existing in nature processes are allegedly not described. Here in such a form the uncorrected SRT is studied in all textbooks of physics up to now.

Nevertheless, at the initial stage of creation of SRT such variant of its statement was quite acceptable, though it obviously contained, as well as all new theories, some misconceptions. However, at present, when it has been found out the fallacy of some assumptions used by its authors a hundred years ago, which are further explained, ignoring these circumstances is no longer justified. All the more that now such a corrected interpretation of SRT already hinders the development of the whole science.

Physical reality of imaginary numbers

But there are other sciences besides physics. Including electrical engineering and radio engineering created before SRT. And in these sciences the theory of linear electric circuits of alternating current is used, in which the fundamental is the Ohm's law discovered in 1893 in the interpretation of Steinmetz [10]. And a simpler version of this law for DC electric circuits [11], [12], studied now in school physics textbooks, was discovered by Ohm himself in 1826, when no electrical measuring device existed yet. About the physics of that time, the professor of the Imperial Moscow University,

Alexander Grigorievich Stoletov wrote: *"...physics especially seduced natural philosophers. What a grateful theme for the most unbridled fantasies were electrical phenomena... Beautiful and vague deductions were in the foreground: painstaking work of the experimenter, precise mathematical analysis were not in honor; they seemed superfluous and harmful in the study of nature..."*. Therefore, in 1828 Om was dismissed from his job by the Minister of Education for publishing about the law he had discovered. The high-ranking official believed that the use of mathematics and experimental research in natural philosophy was inadmissible.

And Ohm's law as interpreted by Steinmetz is now used daily in practice by millions of electrical and radio engineers all over the world. Thereby, of course, confirming that it is true.

But in SRT the existence of this law is ignored, because from the postulate about the non unexceeded speed of light the conclusion about physical unreality of imaginary numbers is made, which is obligatory not only for physics but also for all other sciences. Including electrical and radio engineering. After all, mathematics is the common language of all exact sciences. Therefore, mathematics cannot be one in physics and another in electrical and radio engineering. And in SRT it is stated (although it is not written anywhere) that Ohm's law as interpreted by Steinmetz is wrong, because it follows from this law that electrical resistances of capacitors and inductors (also called inductance coils) are measured by imaginary numbers, and only resistances of resistors are measured by real numbers. Due to this circumstance

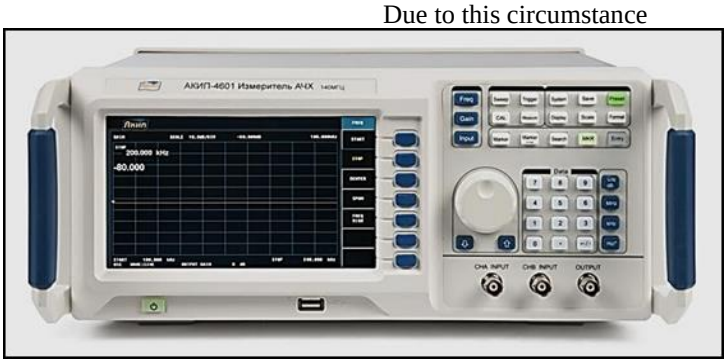

Fig. 2. In any radio-technical laboratory there are devices called frequency response meters, which prove the physical reality of imaginary and complex numbers by their mere existence

imaginary resistances of capacitors and inductors SRT proposes to consider actually imaginary, i.e. physically non-existent.

Note - the formulation of Ohm's law in Steinmetz's interpretation states that imaginary resistances are measurable. And in fact, any electrical and radio laboratory has been using commercially available devices for measuring imaginary resistances and other imaginary electrical quantities for many decades (Fig. 2)

But everything that can be measured always exists. This is the fundamental position of any science. If people in their activities did not use instruments, and relied on knowledge obtained only from their sensations, then science would not exist. And physicists can't help but know this. And since in electrical and radio engineering the resistances of capacitors and inductors, which someone unsuccessfully called imaginary, are in fact measured by existing devices, then they are not imaginary at all, but the most real physically existing ones.

Nevertheless, in SRT, in accordance with the principle of non-exceeding the speed of light, it is actually asserted that imaginary resistances of capacitors and inductors, since they are called imaginary, should not really exist. Therefore, electrical and radio engineering also should not exist [13]-[32].

In fact they existed even before the creation of SRT by publications of Einstein and Poincaré in 1905. But physicists of that time probably did not know and/or did not understand these sciences. They don't want to understand them now, since the theory of linear AC electric circuits is not taught to physics students.

Nevertheless, since in electrical and radio engineering the used imaginary quantities - resistances, transfer functions, etc. - correspond to real physical entities (since they are measured), it proves in the most indisputable way that the named imaginary numbers contrary to the postulate of SRT about non-exceeding the speed of light not only in electrical and radio engineering, but always and everywhere in all sciences are physically real. And it is time to realize that mathematics cannot be one for Einstein, another for Steinmetz, another for someone else. So imaginary numbers are physically real in all sciences. Textbooks on different sciences (for example, physics textbooks and radio engineering textbooks) should not contradict each other. And it is unethical to teach schoolchildren and students using such text-books.

There are other experimental proofs of the general scientific principle of the physical reality of imaginary numbers [33]-[44]. And no experiments are never refuted by postulates. And since the following from the postulate about not exceeding the speed of light SRT statement about physical unreality of imaginary numbers turned out to be incorrect, this postulate itself is incorrect. Therefore the generally accepted version of the SRT itself also turned out to be incorrect. There are also other proofs of the incorrectness of the version of SRT [45]-[65] still studied in all physics textbooks.

Corrected version of SRT

Since the principle of the physical reality of imaginary numbers has been experimentally proven in the most indisputable way, the relativistic formulas must now be explained for the super- luminal speed range [66]-[73]. But for these relativistic formulas to be explainable, they must first be corrected. To their graphs in the superluminal speed range $V > C$ (Fig. 1a, b, c) were similar to the graphs of the same quantities in the sublight speed range $V < C$, as shown in Fig. 1d,e,f. And for this, it is necessary to introduce the factor i^q into formulas (1)-(3). After which they will take the form

$$m(q) = m_0 i^q / \sqrt{1 - (\frac{v}{c} - q)^2} \quad (4)$$

$$\Delta t(q) = \Delta t_0 i^q \sqrt{1 - (\frac{v}{c} - q)^2} \quad (5)$$

$$l(q) = l_0 i^q \sqrt{1 - (\frac{v}{c} - q)^2} \quad (6)$$

where q(v)=⌊v/c⌋ is the "floor" function of discrete mathematics of the argument

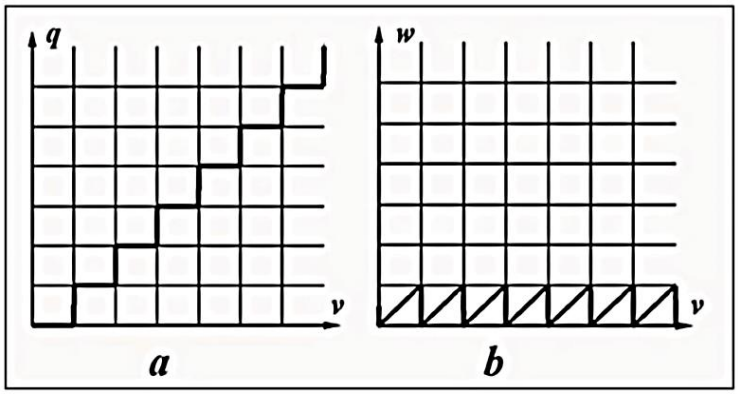

Fig. 3. Graphs of functions $q(v)$ *and* $w(v)$*, illustrating the meaning of the "floor" function of discrete mathematics*

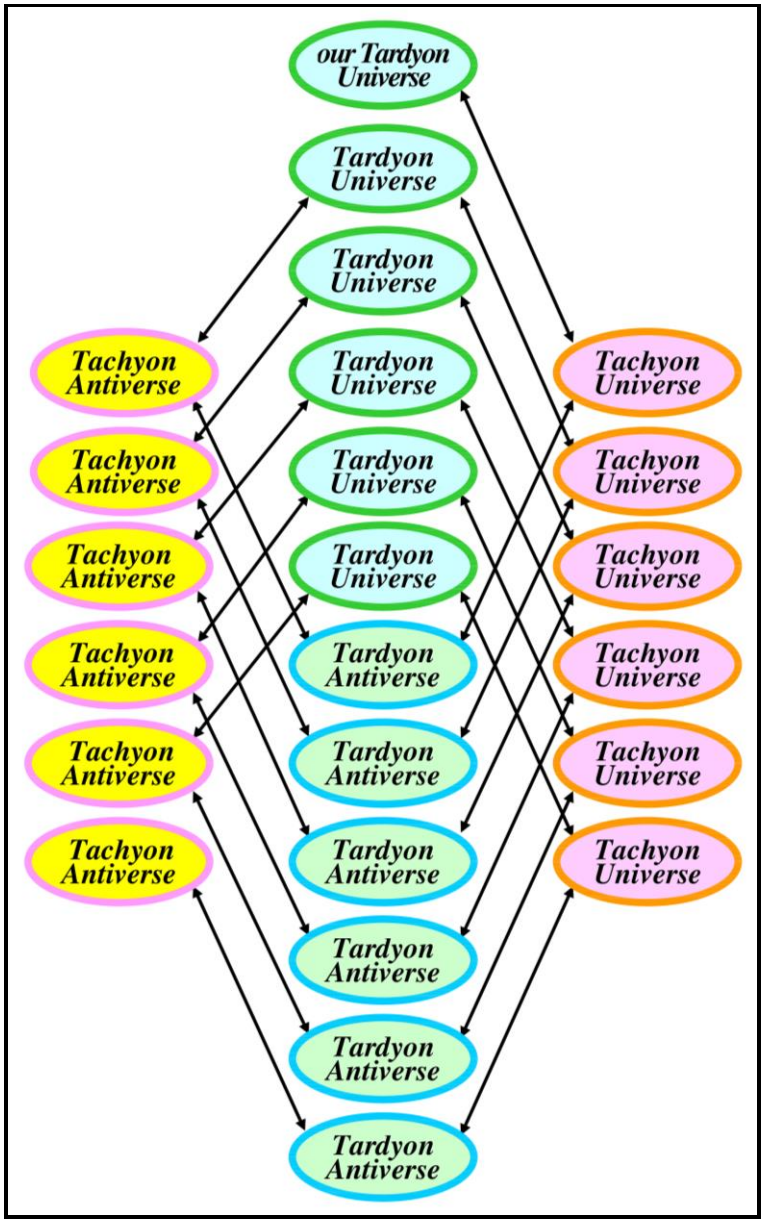

Fig. 4. Structure of the hidden Multiverse corresponding to the principle of physical reality of complex numbers

v/c (its graph is shown in Fig. 3a), which is the fourth spatial dimension;

w(v)=v-qc is the local velocity for each universe (its graph is shown in Fig. 3b).

Therefore, the function i^q for successive values of *q(v)* equal to *0,1,2, 3,4,5,...* takes the values *+1,+i,-1, -i,+1,+i,...* And the value *q(v)=0* in formulas (1)-(3) for the speed range $V < C$ corresponds to our visible universe, which for definiteness we will call the tardyon universe. The value *q(v)=1* in the speed range $V > C$ corresponds to the invisible universe, since it is beyond the event horizon. For definiteness, we will call it tachyon. The value *q(v)=2* will then correspond to an invisible tardyon antiuniverse, the value *q(v)=3* will correspond to an invisible tachyon antiuniverse, the value *q(v)=4* will correspond to another (and therefore also invisible) tardion universe, the value *q(v)=5* will correspond to another tachyon universe. Etc.

Thus, from the corrected relativistic formulas (4)-(6) it follows that in reality in nature there exists a Multiverse, which contains, in addition to our visible universe, also many other mutually invisible parallel (since they do not intersect) universes[3], since relative to each other they are all located beyond the event horizon. And such a Multiverse, which we will therefore call hidden, has an openended screw structure (as, for example, in Fig. 4).

How to calculate the function i^q for non-integer argument values?

But the function i^q which was very convenient and understandable in the presentation of the previous section, is not currently used in the theory of functions of a complex variable. Therefore, it is useful to clarify this situation. The i^q function is not used because it is now known how to calculate it only for integer values of the argument - you just need to multiply by ***i*** the original value, equal to one, q times. But in the case of non-integer values of *q*, this algorithm does not work. That's all.

Nevertheless, this situation is completely solvable. After all, the values *+1,+i, -1,-i,* etc. are the same as the function i^q for integer argument values *0,1,2,3,* etc. in function also accepts in Euler's formula $e^{iq\pi/2} = cos(iq\pi/2)+ isin(iq\pi/2)$, which allows you to calculate its values for non-integer values of the argument. Therefore, it is acceptable to assume that these two formulas i^q and $e^{iq\pi/2}$ rare identically equal to each other. And then we get the formula

$$i^q = cos\,(q\pi/2) + isin(q\pi/2) \quad (7)$$

by which for the function i^q one can find its values for both integer and non-integer values of the argument ***q.***

Thus, the last mathematical operation from algebra, which until now was not feasible in the theory of functions of a complex variable, has now also become feasible.

Analysis of experimental data obtained by the WMAP and Planck spacecraft

In order to obtain more information about the possible structure of the hidden Multiverse and to verify that it is correct, we will analyze the data obtained by the WMAP [74] spacecraft, launched in 2001 by the National Aeronautics and Space Administration (NASA), which operated until 2010, and Planck [75], launched by the European Space Agency (ESA) in 2009, which operated until 2013.

According to the data obtained by the WMAP spacecraft, the entire universe (in fact, the entire hidden Multiverse) consists of 4.6% baryonic matter, 22.4% dark matter, and 73.0% dark energy. And according to more recent data obtained by the Planck spacecraft, the entire universe (again, in fact, the entire hidden Multiverse) consists of 4.9% baryonic matter, 26.8% dark matter, and 68.3% dark energy. As you can see, these results differ little from each other, which proves their truth. But what dark matter and dark energy themselves are has never been explained.

It is for this incomprehensibility that these physical entities were called dark. Therefore, Stephen William Hawking wrote: *"The missing link in cosmology is the nature of dark matter and dark energy."*

And since it was proven above in the most indisputable way that in nature there is not a monoverse, but a hidden Multiverse, then dark matter and dark energy must somehow be present in it [76]-[80]. Consequently, the structure of the hidden Multiverse discussed above, shown in Fig. 4, must be accordingly corrected.

But how? To do this, we will abandon the assertion of the version of STR presented in textbooks that explanations for the phenomena of dark matter and dark energy must certainly be sought in our visible Universe. And we will look for them in the hidden Multiverse, since its existence has been proven. Let us assume that these phenomena are somehow generated by the very structure of the hidden Multiverse and are caused by the mutual influence of invisible parallel universes on each other. And then it's possible it is quite clear and convincing to explain the hitherto inexplicable main features of these phenomena - their invisibility and undetectability of corpuscular contents:

• dark matter and dark energy are actually not some kind of material physical entities, but just phenomena (presumably a gravitational shadow) generated by the existence, in addition to our visible tardion universe, of other invisible ones parallel universes of the hidden Multiverse;

• moreover, dark matter is a phenomenon generated by the existence of invisible parallel universes of the hidden Multiverse adjacent to our visible universe;

• and dark energy is a phenomenon generated by the existence of the rest, in addition to our visible universe and the invisible universes adjacent to it, the remaining invisible parallel universes of the hidden Multiverse;

[3] In other dimensions, therefore on Earth invisible

• and precisely because dark matter and dark energy are just phenomena, they have no material content, as a result of which they themselves are invisible.

Then it becomes obvious that some unusual material content in dark matter and in dark energy in nature probably does not actually exist. Just as there is no material content in our shadow on a sunny day. Therefore, attempts to detect some subatomic particles of dark matter and dark energy by the ongoing research at the Large Hadron Collider are probably not very promising.

This explanation of these phenomena also makes it possible to clarify the structure of the hidden Multiverse. Indeed, assuming the mass of different invisible parallel universes in the hidden Multiverse with a high degree of accuracy due to the presence between them of a large number of portals that have existed for billions of years is almost identical[4], it is possible to determine:

• how many parallel universes form the hidden Multiverse. And in accordance with the above data obtained by the WMAP spacecraft, their number is 100% / 4.6% = 21.74. And in accordance with the data obtained by the Planck spacecraft, their number is 100% / 4.9% = 20.41. Consequently, their real number is equal to 20...22 universes. Those in addition to our visible universe, there are also 19...21 invisible universes.

• how many parallel universes are neighboring our universe and give rise to the phenomenon of dark matter. According to data obtained by the WMAP spacecraft, their number is 22.4% / 4.6% = 4.87. And in accordance with the data,. received by the Planck spacecraft, their number is 26.8% / 4.9% = 5.47. Therefore, their real number is most likely equal to 5...6 parallel universes.

• how many parallel universes give rise to the phenomenon of dark energy. And in accordance with the data obtained by the WMAP spacecraft, their number is 73.0% / 4.6% = 15.87. And according to data obtained by the Planck spacecraft, their number is 68.3% / 4.9% = 13.94. Consequently, their real number is presumably equal to 14...16 parallel universes.

Corrected version of SRT (continued)

As can be seen, the experimental data obtained by the WMAP and Planck spacecraft did not confirm the above conclusions about the structure of the hidden Multiverse, since our visible universe in this structure should have not two neighboring invisible universes - more precisely, one tachyon universe and one tachyon antiuniverse - but five or six.

Therefore, it is logical to assume that there was some error in the previous reasoning. And this error is that earlier, for the sake of simplicity, we assumed in the hidden Multiverse[5] the existence of only one additional dimension q and, consequently, its correspondence to physically real complex numbers containing only one imaginary unit. And in order for our universe to be neighbors of six other parallel universes[6] - three tachyon universes and three tachyon antiuniverses - it is necessary to have three additional dimensions q, r, s, which will determine their position in space. Consequently, the space of such a hidden Multiverse will be six-dimensional (see Fig. 5). And its structure will correspond to quaternions $\sigma + i_1\omega_1 + i_2\omega_2 + i_3\omega_3$, i.e. hypercomplex numbers [81], containing three imaginary units i_1, i_2, i_3, which are related to each other by the relations

$$i_1^2 = i_2^2 = i_3^2 = -1 \quad (8)$$

$$i_1 i_2 i_3 = i_2 i_3 i_1 = i_3 i_1 i_2 = -1 \quad (9)$$

$$i_1 i_3 i_2 = i_2 i_1 i_3 = i_3 i_2 i_1 = 1 \quad (10)$$

In such a quaternion structure of the hidden Multiverse [82], [83] the distribution of material content in each three-dimensional parallel universe will be determined by some the function $f_{q,r,s}(x, y, z)$ and the quantities $i_1 q$, $i_2 r$ и $i_3 s$ and are the coordinates of these universes. Those. the structure of the hidden Multiverse is described by the formula $f_{q,r,s}(x, y, z) + i_1 q + i_2 r + i_3 s$. This is exactly what Lisa Randall predicted: *"We could be living in a three-dimensional slit of higher dimensional space."*

And therefore the relativistic formulas (4)-(6) must be corrected once again as follows

$$m(q,r,s) = \frac{m_0 i_1^q i_2^r i_3^s}{\sqrt{1 - [v/c - (q+r+s)]^2}} \quad (11)$$

$$\Delta t(q,r,s) = \Delta t_0 i_1^q i_2^r i_3^s \sqrt{1 - [v/c - (q+r+s)]^2} \quad (12)$$

$$l(q,r,s) = l_0 i_1^q i_2^r i_3^s \sqrt{1 - [v/c - (q+r+s)]^2} \quad (13)$$

Information about the helical structure of such a hidden Multiverse is contained in formulas (11)-(13). It follows from them that it is possible to move from a tardion universe to a tardion antiuniverse and from a tardion antiuniverse to a tardion univer-se in different ways, but not in an arbitrary way, but only in such a way (see Fig. 6)

[4] according to the law of communicating vessels

[5] Just like in the single visible universe in the generally accepted version of STR

[6] Or less. Then some parallel universes of our hidden Multiverse may be absent and replaced by universes of neighboring Multiverses.

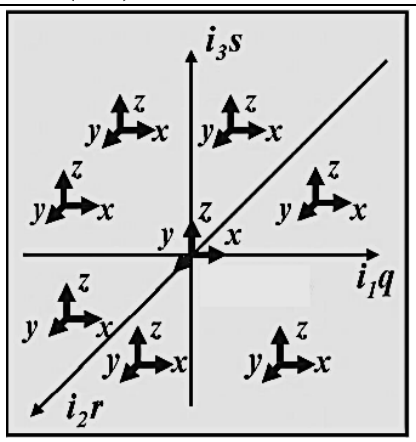

Fig. 5. Six-dimensional space of the hidden Multiverse, where q, r, s are the coordinates of invisible parallel universes, and x, y, z are the coordinates of the matter content in each parallel universe

that the quantity $i_1^q\ i_2^r\ i_3^s$ will successively take on the values +1, $+i_1 \oplus +i_2 \oplus +i_3$, -1, $-i_1 \oplus -i_2 \oplus -i_3$, +1,… etc., where $\oplus$ is the symbol of the logical operation of discrete mathematics 'exclusive OR'. In this case, different trajectories of movement from one universe (or antiuniverse) to another can differ only due to the replacement of some tachyon universes $i_1^q\ i_2^r\ i_3^s$ with others and some tachyon antiuniverses $i_1^q\ i_2^r\ i_3^s$ with others. Consequently, the tachyon universes $i_1^q\ i_2^r\ i_3^s$ in the hidden Multiverse are located parallel to each other. The tachyon antiuniverses $i_1^q\ i_2^r\ i_3^s$ for the same reasons are also located parallel to each other. And therefore, in the hidden Multiverse, when moving from any tardyon universe to a tardyon antiuniverse and then to another tardyon universe, parallel universes and anti-universes must alternate in the following sequence – 'tardyon universe', 'one of the tachyon universes', 'tardyon anti-universe', 'one of the tachyon anti-universes', 'tardyon universe', 'one of the tachyon universes', etc.

The simplest such quaternion structure of the hidden Multiverse to explain is shown in Fig. 6. However, it is possible that more complex structures exist in nature, formed by the interweaving of many (perhaps even infinitely many) sequences of tardion and tachyon universes and antiuniverses in the hidden Multiverse and located beyond it in the Hyperverse. But we will not consider them, since we do not have any experimentally obtained knowledge for this, and one can assume a great many such hypothetically possible structures.

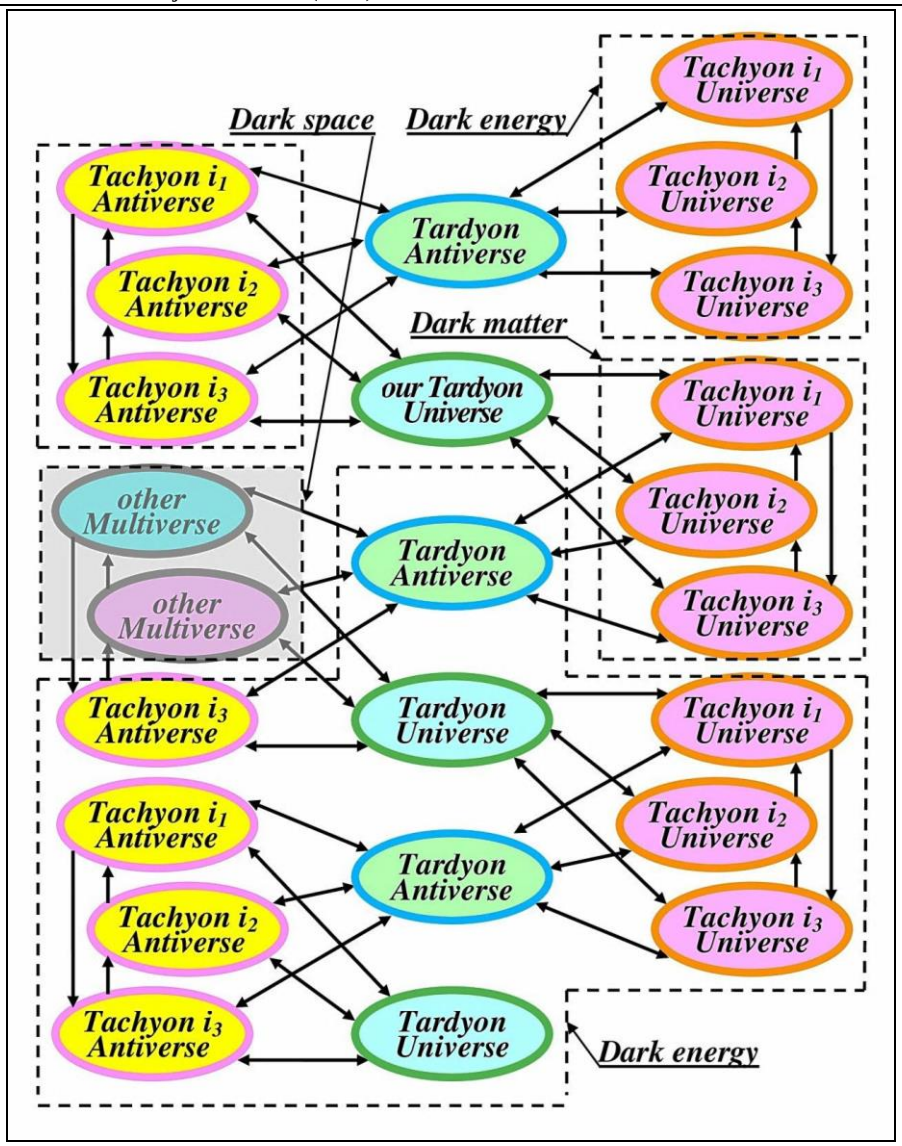

Fig. 6. Possible quaternion structure of the hidden Multiverse containing twenty-two parallel universes, including six invisible universes adjacent to our visible universe

The difference between the structure shown in Fig. 6 structure from the structure shown in Fig. 4 is the presence in it of several different tachyon universes and antiuniverses corresponding to three imaginary units $i_1^q\ i_2^r\ i_3^s$. Another difference is the presence in such a structure of the Multiverse of not only bidirectional portals corresponding to formula (8) and designated by double-sided arrows, but also unidirectional portals[7], corresponding to formulas (9), (10) and designated by single-sided arrows.

Moreover, naturally, the movement from our tardyon universe to the tardyon antiuniverse through some tachyon universe – for example $\boldsymbol{i}_1$ – does not necessarily have to proceed further through the tachyon antiuniverse $\boldsymbol{i}_1$. It can proceed further through the tachyon antiuniverses $\boldsymbol{i}_2$ and $\boldsymbol{i}_3$. The same reservation applies to the situation if the movement from the tardyon universe to the tardyon antiuniverse begins through the tachyon universes $\boldsymbol{i}_2$ or $\boldsymbol{i}_3$.

In Fig. 6 all these transitions are shown. Moreover, since the data obtained by the WMAP and Planck spacecraft correspond to the open spring-like structures of our hidden Multiverse, united through the corresponding portals with other Multiverses, then all together they form the Hyperverse.

And there may be many other similar structures. And to clarify which of them really exists in our hidden Multiverse, additional experimental research is naturally necessary.

[7] Due to what circumstances in such portals movement is possible only in one direction - from entrance to exit - it is difficult for us, living in a space in which movement in nature is possible in any direction, even to imagine. And the processes that make such movement possible in nature are yet to be understood. But they are more dangerous for visitors who have fallen into such unidirectional portals than bidirectional portals, because it is impossible to return to one's own universe from them. And while there is one-way travel on escalators in the subway, the subway is not nature.

Physical reality of invisible universes

But this is not the main thing for us now.

The main thing is to prove experimentally, in an indisputable way, that there is a Multiverse in nature, and not the only visible universe in nature, as it is asserted not only in the generally recognized version of SRT, but also in string theory and in quantum physics.

And for this purpose, without wasting time on analyzing complex theories, it is necessary to prove experimentally that invisible universes corresponding to the corrected version of SRT, actually exist in nature. And it is possible to do it, if to see on a starry sky corresponding to them other constellations [84]-[89]. But that can only be done where no one has ever seen them before. And these other constellations[8] (invisible outside the portals) can be seen in the starry sky in the portals, i.e. in the transitions between our visible universe and neighboring invisible universes. Similarly, as it is possible to see neighboring with our visible room, in which we are now, neighboring invisible room (or at least its edge to be convinced of its existence), only if you go into the corridor between the rooms. Portal are such corridor between universes.

And for this purpose, without wasting time on the analysis of these complex theories, let us try to prove experimentally that invisible universes corresponding to the corrected version of SRT, actually exist in nature. Then theoretical considerations on this subject will become unnecessary. And it can be done, if to see on a starry sky corresponding to other universes other constellations. But this can only be done where no one has ever seen them before. And these other constellations (invisible outside the portals) can be seen in the starry sky in the portals, i.e. in the transitions between our visible universe and neighboring invisible universes. Similarly, as it is possible to see neighboring to our visible room, in which we are now, the neighboring invisible room (or at least its edge to make sure of its existence), only if you go into the corridor between these rooms. Such corridors between universes are portals [90]-[92]. And the entrances to the portals are the so-called anomalous zones, of which there are many on our planet - more than a hundred thousand [93]-[96]. And in some of these anomalous zones even already placed observatories. As, for example, the Main Astronomical Observatory of the National Academy of Sciences of Ukraine, which is located in the Goloseevsky forest just 12 km. from the center of the capital of Ukraine, Kiev.

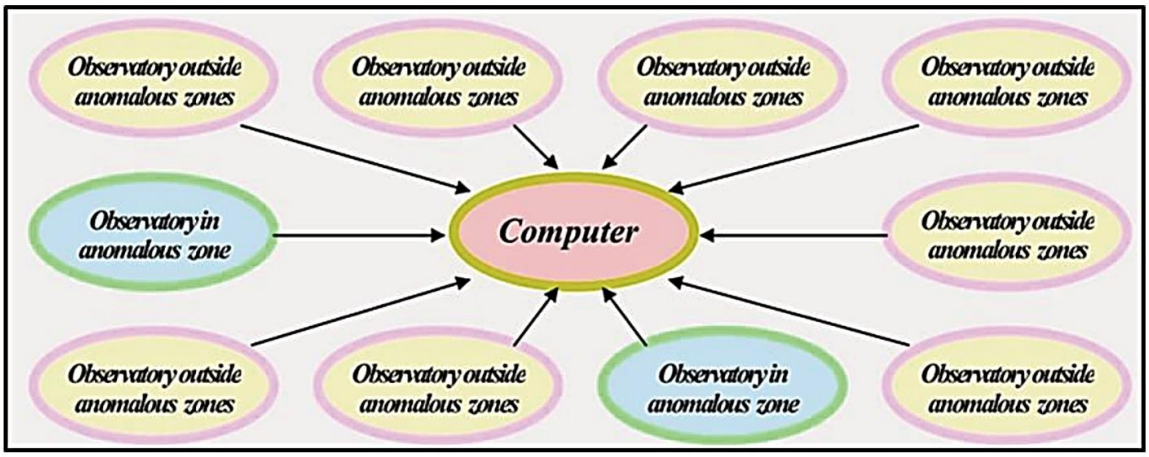

Fig. 7. Scheme of an astronomical experiment to detect invisible universes

But people avoid going into portals. And rightly so, because portals are invisible labyrinths. That's why it's almost impossible to get out of them after accidentally entering them. But it is possible to create equipment for orientation in portals. It is also possible to use unmanned remote-controlled robotic means to explore portals. You just need to want to do all this.

It is even possible not to go far into the portals, but to limit ourselves to the use of anomalous zones (e.g., the above-mentioned Main Astronomical Observatory of the National Academy of Sciences of Ukraine). Although in anomalous zones, i.e., at the very edge of the portals, the change in the appearance of familiar constellations is very small, they can still be detected with modern equipment, comparing on the computer (Fig. 6) observations of the same areas of the starry sky by different observatories located both in the anomalous zones and outside the anomalous zones in the same region.

After all, the English astrophysicist Sir Arthur Stanley Eddington [97] was able to his famous experiment, similar to the one described above in Fig. 7, back in 1919 to confirm the predicted by the general theory of relativity deviation of light rays in the gravitational field of the Sun. That's what it means to actually want to.

Why hasn't this experiment been done yet?

So why hasn't this simple and very low-cost experiment has not yet been done? Even though in case of a positive result one could hope for a Nobel Prize for the discovery of invisible universes neighboring our visible universe. And in the case of a negative result, one could hope to get a very authoritative proof that Einstein and his theory were right. That is, any result of such an experiment is very important for science.

[8] During the transition from one universe to another, the map of the starry sky in the portal, continuously changing all the time, smoothly transforms from the map of one universe into the map of the neighboring universe. But at the same time it will naturally differ from the map of the starry sky on the Earth outside the portal at any place in the portal

And because astronomers don't need the first result at all, so as not to complicate their relations with relativistic physicists. It is more important for them than even the Nobel Prize. And the second result, as they themselves realize, is very unlikely. But after realization of such experiment all scientific disputes about whether the version of SRT studied in physics textbooks is correct or incorrect, and also any references to string theory, to quantum physics and to nothing else will not be taken into account any more, as on this question will be received indisputably correct answer. And this answer is most likely to prove unambiguously the infidelity of the generally recognized version of SRT.

Even physicists themselves are sure of it. After all, if physicists hoped that this experiment would confirm the truth of the existing version of SRT, it would have been done long ago.

Civilizations and supercivilizations

But even if there were only our visible universe, then, despite the big bang theory, when exploring the cosmos it is impossible not to take into account that different stars with their planets arose in our visible universe at different times. And they still continue to arise. According to modern estimates, the number of galaxies in our visible universe alone is about 2E11. And each galaxy contains about 1E8 stars. Of these, at least 8E9 contain Earth-like planets on which life is possible. And the ages of the stars are very different. For example, the star HE1523-0901 is 13.2E9 years old, the Sun is 4.6E9 years old, Sirius is 2.3E8, and the recently discovered star SwiftJ1818.0-1607 is only about 240 years old. For comparison, recall that the age of our visible universe is about 13.8E9 years. In the invisible universes of the hidden Multiverse and Gi-universe this diversity is surely even greater. And even the invisible universes themselves, contrary to the Big Bang theory, probably did not appear in nature at the same time. Consequently, at least on some planets, the age of the supercivilizations existing there exceeds the age of our earthly human civilization by billions of years. And comparing our civilization of the XXI century with the human civilization, for example, of the IXX century, i.e. existing only 200 years ago[9] it is not difficult to understand how much our civilization is surpassed by super-civilizations.

Therefore, the inhabitants of supercivilizations are real all-powerful Gods for us. And some information about these supercivilizations is contained (though in a in allegorical form to be somehow understandable to people) in the church books of all world religions.

But other civilizations also exist on Earth. These are numerous communities of living beings - mammals, birds, dolphins, even ants and bees - which form hierarchical structures united by common vital interests and coordinate their activities for the benefit of the whole community as a result of exchange by information between these living beings. Only these civilizations, unlike human civilization, are not machine civilizations. Although primitive human civilizations, still existing now according to some reports in some remote areas of the Earth, are not machine civilizations either.

And these non-machine civilizations are also of great interest for people, because due to the fact that other living beings have sensory organs different from those of humans, they possess knowledge about nature unknown to humans. For example, cats feel geopathogenic zones, which are not registered by any existing equipment. Consequently, there are some other physical fields unknown to people in the nature, besides electromagnetic and gravitational fields known to people. Cats can also cure people in some unknown way. But people don't know how they do it. And how to learn it from them.

Fermi paradox, which proves the existence of supercivilizations in other spatial dimensions.

The Fermi paradox is a statement of a seemingly paradoxical situation in which, on the one hand, it is known that there are many star systems suitable for life in the cosmos, and on the other hand, despite all the efforts of scientists, no signs of life have been found in this cosmos. And it would seem very strange [98]-[100].

But in fact there is nothing strange about this. After all, what are we looking for? What signs of life do we expect to see? The same as on Earth now? So that the same radio stations as on Earth would work, which, when transmitting signals, would spend most of their energy on transmitting signals to nowhere due to the use of a non-optimal directional diagram? So that, in addition, these radio stations would also spend a considerable part of their energy on out-of-band radiation? So that aliens would detonate atomic and hydrogen bombs? And so on.

But first of all, these are all defects of our imperfect civilization, which supercivilizations have long ago got rid of. And that's why they're invisible. And secondly, why not assume that we do not see their ships in space also because they have different logistics as a result of using their super knowledge. Even on Earth, people on their way to work in big cities often use the subway. And then their movement underground cannot be detected from space. But then it is necessary to recognize the existence of invisible parallel universes, portals between them and admit that the generally accepted version of SRT is wrong.

Besides, they certainly know stealth technology or some other super stealth technology. So the cost of all the searches for signs of life in space is money wasted.

And finally, why do we assume that as soon as people want to establish contacts with the inhabitants of supercivilizations, for example, on the Moon or on Mars, their inhabitants will immediately want to contact us? Always and everywhere to be or not to be contacts are decided by the masters of the situation. To be sure of it try to meet your director or minister at least. That is why in this situation the inhabitants of supercivilizations make decisions, not us. After all, we also do not seek contact neither with wild animals, nor with insects, nor with snakes that try to get into our dwellings. For example, rats are very smart and even in some situations, out of gratitude for the fact that the miners fed them, they sometimes saved their lives. Nevertheless,

[9] When russian writers A. S. Pushkin and M. Yu. Lermontov lived, there were no computers, no Internet, no cars, no rail transport, no aviation, and many other things that have become familiar to us in the 21st century.

no one keeps rats as pets. And we lock our houses even from people we don't need.

And the inhabitants of supercivilizations are perfectly capable of protecting themselves to protect themselves from unnecessary human contact, even on Earth. For example, presumably in Shambhala. Or Antarctida. Or at the bottom of the oceans.

And another thing. Why do we seek contact with supercivilizations? We won't understand anything. After all, they have been sending us messages in the form of crop circles for centuries. But we don't have enough intelligence to read them. So we should not try to solve problems that are beyond human intellect. We need to increase our intelligence. And first we have to read the crop circles in the margins. And what to do next will be clear late

The phenomenon of déjà vu, which proves the existence of super civilizations in other time dimensions

This is an extremely interesting phenomenon [101]. Déjà vu from French translates as "already seen". There have even been 84 films made on this topic at different times and in different countries. The essence of the phenomenon is that practically every person (more precisely, about 97% of people) sooner or later, at least once in his life, found himself in a situation in which he had already been once before. Or so it seems to him. Psychologists have offered many medical explanations for this phenomenon. But all of them are not very convincing, since science does not know of any disease, much less a mental one, with which 97% of the world's population could have been infected (and how?).

So let's offer another explanation, but this time a physical one. It is also quite unusual. Let's assume that this phenomenon is explained by interference in our life by our descendants from the distant future, who have unusually perfect computers capable of calculating our behavior down to the smallest detail, as well as time machines, with the help of which our descendants can move both to the past and future time. Which is plausible. And then these descendants of ours, in order to correct their existence in their future, go by time machines (and for them it is easier and cheaper than other variants of obtaining the same result) to our past and correct this past by algorithms created by supercomputers of the future (for example, Hitler's mother is married to another man). Then the inhabitants of the future, naturally, get to another future, which they like better. And in order not to lose any of their relatives, who have many other relatives and friends, etc., they have to interfere in the lives of all the people currently living on Earth. That is why the above-mentioned figure of 97% appeared.

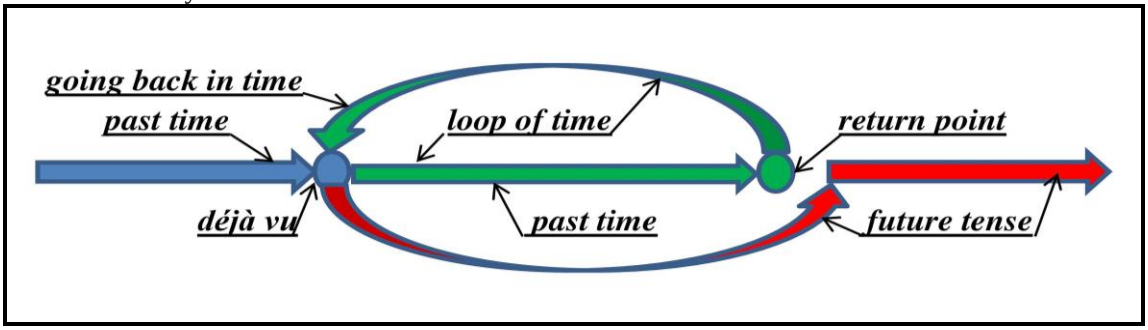

Fig. 8. Explanation of the phenomenon of déjà vu occurring as a result of intersection of timelines "going back in time" and "past time" with the formation of a "loop of time"

And people of our time on Earth because of this interference in our lives of aliens from the future make a journey through a time loop (see Fig. 8). Which they then forget. Or our descendants from the distant future erase it from our memory. But because of the existence of the time loop, they have to actually visit the 'déjà vu' point twice. And this is not erasable from their memory.

The invisible afterlife world, where the Gods and souls of the dead dwell, really exists

But religions, unlike many modern scientific hypotheses that have not been confirmed ex-perimentally, which for some reason in the twentieth century unreasonably began to be called theories, do not try to deceive people. At least because all world religions, without collusion, actually tell people about the same thing.

That there are Gods. Well, it's true. It was explained above that the Gods are all-powerful inhabitants of super-civilizations in star systems that appeared billions of years before our solar system. And who help humans to become more civilized and advanced. Gods also through Religions somehow allegorically (and otherwise people would not understand anything and this information was not preserved to the next generations) explain to us the structure of the world in which they and we actually live. Church books are therefore invaluable teaching aids for us to learn the science of the distant future. They also try to instill in us a more humane morality of these super-civilizations (e.g., in the form of Christ's commandments), in contrast to the far from perfect morality that people live by today. And largely due to the efforts of Religions, people are becoming more and more humane.

But Gods and the souls of the dead also have to be somewhere. The invisible world in which they dwell in religions is called beyond the grave. And as it is shown above in the hidden Multiverse and Giperuniverse there are many (perhaps even infinitely many) mutually invisible parallel universes in which there are inevitably super-civilizations. Which therefore may be this invisible afterlife world.

Religions also tell us that people have an immortal soul that passes into this afterlife world after death. There are many testimonies of this from people who have been in a state of clinical death. And the author believes that this is also true. Therefore, the author is

happy that after his death he will be able to reunite with his beloved parents, his wife and his wife's parents.

But in the version of STR, studied in physics textbooks, the existence of an invisible afterlife is denied for quite understandable reasons. It and its inhabitants - Gods, souls of the dead and others - simply have no place in this, the only one existing in nature according to the generally accepted version of STR, our visible Universe.

Conclusion

Thus, in the article it is experimentally proved and theoretically explained that up to now studied in all textbooks of physics the version of SRT, created in the XX century, is incorrect, because:

- the relativistic formulas obtained in it are incorrect;
- these formulas are incorrectly explained using the incorrect postulate called the principle of non-exceeding of the speed of light;
- from these formulas wrong conclusions about physical unreality of imaginary numbers and about existence in the nature of our only visible universe in which everything is measured only by real numbers are made.

But in the XXI century, a corrected version of the STR was created, in which, instead of the incorrect postulate about not exceeding the speed of light, an experimentally proven principle of the physical reality of imaginary numbers is used. And the physical reality of such numbers is proven by the existence of not only electrical engineering, radio engineering and computer technology (which was written about above), but also by the existence of the natural phenomenon of tsunamis and even swings swinging on playgrounds, as well as music created by pianos and other musical instruments. What more convincing refutations are needed? After all, these refutations have not been refuted by anyone.

Thus, naturally, the postulate of the generally accepted version of STR about not exceeding the speed of light, from which this conclusion about the physical unreality of imaginary numbers was made, is also experimentally refuted. For the same reasons, the conclusion about the existence in nature of our only visible universe is also refuted. And instead, it is asserted that in fact, in addition to our visible universe, there are many other mutually invisible parallel universes. The corrected version of STR also explains that the existence of these invisible universes can be experimentally proven by astronomical observations in the starry sky in the portals of constellations that are invisible outside the portals.

But the significance for science of the principle of physical reality of imaginary numbers is not limited to the possibility of correcting the generally recognized version of SRT. From this principle follows the necessity of corresponding correction in exact sciences of all theories and hypotheses in which imaginary numbers are used.

It also follows from this principle that around us there exists not only the visible world known and clear to us, but also a much larger almost completely unknown and not yet completely cognized by us invisible world [102]-[111]. Including the invisible afterlife world [112]-[123], where Gods, souls of the dead and numerous other inhabitants of supercivilizations dwell.

The author hopes that the realization of all this will encourage Science and Religion to cooperate mutually beneficially in their activities for the benefit of people.

Acknowledgments

The author sincerely thanks his wife Olga Ilyinichna Antonova for her participation in the discussion, understanding and valuable advice, with whose support he also wrote the book “A Corrected Version of the Special Theory of Relativity”. And for its publication he is now looking for a sponsor and publisher

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"FLIPPED CLASSROOM" METHOD AND ITS ADVANTAGES

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Abstract

The "Flipped Classroom" is a pedagogical model that inverts traditional teaching methods by delivering instructional content, often online, outside of the classroom. Instead of the conventional model where students learn new content in class and then complete assignments at home, the flipped classroom approach has students engage with new material at home, typically through video lectures or readings, and use classroom time for interactive, hands-on activities. This model shifts the focus of learning from passive reception of information to active participation and problem-solving, fostering deeper understanding and application of concepts.

The origins of the flipped classroom can be traced back to the early 2000s, with its rise in popularity due to its potential to cater to diverse learning styles and paces. Allowing students to absorb new information at their speed outside of class enables more personalized and student-centred learning experiences during in-class time. The successful implementation of this model requires adequate technological infrastructure and a shift in both student and teacher roles, where students take more responsibility for their learning, and teachers act as facilitators rather than sole providers of knowledge.

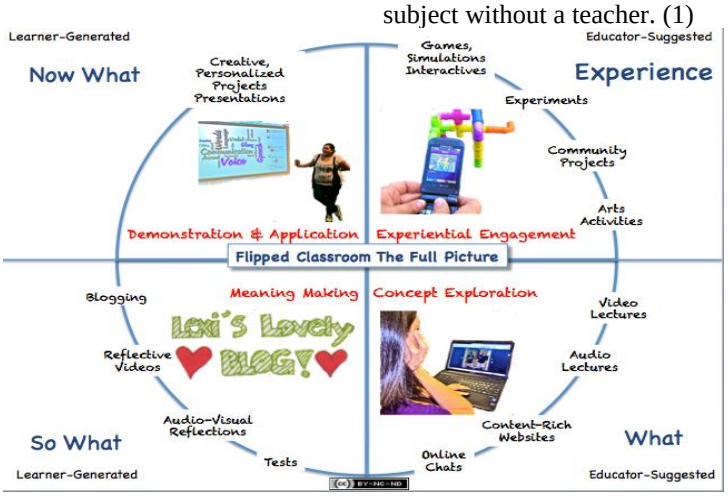
Despite challenges such as the digital divide and the need for teacher training, the flipped classroom model has demonstrated significant potential in enhancing student engagement, improving comprehension, and preparing students for real-world problem-solving. It has been particularly effective in STEM education and is being adopted in various educational levels increasingly and contexts worldwide.

Keywords: flipped classroom, active learning, educational technology, classroom interaction, digital resources, homework and in-class activities, pedagogical innovation, critical thinking, STEM Education.

Introduction

We live in a time where technology is developing rapidly. As in all fields, it is possible to apply new technologies in education and achieve high results. One of the models created in education with the application of new technology is the "Flipped classroom" model. Suppose we pay attention to the students around us. In that case, they constantly use phones, the Internet, computers, and tablets, and for a student who is in so much contact with technology every day, solving a task in a notebook and reading the subject only from a book can be somewhat depressing. Undoubtedly, the student's learning depends on his motivation and attitude towards education. One of the main goals in the implementation of the "Flipped classroom" model is to ensure that students use phones and computers, which are a part of their lives, for educational purposes, which will be more useful for them.

In traditional training, the teacher transfers information to the students in the classroom. It is more difficult to master and apply it, and it is assigned to the student himself through homework. Very few students can cope with this difficult task because it is really difficult for them to apply what they have learned from the subject without a teacher. (1)



The "Flipped Classroom" represents a transformative approach to education that challenges the traditional model of teaching. In conventional classrooms, students receive instruction during class time and complete assignments or further exploration at home. However, the flipped classroom inverts this process, having students first encounter new material outside of class, often through digital resources like videos, readings, or podcasts. Classroom time is then dedicated to deeper exploration of the content including discussions, collaborative projects, and practical applications.

This process model is reversed in the "Flipped classroom". If we pay attention to its literal meaning "Flipped classroom" means a turned class. Unlike the traditional system, in the "Flipped classroom" model information is given to the student at home and its assimilation and application are carried out in the classroom. (2)

This model emerged in the early 21st century as educators sought to leverage advancements in technology to enhance student learning. The flipped classroom approach is rooted in the belief that students can benefit from engaging with instructional material at their own pace before coming to class, where they can then apply what they have learned with the guidance and support of their teacher and peers.

The focus from passive reception to active engagement, the flipped classroom seeks to foster a more personalized and interactive learning experience by shifting. It encourages students to take greater responsibility for their education while enabling teachers to provide more targeted support. As this model gains traction, it continues to reshape educational practices, offering new opportunities for enhancing student understanding and success across various disciplines.

The "Flipped Classroom" is an innovative educational model that serves as an alternative to traditional teaching methods. In this approach, the learning process is "flipped," meaning that students are introduced to new content at home, typically through videos, articles, or other digital resources, and then spend class time engaging in discussions, problem-solving activities, and practical applications of the material.

Key Features:

1. **Learning location is reversed**: Students learn new content at home before coming to class, which allows them to process information at their own pace. This is usually done through videos, readings, or other online resources.
2. **Class time is more interactive**: In the classroom, the teacher focuses on deepening understanding through discussions, answering questions, and facilitating group work. This allows for a more interactive and engaging learning experience.
3. **Increased student responsibility**: Students are expected to come to class prepared, having already familiarized themselves with the material. This encourages active participation and deeper engagement during class.

Advantages of the Flipped Classroom:

- **Self-paced learning**: Students can learn their speed by reviewing difficult concepts as needed.
- **Development of essential skills**: Classroom activities promote critical thinking, communication, and collaboration skills among students.
- **Enhanced teacher-student interaction**: More time is available for personalized support, as teachers can address individual needs and questions during class.

The Flipped Classroom model leverages modern technology to create more effective and engaging educational experiences, and it has gained popularity in recent years.

History and Development

If we look at the history of this method we can see that it was first introduced in 1993 by the writer Alison King in her book "Sage on the Stage to Guide on the Side", drawing attention to the safety of using class time to understand many topics better that meet the requirements during class. Although she did not deal with the concept of the Flipped Classroom in this book, King's work provided impetus for the proposal of this method in the field of education.

With this, the search for a strategy that would meet the needs of every student with different learning methods with the available technical capabilities over the years was started. In some universities in the United States in 2000, conditions were created to record classes in video form. These conditions began to reveal the further usefulness of this method for students. (2)

The "Flipped Classroom" model became widespread in the early 2000s popularized by two chemistry teachers Jonathan Bergmann and Aaron Sams. They proposed the idea of having students watch lessons at home and dedicating classroom time to more interactive activities. Initially applied in middle and high schools, this approach soon gained popularity in universities and other educational institutions.

Bergman and Sams observed that school students who were forced to participate in sports competitions found it difficult to make up for the gaps in lessons when they missed classes. One day, Sams comes across a program in a technology magazine that he can make in video format by playing PowerPoint presentations. Both teachers decide to prepare a video tutorial for sports and students who cannot attend classes for various reasons.

By uploading the videos they prepared to the Internet, students who cannot attend classes can study the lessons they missed. These videos soon attract the interest of other students, and the students participating in the classes also start watching the videos. Thus, by watching these videos again and again, students could learn the points they did not understand in the lesson and reinforce what they learned. They even used these videos when preparing for the exam. The fame of this method soon began to spread in the educational institutions of the country and it started to be used in different schools and by different teachers.

At the end of this experiment, Sams suggests that the curriculum be reviewed and updated. He advocates that students can learn independently at home through these videos and work with teachers on more practical tasks and issues during class. Finally, he is able to convince and this method is added to the curriculum. This is how the Flipped Classroom method is born. During the trial period of 1 year, this method gives successful results and becomes popular by appearing on news channels. The name "Flipped Classroom" is also a name given by the local media.

Apparently, this method reverses the lecture format, which is considered a traditional compressive method for requirements. Students have the opportunity to watch the explanation of each new lesson a day in advance with a video tutorial prepared by teachers. As a result, unclear points are explained to them during the live lesson, their questions are answered, and their knowledge is strengthened by working on more practical problems and projects. (2)

Typical Structure of the Flipped Classroom Model

1. **Homework (Lesson Preparation)**: Students review assigned materials at home (video lessons, articles, podcasts, etc.), which allows them to learn the core concepts at their own pace.
2. **In-Class Activities**:

Discussions and Analysis: Classroom discussions help students deepen their understanding of the material they have studied.

Problem Solving: Students work on individual or group assignments in class, applying concepts and addressing real-world problems.

Teacher Interaction: The teacher provides individual support during class, answering questions and explaining complex topics.

Technologies Supporting the Flipped Classroom Model

The effective implementation of this model relies on various technologies:

Video Platforms: Platforms like YouTube, Vimeo, and specialized educational platforms provide ample opportunities for students to watch lessons at home.

Learning Management Systems: Systems like Moodle and Google Classroom help track student activities and share assignments.

Interactive Tools: Programs like Kahoot and Quizlet can be used to test students' understanding of the material.

Challenges in Implementing the Flipped Classroom

Student Independence: Not all students are equally capable of learning at their own pace, which can lead to difficulties in class.

Technological Barriers: The lack of necessary technological resources at home can hinder the implementation of this model.

Teacher Preparation: Teachers require additional training and resources to apply this model effectively.

Success Stories of the Flipped Classroom Model

There are numerous examples of the successful implementation of this model. For instance, in STEM (Science, Technology, Engineering, and Mathematics) fields students use this method to better understand complex topics. The Flipped Classroom Model has been applied in higher education successfully and in corporate training programs.

Conclusion

The "Flipped Classroom" model has proven to be a significant innovation in modern education, offering a dynamic alternative to traditional teaching methods. By reversing the conventional structure of in-class instruction followed by homework, it emphasizes active learning and student engagement. This approach allows students to absorb content at their pace also maximizes classroom time for interactive, hands-on activities that reinforce and deepen their understanding.

While the model presents challenges, such as the need for technological resources and the shift in both teaching and learning dynamics, its benefits are evident in fostering critical thinking, collaboration, and practical problem-solving skills. The flipped classroom aligns well with the needs of 21st-century learners, preparing them for real-world challenges by promoting self-directed learning and enabling teachers to act as facilitators rather than mere transmitters of knowledge.

As educational institutions continue to explore and refine this approach, the flipped classroom has the potential to significantly enhance the effectiveness of teaching and learning, making education more personalized, engaging, and adaptable to the needs of diverse learners.

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THE ROLE OF MIND MAPPING IN LANGUAGE LEARNING

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Abstract

Language learning poses significant challenges, particularly given the vast amount of vocabulary, grammar rules, and cultural nuances that students must absorb. To navigate these complexities, innovative learning techniques have emerged. One such technique is mind mapping, a visual aid that enhances understanding, retention, and organization of information. Mind mapping is a visual tool that enhances language learning by organizing information and fostering creativity. This technique involves creating diagrams that represent concepts and their relationships, allowing learners to visualize vocabulary, grammar, and contextual usage. By engaging both hemispheres of the brain, mind mapping aids in retention and recall, making it easier to grasp complex language structures. It also encourages active participation, as learners can customize their maps to reflect personal understanding and interests. Additionally, mind mapping promotes collaborative learning and problem-solving, making it an effective strategy for language educators seeking to improve student engagement and comprehension.

This article explores the role of mind mapping in language learning, examining its benefits, applications, and effectiveness in various educational contexts.

Keywords: mind map, language learning, vocabulary, grammar, learners, concepts, recall, collabarotive learning, research, visual.

Mind mapping is a cognitive tool developed by British psychologist Tony Buzan in the 1970s. It involves creating a visual representation of information, where a central idea branches out into subtopics and related concepts. This approach can incorporate images, colors, and keywords, facilitating a dynamic and engaging way to organize thoughts. By structuring information visually, learners can see relationships among concepts, making it easier to comprehend complex material. t Several studies have highlighted the effectiveness of mind mapping in enhancing language learning outcomes. Research indicates that students who utilize mind mapping techniques show improved vocabulary retention and comprehension skills compared to those who rely solely on traditional methods.

Furthermore, qualitative feedback from learners often highlights the increased confidence they experience when utilizing mind maps. [1,19] By providing a clear structure for their thoughts, students report feeling more capable of engaging in conversations and writing in the target language, ultimately leading to increased motivation and commitment to their studies.

- **Enhancing Vocabulary Acquisition**

One of the primary challenges in language learning is acquiring a robust vocabulary. Traditional methods, such as rote memorization, can often lead to disengagement and low retention rates. Mind mapping addresses this issue by enabling learners to visualize word associations. For instance, when learning the word "tree," a student might create branches for related terms like "leaves," "branches," "types of trees," and "ecosystems." This interconnected framework not only aids in memory retention but also promotes a deeper understanding of context, encouraging learners to use vocabulary in varied situations.[2, 26]

Mind mapping is an exceptionally effective technique for vocabulary learning, as it fosters a visual understanding of words and their relationships. By starting with a central word or concept, learners can branch out to include synonyms, antonyms, related terms, and example sentences, creating a web of interconnected ideas. When creating mind map on paper , whiteboard or digital platform, the central word is placed in the middle and branches for possible categories (synonyms, antonyms, related terms, example sentences) and sub-categories for each item (e.g, formal / informal words) are drawn.

This approach encourages active engagement with the vocabulary, transforming the process from rote memorization into a dynamic exploration of language. Visual elements such as colors, images, and symbols can further enhance the learning experience by making abstract concepts more tangible and memorable. As learners visually map out the connections between words, they develop a deeper understanding of their meanings and contexts, which aids retention and recall. Additionally, mind mapping promotes critical thinking, as students analyze how words relate to one another and to broader concepts. By revisiting and expanding their mind maps over time, learners can continuously integrate new vocabulary into their existing knowledge base, making this technique particularly versatile. Ultimately, mind mapping not only facilitates the acquisition of individual words but also enhances overall language proficiency by fostering a comprehensive understanding of vocabulary within a rich semantic network.

- **Improving Grammatical Understanding**

Grammar can be one of the most challenging aspects of language learning. Mind mapping facilitates grammar comprehension by visually breaking down complex rules and structures. For example, learners can create a mind map to depict the different tenses in a language, highlighting their uses with example sentences and key conjugation patterns. This approach enables students to see grammatical concepts in relation to one another, promoting clarity and aiding in the application of these rules in both written and spoken language.

By placing the central topic—such as a specific grammatical rule or structure—at the center of a diagram, learners can branch out into various subcategories that detail examples, rules, and exceptions. This visual representation organizes thoughts and encourages connections between different grammatical concepts, making it easier to understand how they interact. For instance, when studying verb tenses, a mind map can illustrate the relationships between present, past, and future tenses, along with their respective forms and uses. Additionally, incorporating color coding and symbols can further aid retention, as the brain tends to remember visual information better than text alone. [3, 20} Mind maps also enable learners to see the "big picture," helping them understand how grammar functions within the structure of language. By engaging in this active, creative learning process, students not only improve their grammar knowledge but also enhance critical thinking skills as they synthesize and categorize information. Ultimately, mind mapping transforms grammar learning from a daunting task into an engaging and effective exploration of language mechanics.

Here is an example of mind maps related to grammar:

Example: Mind Map for Verb Tenses

Main Idea: Verb Tenses + **Sub-branches**: - Present Continuous Tense

- Definition: Used to describe actions that are happening now

- Example: I am studying English.

- Past Simple Tense

- Definition: Used to describe actions that happened in the past

- Example: I studied English yesterday.

- Future Simple Tense

- Definition: Used to describe actions that will happen in the future

- Example: I will study English tomorrow.

These are just a few examples of how mind mapping can be used to organize and visualize grammar concepts. The key is to create a visual representation that helps learners understand and connect the ideas and relationships between them.

- **Facilitating Reading Comprehension**

Reading comprehension is vital for language learners, yet it can also be a daunting task. Mind mapping can transform the reading process by allowing learners to summarize and visually represent the main ideas and themes of a text. After reading an article or story, students can create a mind map that outlines key points, character relationships, and underlying themes. This process encourages active engagement with the text and supports retention, ensuring that learners can recall and discuss the material more efficiently. [4, 110]

- **Encouraging Creative Expression**

Language learning is not solely about memorization; it also involves the ability to express thoughts and ideas. Mind mapping fosters creative expression by allowing learners to brainstorm and organize their ideas visually before crafting sentences or paragraphs. For example, when tasked with writing an essay or a story, students can create a mind map to organize their thoughts, plot points, or arguments. [5, 9] This visual framework can help reduce writer's block and lead to more coherent and structured writing, ultimately improving language proficiency.

- **Promoting Collaborative Learning**

In group settings, mind mapping can facilitate collaborative language learning. Students can work together to create a collective mind map on a topic, brainstorming ideas and vocabulary collaboratively. This not only helps learners practice speaking and listening skills but also cultivates teamwork and communication abilities. Working together in this manner fosters a supportive learning environment where students can share insights and build upon each other's ideas, reinforcing their language skills in a meaningful context.

Mind mapping can be applied across various language learning settings, from classrooms to online courses. Educators can incorporate mind mapping as part of lesson plans, allowing students to create maps individually or in groups. Digital tools, such as mind mapping software and apps, can enhance this process by enabling easy editing and sharing, making it accessible for remote learners. Additionally, mind mapping can be integrated into language assessments. Instead of traditional exams, educators can ask students to create a mind map to demonstrate vocabulary usage or grammatical understanding, providing a more holistic view of their language proficiency.

Conclusion: Mind mapping stands out as a powerful tool in language learning, addressing key challenges such as vocabulary acquisition, grammatical understanding, reading comprehension, creative expression, and collaborative learning. By facilitating the visualization of complex information, mind mapping promotes better retention and understanding, leading to improved language proficiency. As educators and learners continue to explore innovative teaching methods, incorporating mind mapping into language curricula presents a promising avenue for enhancing the learning experience. Ultimately, equipping students with effective cognitive strategies like mind mapping can empower them to become confident and capable communicators in their target language.

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NEW EQUIPMENT USED IN THE DEVELOPMENT OF DISTANCE EDUCATION

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Abstract

According to experts, distance education tools greatly simplify the educational process, make it dynamic, flexible and attractive. Advanced world experience proves the possibility of achieving successful results in education using distance education.

Unlike traditional classes, classes conducted through distance education are very attractive and interesting for both students and teachers. The use of a computer or an interactive board in the teaching process ensures the visibility of the main principles of the lesson. By gently touching the sensitive surface of the electronic board with a special pen or finger, all operations possible on the computer can be performed on it in interactive mode. A "smart" board is also a microscope, scanner, digital camera, video camera, etc. connected to a computer. can also receive images from the devices through the projector. At this time, it is possible to watch the explanation and video footage of any pedagogical facts, events and situations, the working principles of individual devices, devices, and technical means on the screen. This means that by integrating theoretical-methodological issues, practical skills and habits, it will be possible to significantly revive teaching, to approach work creatively, to think, to be proactive, to understand the teaching material more deeply. When using electronic presentations in the teaching of pedagogically oriented subjects, information is described more clearly, colorfully and dynamically. At this time, the teacher usually acts as a guide and can observe and stimulate the students' activity and freedom. In the process of giving presentations, students are at the center of the action, and they can better understand the problem situation based on their individual skills and interests. This allows the teacher to assimilate more theoretical information to the students in a short period of time (2).

Keywords: information, education, electronic, students, distance, higher school.

Implementation of the modern education model using distance education puts new demands on higher school teachers. On the other hand, high school teachers have a great responsibility for training staff according to the needs of the society.

Today, higher education teachers must use distance education to achieve high results in education. Therefore, each higher school teacher should synthesize new methodical approaches, psychological-pedagogical views and distance education knowledge along with basic knowledge in his activity.

"The experience of countries that have made significant progress in the development of education shows that modern, active-interactive training methods based on information and communication technologies, which develop creative thinking and take into account the individual characteristics of the student, give higher results. For that purpose, continuously creating progressive teaching methods and increasing the competence of teachers occupy an important place in the field of education" (4).

It is no coincidence that as one of the eight development goals of the Third Millennium adopted by all the member states of the UN, it was accepted in the direction of the development of global partnership that the opportunity to use distance education should be created.

The history of using distance education in higher education institutions of our country is very young. Nevertheless, certain measures and steps are taken in this area.

Researches show that if the teacher was the leading source of information because the 20th century educational process was built on the basis of traditional education, the situation was different in the 21st century. Currently, the teacher acts as a mediator between information sources and students. He should teach the student effective methods of working with various sources of information, ways of obtaining information. This requires improving the content and technology of education. Therefore, higher school teachers should build a work system in accordance with the requirements of the information and innovation society (3).

The quality of pedagogical training directly depends on the knowledge, skills and activities of the teacher. One of the priority directions is the training of teaching staff on distance education within the framework of the state program. The teaching staff of the higher education system undergoes trainings for the effective use of information and communication technologies in the teaching process. Using the possibilities of distance education, they gain initial experience in conducting effective classes, psychological preparation, in short, innovative knowledge and learn how to apply them in the teaching process. According to experts, the use of distance education enriches the educational process with its visuality, gives students opportunities to conduct research, benefit from numerous information bases, choose what is necessary and use what is appropriate, and also encourages practical application of knowledge and skills.

Search It is clear from the results that in the pedagogical research conducted in the republic, the study of ways and means of purposeful use of distance education by higher school teachers was not set as a special research goal. At the same time, studies were conducted on various aspects of higher school teachers' effective use of distance education, scientific conferences were held, and current issues were discussed (4).

The introduction of distance learning technologies into the educational process makes the educational process technological and result-oriented. Yes, there are difficulties and mistakes on this path, from which it will not be possible to get rid of them in the future. But the main success is students' striving for independence, creativity, eyes shining with the desire to acquire new knowledge. The computer allows you to make the lessons different from each other. The desire to constantly innovate creates an interest in training.

A modern higher school teacher uses various modern information technology tools in his professional pedagogical activity. Today, interactive whiteboards are mostly used in educational institutions (3).

- Interactive board - is a sensitive screen (touch screen). It is connected to a computer, and displays images on the screen with the help of a projector. To start working on the computer, it is enough to touch the surface of the board. Special software allows working with objects and texts, audio and video materials. It allows the use of Internet resources, the copying of open documents and the storage of information. Interactive whiteboards open unique opportunities for work and creativity of teachers and students. This tool, which greatly helps in the organization of the training process, also helps in conducting theoretical and practical exercises. From the outside, this device does not differ from an ordinary board. But it is impossible not to feel the difference from the first acquaintance with him. Through this teaching, the work and its wide range of possibilities increases the students' interest in the subject, makes the lesson more interesting with the help of the computer, increases visibility and dynamism in the process of giving and receiving the material in the lesson, and the effectiveness of the feedback makes it immediately clear whether the material has been mastered or not.

Interactive whiteboard has a wide range of possibilities. Using this educational tool increases the effectiveness of the learning process. This self-developer is used in visual resources, in the teaching of various subjects, in teaching materials, in carrying out experiments and experiments, in providing the opportunity for modeling, and allows the use of tests to quickly determine the results on the board.

Using an interactive whiteboard really helps with training. For the teacher, the interactive whiteboard is the best tool to increase interest in the lesson and facilitate learning. The interactive whiteboard eliminates the formality of giving the material in the form of a presentation through a computer and reduces the time spent on summarizing the material (4).

Although the training conducted using the interactive whiteboard differs from the traditional methods of passing, at the same time, there is a similarity in the success of each lesson. It is possible to use the interactive board both during the entire course of the lesson and at its separate stages. The structure of lessons built using an interactive whiteboard can be different. Depending on the subject and the type of topic, teachers use different possibilities of the interactive whiteboard. Some teachers focus students' attention on the lesson by making certain changes on the board with texts, media objects, connecting fields.

A lesson conducted with interactive devices in theoretical exercises can make any lesson dynamic, which ultimately keeps the attention of students awake throughout the lesson. Students find a lesson taught with an interactive whiteboard more interesting than a lesson taught with a regular whiteboard or by handing out written material. They admit that lessons with an interactive board are more interesting.

Higher school teachers use interactive whiteboard more in their professional activities. Especially when explaining a new lesson, attracting students' attention to the explanation of difficult materials, as well as evaluating students' knowledge on some thematic topics, performing free work, etc.

The use of an interactive board in theoretical exercises enables the activity of all students, even those who read poorly. The ability to save all the work and corrections made by students on the board for future use is also an advantage of the interactive whiteboard. It is possible to save the writings by placing them on the side of the board, which allows the teacher to refer to them at the right time.

Using remote technologies, the main goal of teachers is to develop thinking and form creative thinking.

In addition, by using remote technologies, teachers can use various teaching and demonstration programs, models and games. For this, teachers use different methods and principles also does. Teachers can use the following distance development methods and principles:

- analysis method;
- comparison method;
- generalization method;
- classification method;
- method of correcting ideas;
- internal plan of activity, etc.

Distance technologies of the higher school teacher can use the following directions of work: 1. Use of Internet resources. 2. Use of ready educational materials. 3. Preparing a presentation for the lesson. 4.Self-authored software for study and use. 5. Involve students in project work, research, preparation of presentations in the auditorium and non-auditory events, etc. (1).

In modern times, the computer provides a full opportunity for the creation of a new model of training by entering educational institutions as an individual trainer. As a result of the penetration of new technological tools that process sound, copy and information into the educational system, the creation of a modern informational educational space becomes a necessity. Because "...the information on a page stored in a computer is only eighty-thousandth of the information used to voice that page. The same can be said about television and video. A screen has an average of 300,000 dots. Each of these points represents a piece of information, and it changes on average 50 times per second. This means 15 million data per second. The amount of information obtained by watching a copy in one minute reaches one billion. For this reason, getting information from a book in the usual way or just using a blackboard

to convey information in writing is quite inadequate for video and audio (audio-visual) teaching. The speed of human information processing is so high that when learning something by reading from a book or looking at a blackboard, the brain is not fully engaged and attention can be easily distracted. As a result of the superiority of speed and sound over written information, a trend towards speed and sound interactive systems has been observed in the computer-aided teaching process over the last 15 years" (4).

Higher school teachers are trying to use the possibilities of multimedia in lessons. Multimedia is the joint integration and use of multimedia communication devices. "Multimedia is a phenomenon that can change the teaching and communication forms of today and the future and determine the role of the computer in the individual and social life of a person. It is not just simple technology, nor software, nor the skill of the user. It is an instructional technology that emerges through the use of the triad of technology, appropriate software, and a productive, skilled user" (6).

Research shows that using multimedia is another way to apply vision and hearing, the oldest learning method of mankind, in the educational process. Observations show that now students do not like to study only through books. Therefore, teachers have to turn to multimedia tools that incorporate elements such as sight, hearing, reading, and interesting images, which are all ways of learning and acquiring information. At this time, of course, teachers should have the skills to use multimedia technologies. In such a case, the teacher can be perceived by the students as an expert who can directly intervene, teach, learn, use and change events, not just comment and watch (5).

In modern educational institutions, the main content component involves informatization as a process of actively using information and communication technologies and creating normal conditions for this. The use of distance education in the work of educational institutions ensures the improvement of the educational results of most students, the compliance with the new requirements of modern social life and the labor market.

Inclusion in the training process in the management of distance education is directly related to the provision of information technologies of the educational institution. The following can be attributed to information technology in an educational institution:

- a computer room equipped with the necessary software materials, internet access, and personal computer equipment connected to the local network;
- training rooms with only one personal computer, multimedia projector and interactive board;
- the workplace of the educational institution administrative staff, which is provided with the necessary software material and has access to the Internet;
- a media library that provides access to various information resources.

Today, there is a great deal of distance technology equipment that a teacher can use. The following can be used during the preparation and conduct of the lesson:

- office technologies (MS Word, MS Excel, Power Point, etc.) that create opportunities and conditions for organizing students' creative and research activities and delivering the content of the taught subject;
- internet etc educational resources of Abeka;
- electronic educational resources that create conditions for the development of students' creative thinking and expand the possibilities of educational tools.

Distance learning resources are learning materials delivered through electronic devices. Relatively modern and effective electronic educational resources for education are available with the help of computers.

Distance education resources can be classified as follows:

1. The first level - textographic electronic educational resources that differ from a regular book in the display of text and images, that is, the material is displayed not on paper, but on the computer screen;
2. Second level - textographic electronic educational resources with the possibility to follow the text;
3. The third level - electronic educational resources consisting entirely of visual and audio fragments. The formal difference of this level from the book is that neither film, nor animation, nor sound can be published;
4. The fourth level - multimedia electronic resources with the ability to provide text, graphics, images, video, animation and sounds at the same time;
5. The fifth level - a new generation of electronic educational resources, which includes open educational modular multimedia systems. These include active author network products posted on websites and open to everyone.

Currently, several options are available for teachers to increase their computer literacy: refresher courses outside the educational institution, organization of courses within the institution itself, through mutual education and self-education. A modern high school teacher should have the ability to use information technology, such as computer technology.

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PEDAGOGY

THE ROLE OF TECHNOLOGY IN THE MODERN CLASSROOM

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Abstract

The integration of technology in education has transformed traditional teaching methods and created new opportunities for both educators and students. This paper explores the impact of technological advancements on modern education, highlighting the benefits of enhanced student engagement, improved accessibility, and personalized learning. At the same time, challenges such as distractions, the digital divide, and reduced face-to-face social interactions are discussed. Through examples of successful technology integration in universities, this paper emphasizes the need to strike a balance between technology and traditional methods to ensure a more effective and equitable educational experience for all.

Keywords: technology in education, student engagement, personalized learning, digital divide.

Introduction

The rapid advancement of technology has brought about significant changes in many aspects of our lives, and education is no exception. Over the past few decades, educational institutions across the globe have increasingly integrated technology into their classrooms and curricula. From smartboards and tablets to online learning platforms and educational software, these technological tools have transformed the way educators teach and how students learn. While the adoption of technology in education offers numerous benefits, it also presents certain challenges that must be addressed to ensure a balanced and effective educational experience.

Benefits of Technology in the Classroom

Enhanced Student Engagement

One of the most significant benefits of incorporating technology in the classroom is the increased engagement of students. Interactive tools such as smartboards, educational games, and multimedia presentations capture students' attention far more effectively than traditional teaching methods. These tools enable a more dynamic and interactive learning experience, which can foster greater interest and active participation in the subject matter. A study by Johnson et al. (2016) found that the use of technology in classrooms contributed to a more engaged and motivated student body.

Improved Accessibility

Accessibility is another critical advantage of technology in education. Digital resources and online platforms provide students with access to an abundance of information and learning materials that were previously unavailable or difficult to obtain. This accessibility is particularly beneficial for students in remote or underserved areas who may not have access to well-equipped libraries or educational facilities. Moreover, assistive technologies such as screen readers, speech-to-text software, and other tools help students with disabilities engage more fully with the curriculum. Kelly (2020) highlights how these technologies have made education more inclusive, allowing all students to reach their full potential.

Personalized Learning

Technology has also made a significant impact on personalized learning. Adaptive learning software tailors educational content to meet the individual needs and learning styles of students. This personalized approach allows students to learn at their own pace, ensuring that they fully grasp each concept before moving on to the next. By providing immediate feedback and adjusting the difficulty level based on student performance, these tools can help close learning gaps and support student success. McCarthy (2019) noted that adaptive learning technologies have been shown to improve academic outcomes by addressing individual learning needs more effectively than traditional methods.

Challenges and Drawbacks

Distractions in the Classroom

Despite the numerous benefits, the integration of technology in education presents several challenges. One of the primary concerns is the potential for distraction. With the constant availability of social media, games, and other non-educational content, students may find it challenging to stay focused on their studies. Teachers, therefore, must implement strategies to manage and minimize these distractions in the classroom. Edutopia (2020) suggests that setting clear guidelines for device usage and using technology in a way that complements, rather than detracts from, the learning process can help mitigate this issue.

The Digital Divide

The digital divide is another significant challenge associated with technology in education. Not all students have equal access to technology, and this disparity can exacerbate existing inequalities in education. Students from low-income families or rural areas may lack the necessary devices or reliable internet connectivity to fully participate in digital learning. Addressing this issue requires concerted efforts from governments, educational institutions, and communities to ensure that all students have the tools they need to succeed. Warschauer and Matuchniak (2010) emphasize the importance of bridging this divide to create equitable educational opportunities for all learners.

Decreased Face-to-Face Social Interactions

Another drawback of increased technology use in education is the potential reduction in face-to-face social interactions. While digital communication tools enable students to collaborate online, they cannot fully replace the benefits of in-person interactions. Social skills, teamwork, and the ability to navigate complex social situations are crucial aspects of education that may be diminished if students spend too much time in front of screens. ScienceDirect (2013) highlights the importance of balancing screen time with opportunities for students to develop these essential interpersonal skills.

Examples of Successful Technology Integration in Universities

Stanford University: Flipped Classroom Model

Several universities have successfully integrated technology into their educational programs, demonstrating the potential for positive outcomes. For instance, Stanford University has implemented a flipped classroom model, where students watch lectures online and use classroom time for interactive discussions and problem-solving activities. This approach has led to increased student engagement and improved learning outcomes, as reported by Stanford University (2015). The flipped classroom model allows students to digest lecture material at their own pace and come to class prepared to apply what they have learned in a more interactive setting.

Massachusetts Institute of Technology (MIT): OpenCourseWare

Similarly, the Massachusetts Institute of Technology (MIT) has expanded access to education through its MIT OpenCourseWare platform. This initiative provides free access to course materials for learners worldwide, promoting lifelong learning and expanding educational opportunities beyond traditional campus boundaries. MIT OpenCourseWare (2020) has allowed millions of people globally to benefit from high-quality educational resources without the constraints of location or financial means.

University of Central Florida: Adaptive Learning Technology

The University of Central Florida has also seen success with the use of adaptive learning technology in its introductory courses. This technology has resulted in higher pass rates and improved student retention. By personalizing the learning experience, the university has been able to better support students' academic success. UCEA (2020) highlights how the implementation of adaptive learning tools has helped students overcome academic challenges and achieve their educational goals.

Conclusion

The future of education undoubtedly lies in finding the right balance between technology and traditional methods. While technology offers numerous benefits, such as increased engagement, improved accessibility, and personalized learning experiences, it also presents challenges that must be carefully managed. Educators and policymakers must ensure that the integration of technology enhances rather than detracts from the educational experience. By addressing issues such as the digital divide and ensuring that students continue to develop essential social skills, we can harness the power of technology to create a more effective and equitable educational system for all.

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PHILOLOGY

NATIONAL SENTIMENT IN THE CARAGIALE DYNASTY OF WRITERS- A RELIGIOUS NUANCE

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Abstract

This paper delves into the spiritual and historical dimensions of the Caragiale family's literary legacy, focusing on the profound intersection of religion, nationalism, and the remnants of Romania's aristocratic past. I. L. Caragiale and Mateiu I. Caragiale are central figures whose writings reflect the spiritual dissonance of Romanian identity through their critique of political systems, national values, and historical allegories. I. L. Caragiale's satirical works, including *O scrisoare pierdută* (*A Lost Letter*) and *D-ale carnavalului* (*Of the Carnival*), serve as powerful tools to explore the collision between Christian morality and political corruption. His son, Mateiu, presents a melancholic vision of Romania's spiritual and historical decline, particularly in *Craii de Curtea-Veche* (*The Rakes of the Old Court*), where decayed nobility and forgotten courts become allegories of a sacred, yet lost past. This study combines theological reflections with a literary analysis, offering a nuanced reading of how the Caragiale family's works provide insight into the Romanian soul's enduring struggle with its divine and national identity.

Keywords: Caragiale, Romanian identity, nationalism, spirituality, Christian morality, political satire, historical allegory

Introduction

The Caragiale family's contributions to Romanian literature extend beyond the realm of satirical comedy and historical narrative. At the heart of their works lies a deep exploration of the Romanian soul, which is continuously caught between the forces of nationalism and spirituality. This paper embarks on a journey through the writings of I. L. Caragiale and Mateiu I. Caragiale, examining the spiritual dissonance that defines their portrayal of Romania's national identity. While I. L. Caragiale is often remembered for his biting satire of political life in works such as *O scrisoare pierdută* (*A Lost Letter*) and *D-ale carnavalului* (*Of the Carnival*), his literary legacy also reveals a complex moral inquiry rooted in Christian values. His critique of political and social institutions serves as a theological reflection on the decay of Romanian society, where morality and ethics are sacrificed at the altar of ambition and power (Cioculescu, 1998: 135).

Mateiu I. Caragiale, by contrast, embraces a more melancholic and allegorical approach in his depiction of Romania's spiritual decline. His most famous work, *Craii de Curtea-Veche* (*The Rakes of the Old Court*), paints a vivid picture of aristocratic decadence, turning the forgotten palaces of Bucharest into symbols of a lost spiritual and national grandeur. Through his portrayal of decayed nobility, Mateiu reflects on the transient nature of worldly glory, presenting a vision of Romania's past that is both sacred and tragic. The old courts, which once stood as monuments to a noble and divine heritage, have become ruins where the nation's spiritual aspirations lie in decay. By examining these two authors, this paper aims to shed light on how their works offer profound insights into the complex relationship between Romania's historical legacy and its enduring spiritual identity. (Carianopol, 1984: 17)

Through a close reading of their texts, this study will trace how both writers, despite their differences in style and subject matter, converge in their concern with Romania's moral and spiritual crisis. Whether through I. L. Caragiale's sharp socio-political critique or Mateiu I. Caragiale's poetic meditation on the past, their works reveal a shared preoccupation with the fate of the Romanian nation. Their literary output can be read as a theological inquiry, reflecting on the challenges of maintaining Christian morality in a society where political and historical forces often overshadow spiritual values. This tension between the sacred and the secular becomes the foundation for understanding the Caragiales' literary contribution to the broader discourse of national identity.

Costache Caragiale and Iorgu Caragiale: revolutionary patriots and devout visionaries of the 1848 Era

The legacy of Costache and Iorgu Caragiale, significant literary and cultural figures of 19th-century Romania, offers a compelling synthesis of nationalistic fervour and spiritual vision. Their contributions, both in the realms of theatre and revolutionary activism, reveal a complex intertwining of patriotic ideals and religious devotion, which characterized the Romanian intellectual climate during the 1848 revolutions. In this period of heightened national consciousness, the Caragiale family's artistic and political involvement was profoundly influenced by a desire to awaken the collective spirit of the Romanian people, while drawing on a deep reservoir of Christian spirituality as a moral

compass. Their theatrical works and revolutionary actions thus provide a productive ground for examining how religious and national sentiments coalesced to shape the burgeoning identity of a nation on the brink of independence (Marcu, 2012: 135).

Costache Caragiale, one of the pioneering figures of Romanian theatre, played an instrumental role in promoting national identity through the stage. His works were more than mere entertainments; they embodied a didactic purpose, aimed at educating the Romanian public about their cultural heritage and Christian moral values. Through his adaptation and staging of Molière's *Tartuffe* and other classic works, Costache infused his productions with a uniquely Romanian ethos, highlighting the moral dichotomy between virtue and vice in a society striving for national awakening. His decision to frame the corruption of the elite and the moral decay of society as religious concerns illustrates how deeply intertwined faith and patriotism were in his worldview. In many ways, Costache's use of the stage as a pulpit for moral instruction reflects a broader trend in 19th-century European theatre, where artists like Victor Hugo and Friedrich Schiller similarly sought to harness the power of drama for moral and political education (Manolescu, 2008: 45). However, Costache's vision was distinctly local in scope, seeking not only to entertain but also to inspire a sense of divine mission in the hearts of his Romanian audience (Grigurcu, 2006: 47).

Iorgu Caragiale, the younger brother of Costache, shared his sibling's passion for both the stage and the political upheavals of the time. However, Iorgu's contributions were marked by a more direct engagement with the revolutionary activities of 1848, reflecting his conviction that political liberation was inseparable from spiritual renewal (George Călinescu, 1941: 62). As a playwright, Iorgu continued the family tradition of using theatre as a vehicle for social critique, but his works carried an even more pronounced nationalist sentiment, as he sought to articulate the divine purpose of the Romanian nation in the face of foreign domination. His dramatic pieces, such as *Înțeleptul de la Tarascon* and *Proorocul*, reveal an eschatological dimension in which the political liberation of the Romanian people is portrayed as a reflection of God's will (Călinescu, 1985: 70). By interlacing nationalistic enthusiasm with biblical themes of deliverance and justice, Iorgu's writings resonate with the millenarian aspirations of other contemporary European movements, such as those found in Giuseppe Mazzini's *Duties of Man*, where nationhood was cast in explicitly religious terms as part of a divine plan for humanity (Cioculescu, 1998: 148).

Moreover, both Costache and Iorgu Caragiale were shaped by the broader cultural movements of their time, which saw a revival of Orthodox Christian values as a foundation for national identity (Papu, 1977: 53). The Caragiale brothers were part of a generation of intellectuals who saw in the Romanian Orthodox Church a symbol of national continuity and resistance against foreign oppression (Simion, 1996: 150). In this respect, their vision aligns with the ideas propagated by other 19th-century Romanian figures like Nicolae Bălcescu, who, in his relevant work *Românii supt Mihai-Voievod Viteazul*, emphasized the moral and spiritual unity of the Romanian people as a prerequisite for political liberation (Marino, 1985: 212). Similarly, the Caragiale brothers viewed the Romanian people's spiritual renewal as a necessary step toward achieving national independence, a sentiment that was echoed in their theatrical productions, which often portrayed the struggle for national self-determination as a divine mandate (Mincu, 1990: 220).

In addition to their contributions to the theatrical world, both Costache and Iorgu Caragiale were actively involved in the political upheavals of their time, participating in the revolutionary activities of 1848 (Lovinescu, 2000: 158). Their involvement in these movements was not merely a reflection of political opportunism but rather stemmed from a deeply held belief in the providential role of the Romanian people in the wider context of European history. Like other revolutionaries of the time, such as France's Alphonse de Lamartine, whose *Histoire des Girondins* framed the French Revolution in quasi-religious terms, the Caragiale brothers saw the 1848 uprisings as a manifestation of divine justice (Călinescu, 1985: 78). For them, the fight for Romanian independence was not only a political struggle but also a spiritual one, in which the Romanian nation was called upon to fulfil its God-given destiny as a free and sovereign people (Raicu, 1978: 85).

The Caragiale brothers' fusion of patriotic and religious ideals in both their artistic and political endeavours offer a distinctive lens through which to understand the broader cultural and intellectual currents of 19th-century Romania. Their works, imbued with a sense of divine purpose, reflect the prevailing belief among Romanian intellectuals that the nation's political liberation was inextricably linked to its spiritual renewal. In this regard, Costache and Iorgu Caragiale stand as exemplars of a generation of writers and revolutionaries who sought to unite national sentiment with religious devotion, using the stage as both a platform for political critique and a pulpit for moral instruction (Zamfir, 1999: 60). Through their efforts, the Romanian theatre became a space where questions of faith, morality, and national identity could be explored in tandem, offering a vision of nationhood that was as much spiritual as it was political (Streinu, 1968: 65).

The early Caragiale legacy, embodied by Costache and Iorgu, reveals a profound engagement with the spiritual and national questions of their time. Their commitment to the Romanian cause was not merely a reflection of political ambition but was deeply rooted in a Christian understanding of moral duty and divine justice. Through their works, the Caragiale brothers sought to awaken the Romanian people to their God-given mission, using the medium of theatre as a tool for both national awakening and spiritual instruction, thus cementing their place as revolutionary patriots and devout visionaries of the 1848 era.

From Greek ancestry to Romanian faith: the spiritual transformation of the early Caragiale writers

The spiritual journey of the early Caragiale writers from their Greek ancestry to their profound Romanian Christian faith reflects a fascinating cultural and religious evolution. The Caragiale family, originally of Greek origin, became naturalized within the Romanian milieu, undergoing not only a linguistic but also a spiritual transformation. Costache and Iorgu Caragiale's journey epitomizes the broader experience of Hellenic families in the Romanian principalities who, through a gradual process of integration, came to adopt the Romanian Orthodox faith as a central element of their identity. This evolution can be seen as both a response to the wider cultural currents of the 19th century and as a deliberate choice, inspired by a desire to connect with the spiritual and moral fabric of the Romanian people (Mironescu, 1980: 184).

The Caragiale family's shift from a Greek-speaking, Phanariot heritage to a deeply rooted Romanian cultural and spiritual identity is emblematic of the broader Hellenic diaspora's experience in the Balkans. The Hellenic merchants, scholars, and political figures who migrated to the Romanian lands during the late Ottoman period often found themselves at a crossroads between maintaining their ancestral traditions and assimilating into the dominant Orthodox Romanian culture. Costache and Iorgu Caragiale, as representatives of this Greek heritage, chose to embrace Romanian identity wholeheartedly, not only through their adoption of the Romanian language but also through their alignment with Romanian Orthodoxy. This spiritual transformation was not just an external shift but involved a deep internalization of the religious and national values that were central to the Romanian consciousness of the time (Ungureanu, 2005: 90). The Caragiales' embrace of Romanian Orthodoxy marked a significant step in their development as writers who sought to contribute to the cultural and spiritual awakening of the Romanian nation.

This transformation is vividly reflected in their artistic works, where they struggle with themes of moral decay, societal transformation, and spiritual redemption. Costache Caragiale's theatrical works, particularly his adaptations of European classics like *Tartuffe*, demonstrate an awareness of the moral and spiritual dilemmas facing 19th-century Romanian society. Through these works, Costache sought to offer moral guidance to his audience, drawing on the teachings of the Romanian Orthodox Church to challenge corruption and immorality in public life (Preda, 2000: 190). Iorgu Caragiale similarly used the stage as a platform for exploring questions of faith, national identity, and divine justice. His dramas, such as *Proorocul*, demonstrate a clear alignment with Orthodox Christian values, particularly in their portrayal of political and social liberation as inherently tied to spiritual renewal (Cristea, 2005: 102).

As the Caragiale family assimilated into the Romanian context, their literary output became deeply informed by Orthodox theology, which played a central role in shaping the moral vision of their works. This is evident in their portrayal of national identity, which was not conceived in purely secular terms but was instead framed within the broader context of divine providence. In this way, the Caragiale brothers contributed to a distinctive tradition in Romanian literature that saw the nation's political destiny as intertwined with its spiritual mission. This tradition, influenced by figures such as Mihai Eminescu and Nicolae Bălcescu, emphasized the moral and religious responsibilities of the Romanian people as part of their fight for independence and self-determination (Marcu, 2012: 250). The Caragiales' works thus reflect a unique synthesis of national and religious identity, wherein their Greek ancestry gave way to a profound engagement with the spiritual values of the Romanian Orthodox Church.

Theatre as sacred text: the spiritual and moral dimensions of 19th century Romanian drama

Theater in 19th-century Romania, particularly in the hands of the early Caragiale writers, emerged not only as a space for entertainment and social critique but as a medium for conveying moral and spiritual truths. For Costache and Iorgu Caragiale, the theatre functioned almost as a sacred text, through which they could communicate Christian values, critique societal ills, and inspire their audience toward both personal and national transformation. This advancement of theatre to a quasi-religious platform is reflective of the broader European trends of the time, where dramatists like Victor Hugo and Friedrich Schiller infused their works with moral and spiritual significance. However, in the Romanian context, this tendency was even more pronounced, as playwrights drew heavily on the theological and ethical teachings of the Orthodox Church to inform their works (Botez, 1989: 201).

Costache Caragiale, in particular, saw the stage as a means of moral instruction, using his plays to critique the ethical shortcomings of the ruling elite while promoting virtues such as honesty, humility, and piety. His adaptation of Molière's *Tartuffe*, for instance, was not simply a translation of a French classic but a deliberate reinterpretation, infused with Orthodox Christian values. The character of Tartuffe, a hypocritical cleric, becomes a symbol of the moral corruption that Costache perceived in Romanian society. Through his portrayal of Tartuffe's fall, Costache underscored the importance of genuine faith and moral integrity, aligning his theatrical message with the teachings of the Romanian Orthodox Church (Rădulescu, 1991: 112). This approach to theatre as a vehicle for moral and spiritual education set a precedent for later Romanian playwrights, who would similarly use the stage to explore questions of faith and national identity.

Iorgu Caragiale, while sharing his brother's conviction that theatre should serve a higher moral purpose, took this notion further by incorporating explicitly religious themes into his works. In *Proorocul*, for example, Iorgu drew on biblical narratives to frame the political liberation of the Romanian people as part of a divine plan. The prophet figure in the play serves as both a spiritual and political leader, guiding the Romanian people toward freedom in accordance with God's will (Tohăneanu, 2006: 210). In this way, Iorgu's theatre becomes not merely a reflection of societal realities

but a prophetic text, through which he sought to inspire his audience to see their own struggles as part of a larger, divinely ordained narrative. This eschatological dimension of Iorgu's work reflects the millenarian aspirations of the 1848 revolutionaries, who saw their political struggles as part of a cosmic battle between good and evil, order and chaos.

Moreover, the Caragiale brothers' use of theatre as a sacred text was deeply influenced by their engagement with Orthodox Christian rituals and symbols. In *Înțeleptul de la Tarascon*, Iorgu Caragiale employed liturgical imagery and language to underscore the moral gravity of his narrative, transforming the stage into a space of spiritual reflection and moral judgment. This sacralization of theatre was not unique to the Caragiale brothers but was part of a broader trend in 19th-century Romanian drama, where playwrights sought to elevate their works to the status of moral and spiritual instruction. Figures such as Vasile Alecsandri and Bogdan Petriceicu Hasdeu similarly used the stage to explore questions of faith, justice, and national identity, positioning their works as both artistic and ethical interventions in the cultural life of the nation (Carianopol, 1994: 140).

The Caragiales' legacy, therefore, lies not only in their contributions to the development of Romanian drama but also in their elevation of theatre to a medium for spiritual and moral reflection. By infusing their works with Orthodox Christian values, they transformed the stage into a space where national and religious identity could be explored in tandem. Their plays, far from being mere entertainments, functioned as sacred texts, offering their audience a vision of national destiny grounded in spiritual renewal and divine justice. Through their efforts, Costache and Iorgu Caragiale left an indelible mark on Romanian literature, creating a tradition of drama that was as much about moral instruction as it was about artistic expression (Nicolae Iorga, 1972: 145). Their works remain a testament to the power of theatre to serve not only as a mirror to society but as a medium for divine inspiration and national awakening (Mihăilescu, 2001: 220).

The sacred and the secular: I. L. Caragiale's spiritual quest through socio-political commentary

I. L. Caragiale, often regarded as one of Romania's most incisive social commentators, presents a complex interplay between the sacred and the secular in his exploration of Romanian identity. Although he is often celebrated for his satirical critiques of the socio-political structures of his time, a closer examination of his works reveals a deeper spiritual dissonance that reflects both personal and collective tensions within Romanian society. Caragiale's characters, often caught between their own material desires and the moral expectations of society, become vehicles for exploring this underlying tension. In works like *O scrisoare pierdută* and *O noapte furtunoasă*, Caragiale presents a Romania that is grappling with the ambiguities of its national identity, torn between modernizing impulses and traditional, religious values (Morar, 2010: 220).

At the heart of Caragiale's satirical vision lies a profound spiritual quest. Though his plays and short stories are not explicitly religious, they are imbued with moral undertones that reflect his concern for the ethical state of the nation. In his portrayal of the political elite, Caragiale often exposes the disconnect between the public and private lives of his characters, drawing attention to their hypocrisy and moral vacuity. These figures, such as Cațavencu in *O scrisoare pierdută*, embody a society that has lost its spiritual compass, guided instead by ambition, corruption, and self-interest. In this way, Caragiale's works serve as a critique not only of Romania's political landscape but also of the spiritual malaise that pervades the nation. (Chendi, 1975: 74)

The sacred and the secular are further dishevelled in Caragiale's exploration of national identity through socio-political commentary. His characters often invoke religious language and symbols, but these references are frequently hollow, serving as a veneer for deeper moral and ethical shortcomings. For example, in *D-ale carnavalului*, Caragiale portrays characters who use religious rituals and language as a means of reinforcing their own social status or moral superiority, without any genuine understanding of or commitment to the spiritual values they espouse. This dissonance reflects a broader crisis of identity within Romanian society, as it struggles to reconcile its Orthodox Christian heritage with the pressures of modernization and Westernization. Caragiale's works thus reveal a society in which the sacred and the secular coexist uneasily, often in contradiction with one another. (Breazu, 1985: 142)

I. L. Caragiale's exploration of spiritual dissonance is not limited to his satirical critique of society; it also extends to his portrayal of individual characters who grapple with questions of morality, faith, and identity. In *Moftul român*, for instance, Caragiale employs humour and irony to depict characters who are caught between their own selfish desires and the moral expectations placed upon them by society. This tension is particularly evident in his short stories, where characters often find themselves in morally compromising situations, unable to reconcile their personal ambitions with the ethical demands of their social roles. Through these characters, Caragiale explores the moral complexities of Romanian society, revealing the spiritual dissonance that lies at the heart of the nation's identity. (Zafiu, 2007: 92)

Moreover, Caragiale's works suggest that this spiritual dissonance is not merely a product of individual failings but is rooted in the broader socio-political structures of Romanian society. In *O scrisoare pierdută*, for instance, Caragiale presents a political system that is fundamentally corrupt, where moral values are subordinated to the pursuit of power and self-interest. The characters in the play, from the ambitious Cațavencu to the complacent Trahanache, embody a society that has lost its moral compass, where religious and ethical values are invoked only as a means of legitimizing political authority. This portrayal of Romania's political elite as morally bankrupt reflects Caragiale's broader critique of the nation's spiritual state, suggesting that the dissonance between the sacred and the secular is not limited to individual failings but is endemic to the nation as a whole. (Constantinescu, 1966: 64)

At the same time, Caragiale's works also reveal a longing for spiritual renewal, a desire to reconnect with the moral and ethical values that underpin Romanian society. In *O noapte furtunoasă*, for example, the characters' moral failings are ultimately exposed, leading to moments of self-reflection and, in some cases, redemption. This suggests that, despite the spiritual dissonance that pervades his works, Caragiale remains committed to the possibility of moral and spiritual renewal. His characters, though often flawed, are not beyond redemption, and his works suggest that Romania's spiritual crisis can be overcome through a return to the ethical values of the Orthodox Christian tradition (Cioculescu, 1998: 240).

In this way, Caragiale's works serve as both a critique of Romanian society and a call for spiritual renewal. His portrayal of the sacred and the secular as intertwined yet often contradictory reflects the complexities of Romanian identity in the late 19th century, as the nation grappled with the tensions between tradition and modernity, faith and progress. Through his incisive socio-political commentary, Caragiale reveals a society in which spiritual dissonance is endemic, yet also suggests that this dissonance can be resolved through a recommitment to the moral and ethical values that have long defined Romanian identity. In his vision, the sacred and the secular are not mutually exclusive but must be reconciled if Romania is to achieve both moral and political regeneration (Tănăsescu, 1986: 245).

Christian morality and political critique in Caragiale's writings

I. L. Caragiale's work presents a nuanced intersection between Christian morality and political critique, offering a profound commentary on the spiritual dissonance within Romanian identity. While his satirical portrayal of Romanian society is often interpreted as a critique of political corruption and moral decay, Caragiale's deeper engagement with Christian ethics cannot be overlooked. His literary universe reflects an implicit understanding of Orthodox Christian values, which become tools for exposing the moral failures of both individuals and the socio-political structures of his time. Caragiale's characters, although often comical or grotesque, navigate a world that juxtaposes the sacred ideals of Christian morality with the pragmatic demands of a flawed political system. This tension is vividly portrayed in *O scrisoare pierdută* (*The Lost Letter*), where the central figures are entangled in a web of deceit, ambition, and personal gain, all while cloaking their actions in a veneer of respectability (Cioculescu, 1998: 180).

Caragiale's critique of Romanian society can be seen through the lens of Christian morality, particularly in his depiction of the ruling class and their manipulation of religious symbols for personal and political gain. In *D-ale carnavalului* (*Of the Carnival's Frolics*), for instance, the characters invoke religious rituals and language to reinforce their social positions, while their actions betray a complete disregard for the ethical teachings of the Church. This paradox reflects a broader societal dissonance, where religion becomes a superficial marker of respectability rather than a guiding moral force. Caragiale exposes this hypocrisy through his sharp wit, revealing the contradictions between the moral expectations placed upon the political elite and their actual behaviour. Through his satirical lens, Caragiale underscores how religion, particularly Christian morality, is co-opted by a corrupt political system that exploits spiritual values for political legitimacy. (Șăineanu, 1999: 163)

The spiritual dissonance in Caragiale's work is not limited to individuals but extends to his critique of the broader political structures that govern Romanian society. The intersection of Christian morality and political critique is most evident in *O noapte furtunoasă* (*A Stormy Night*), where the characters' petty squabbles and machinations expose the moral bankruptcy of those in positions of power. The play serves as a microcosm of Romanian political life, revealing the extent to which self-interest and ambition have replaced the Christian virtues of humility, honesty, and compassion. Through these portrayals, Caragiale offers a scathing indictment of a society that has lost its moral compass, where political authority is no longer guided by Christian ethics but by the ruthless pursuit of power. This spiritual dissonance is at the heart of Caragiale's critique, as he exposes the moral failings of a society that claims to be Christian while engaging in behavior antithetical to its core teachings. (Anghelescu, 1984: 82)

One of the most compelling aspects of Caragiale's work is his ability to blend humour and satire with a profound moral commentary rooted in Christian ethics. His characters, while often humorous and exaggerated, serve as vehicles for exploring deeper questions of morality and faith. In *Moftul român* (*The Romanian Caprice*), Caragiale uses irony to depict characters who outwardly adhere to Christian norms, yet their actions reveal a disconnection from these values. This moral ambiguity reflects a broader societal crisis, where Christian morality is invoked only as a formality, rather than as a genuine ethical framework. Through his satirical narratives, Caragiale critiques not only the individuals who engage in this hypocrisy but also the societal structures that allow such behavior to flourish. In this way, Caragiale's work functions as both a political critique and a moral commentary on the state of Romanian society. (Albu, 1994: 35)

At the same time, Caragiale's engagement with Christian morality also extends to his exploration of the spiritual struggles of his characters. In *O scrisoare pierdută*, for example, the character of Trahanache embodies a type of moral resignation, where he is aware of the corruption around him but is either unwilling or unable to confront it. His passivity reflects a broader societal apathy, where Christian morality has become a mere facade, and the true ethical teachings of the Church have been forgotten. This moral complacency, Caragiale suggests, is one of the root causes of Romania's political and social malaise. Through this portrayal, Caragiale implicitly calls for a return to genuine Christian values, where morality is not merely a social obligation but a true guiding principle in both personal and public life. (Cioculescu, 1998: 190)

Moreover, Caragiale's works often suggest that the failures of Christian morality within Romanian society are not merely individual but systemic, deeply

embedded within the political and social fabric of the nation. In *Conu' Leonida față cu reacțiunea* (*Mr. Leonida Faces the Reaction*), Caragiale uses the character of Leonida to satirize the naivety and moral blindness of those who cling to outdated political ideologies, using religion as a crutch for their ignorance. This play, while comedic, offers a biting critique of how religion and morality are exploited for political purposes, often by those who do not truly understand or believe in the values they espouse. Through this narrative, Caragiale exposes the dissonance between Christian morality and the political realities of his time, suggesting that the true crisis of Romanian identity lies in this moral and spiritual disconnect. (Vasile, 2007: 121)

Ultimately, I. L. Caragiale's engagement with Christian morality and political critique reveals a profound spiritual dissonance within Romanian society. His characters, often caught between their personal ambitions and the ethical teachings of the Church, reflect a broader societal crisis where Christian values have been subordinated to political expediency. Through his sharp satirical lens, Caragiale critiques not only the individuals who engage in this moral hypocrisy but also the structures of power that perpetuate it. His works, from *O scrisoare pierdută* to *D-ale carnavalului*, serve as both a political commentary and a moral indictment of a society that has lost touch with its spiritual roots. Caragiale's incisive exploration of the tension between Christian morality and political reality remains a powerful reflection on the complexities of Romanian identity, offering a timeless critique of the spiritual and ethical challenges facing both individuals and society as a whole (Cioculescu, 1998: 195).

Theological reflections on national identity: Caragiale's critique as a moral inquiry

I. L. Caragiale's works represent more than mere satirical criticism of Romanian society; they invite a profound theological reflection on national identity. His sharp, often cynical portrayal of the socio-political landscape can be interpreted as a moral inquiry into the soul of the Romanian nation, deeply entangled with spiritual values. While his characters are typically caught in the absurdities of political life, their struggles reveal a deeper existential and ethical crisis rooted in a conflict between Christian morality and the emerging national consciousness. This dissonance between spiritual ideals and national identity becomes a recurring theme in Caragiale's works, offering readers an opportunity to reflect on the theological implications of his critique. (Focșeneanu, 2003: 161)

Caragiale's satire of Romanian society reflects an implicit interrogation of how national identity is constructed and maintained in relation to Christian morality. In *O scrisoare pierdută* (*The Lost Letter*), for instance, the depiction of political manipulation and moral compromise reveals a tension between the Christian values espoused by Romanian society and the reality of its socio-political conduct. The protagonist, Farfuridi, and his fellow politicians demonstrate a superficial attachment to national ideals, while their actions betray a deeper disconnection from Christian ethical teachings. This duality, so vividly portrayed, evokes theological reflections on the relationship between moral integrity and national character. Caragiale's characters often act as mirrors to the nation's soul, where the pursuit of power and self-interest overshadows the Christian virtues of humility, charity, and truth. (Cioculescu, 1998: 135)

The theological dimension of Caragiale's critique is further emphasized by his portrayal of the tension between religious symbolism and political action. In *D-ale carnavalului* (*Of the Carnival's Frolics*), characters invoke religious language and ritual to lend credibility to their schemes, thereby reducing Christian practices to mere performative gestures within the socio-political arena. This distortion of religious symbols within the public sphere raises theological concerns about the nature of Romanian national identity, whether it is grounded in authentic spiritual values or in the empty rhetoric of patriotism. Caragiale's examination of this dissonance suggests that the national identity of Romania, as reflected in the behaviours and attitudes of its political class, is at odds with the theological ideals of its Christian heritage. This conflict invites a moral inquiry into the very fabric of Romanian society, questioning the extent to which Christian ethics can or should shape national identity in the face of political realities. (Grigurcu, 2006: 153)

The juncture of theology and national identity in Caragiale's work also finds expression in his examination of personal morality within the framework of national responsibility. In *O noapte furtunoasă* (*A Stormy Night*), Caragiale uses the private actions of his characters to reflect on the broader moral failures of the nation. The moral ambiguity and duplicity displayed by the characters are not simply personal failings, but reflections of the nation's spiritual disintegration. In this way, Caragiale's critique transcends the immediate socio-political context, delving into theological questions about the moral obligations of individuals within the collective national identity. Through this lens, the playwright's exploration of personal vice becomes a commentary on the spiritual state of the nation itself, raising profound questions about the compatibility of Christian morality with the emerging Romanian nationalism of the late 19th century. (Cioculescu, 1998: 148)

Caragiale's critique of Romanian society, when viewed through a theological lens, can be interpreted as a call for spiritual renewal. His works suggest that the nation's identity crisis is not merely political but deeply moral and spiritual. The characters in *Conu' Leonida față cu reacțiunea* (*Mr. Leonida Faces the Reaction*) illustrate this dissonance, as they grapple with a sense of disillusionment with both the political system and the Christian ideals they claim to uphold. The figure of Leonida, with his outdated and naive views of political reality, reflects the moral and spiritual inertia of a society that has lost its way. This inertia, Caragiale implies, is not only a social or political problem but a theological one, as the nation's identity has become detached from the Christian virtues that once defined it. (Frățilă, 2014: 81)

Furthermore, Caragiale's works often suggest that the reconciliation of national identity with Christian morality is not only desirable but necessary for the survival of the Romanian nation. His satirical depictions

of political corruption, moral decay, and spiritual emptiness serve as warnings about the dangers of abandoning Christian ethical principles in the pursuit of national power. In *Moftul român* (*The Romanian Caprice*), for instance, the characters' disregard for Christian virtues such as honesty and humility reflect a broader societal failure to integrate theological values into national life. The moral vacuity of the characters becomes a metaphor for the spiritual void at the heart of the nation's identity, suggesting that the true crisis facing Romania is not political but theological. (Cioculescu, 1998: 155)

In this sense, Caragiale's critique of Romanian society can be seen as a moral inquiry into the spiritual foundations of national identity. His works, while often humorous and satirical, offer a serious reflection on the moral and theological dimensions of Romanian nationalism. Caragiale's characters, caught between their personal ambitions and the ethical demands of Christian morality, reflect the broader national struggle to define itself in the face of modernity. The playwright's exploration of this struggle raises important theological questions about the role of religion in shaping national identity, particularly in a society where political expediency often takes precedence over spiritual integrity. (Marcu, 2012: 113)

Through his works, Caragiale invites readers to reflect on the moral and spiritual implications of Romanian national identity, offering a critique that is as much theological as it is political. His examination of the tension between Christian morality and national ambition reveals a deep dissonance at the heart of Romanian society, one that continues to resonate in contemporary discussions of identity and faith. In *O scrisoare pierdută*, the juxtaposition of religious language with political manipulation serves as a powerful commentary on the dangers of divorcing national identity from its theological roots. By exposing the moral contradictions within Romanian society, Caragiale challenges his audience to consider the extent to which national identity can be reconciled with Christian morality—a question that remains relevant to this day. (Cioculescu, 1998: 142)

Heraldic mysticism: Mateiu's divine aspiration for noble lineage and historical reverence

Mateiu I. Caragiale's works are imbued with a distinct sense of heraldic mysticism, where noble lineage and historical reverence intersect with a deep, almost divine aspiration. His fascination with aristocratic ancestry, which permeates both his literary style and thematic preoccupations, reflects a longing for transcendence through the preservation of historical memory and the veneration of noble heritage. In *Craii de Curtea-Veche* (*The Rakes of the Old Court*), Mateiu reconstructs a bygone era of noble decadence and moral decline, yet underneath the surface of this critique lies an implicit reverence for the aristocratic ideal, which he portrays as sacred ruins of Romania's history, standing as remnants of a lost grandeur (Cioculescu, 1998: 135).

This heraldic mysticism, in which history is venerated as an almost religious artifact, is deeply intertwined with Mateiu's divine aspirations for noble lineage. Heavily influenced by medievalist and aristocratic imagery, his prose constantly evokes a vision of Romania not only as a political entity but as a metaphysical construct, where the vestiges of the past possess a near-sacred quality. In *Sub pecetea tainei* (*Under the Seal of Mystery*), Mateiu delves into the mystery of forgotten lineages, portraying a Romania whose soul is buried beneath layers of history, each representing an idealized version of the past that must be revered and uncovered. His protagonists are often engaged in this very pursuit, searching for meaning and identity through their connections to a lineage that seems divinely ordained. (Cristea, 2005: 129)

Mateiu's engagement with nobility is not merely an aesthetic preference; it represents a broader philosophical and spiritual inquiry into the nature of power, identity, and history. In this sense, his works reflect a yearning for the sacred, where aristocratic bloodlines are not just marks of social distinction but symbols of a divine order. The baroque richness of his language, coupled with his intricate exploration of historical mysticism, creates a space where history and spirituality converge. *Craii de Curtea-Veche* embodies this tension between the sacred and the decayed, as the titular "rakes" symbolize both the remnants of a once-great aristocracy and the potential for spiritual renewal through the reclamation of noble heritage (Cioculescu, 1998: 142).

The theological undertones of Mateiu's heraldic mysticism are further accentuated by his treatment of time and decay. In *Craii de Curtea-Veche*, the decaying old court represents not just the physical erosion of a noble lineage but the moral and spiritual decline of a society that has lost touch with its divine origins. Mateiu's characters, much like the ruins they inhabit, seem suspended between worlds, between past and present, between nobility and corruption, between the sacred and the profane. This metaphysical space, where history becomes a form of sacred ruin, is key to understanding Mateiu's broader aspirations. His longing for historical reverence is, in essence, a yearning for a return to a divine order where the past is sanctified and the present redeemed through the acknowledgment of its noble lineage (Preda, 2002: 160).

Mateiu's obsession with heraldry and genealogy takes on a near-religious dimension in his work, as these elements are not merely markers of social status but symbols of a deeper metaphysical order. His engagement with these themes is most vividly expressed through his use of symbolism, where the noble bloodlines of his characters are linked to a divine hierarchy. In *Craii de Curtea-Veche*, the old aristocracy is portrayed as both decadent and divine, suggesting a paradox in Mateiu's worldview. The spiritual disillusionment of the present is contrasted with the veneration of a sacred, albeit decayed, past. This duality suggests a complex theological reflection on the nature of nobility, where historical reverence and divine aspiration are intertwined (Cioculescu, 1998: 148).

Mateiu's theological engagement with history is not confined to the external world of politics and power but extends into the personal realm, where his characters' spiritual journeys are often framed within the context of their noble heritage. In *Sub pecetea tainei*, the

search for identity and meaning becomes a quest for spiritual transcendence through the discovery of hidden lineages. This genealogical search reflects a broader theological aspiration, where the unraveling of one's noble ancestry serves as a path toward divine revelation. For Mateiu, the past is not merely an object of nostalgia but a key to unlocking spiritual truths, where history becomes a sacred text to be interpreted and revered (Ungureanu, 2005: 164).

Through his exploration of heraldic mysticism, Mateiu constructs a vision of Romanian history that is deeply intertwined with notions of divinity and nobility. His works suggest that the decline of noble lineages represents not just a societal loss but a spiritual fall, where the erosion of aristocratic values mirrors the disintegration of a divine order. Yet, within this decay, there remains the possibility of redemption, as the sacred ruins of Romanian history continue to exert a powerful spiritual influence. In this sense, Mateiu's characters are not just witnesses to historical decay but active participants in a quest for spiritual renewal, seeking to reclaim their divine inheritance through the veneration of their noble lineage (Cioculescu, 1998: 152).

Mateiu's divine aspiration for noble lineage reflects a broader theological preoccupation with the sacredness of history. His characters' obsession with heraldry and genealogy serves as a metaphor for a deeper spiritual quest, where the search for noble origins becomes a path to divine revelation. This heraldic mysticism is not confined to the past but extends into the present, where the vestiges of Romania's noble heritage continue to shape its spiritual and national identity. Mateiu's works, particularly *Craii de Curtea-Veche*, offer a vision of Romania as a nation whose history is not merely political but metaphysical, where the sacred ruins of its aristocratic past serve as a reminder of a divine order that continues to resonate in the present (Mironescu, 1980: 170).

The sacred ruins: Mateiu's poetic meditation on the transience of glory and the divine melancholy of old courts

Mateiu I. Caragiale's work, especially *Craii de Curtea-Veche* (*The Rakes of the Old Court*), reveals a profound poetic meditation on the transience of glory and the divine melancholy that pervades the remnants of a once-great aristocratic world. His writing reflects a deep understanding of the impermanence of power and human achievement, but within this acknowledgment of decay, Mateiu discovers a form of spiritual beauty. The old courts he portrays are sacred ruins, remnants of a bygone era where nobility and decadence intertwined in a divine drama of human history. These courts, though physically decayed, maintain an ethereal presence in Mateiu's prose, serving as symbols of a lost order that continues to resonate in the collective memory of the Romanian nation (Cioculescu, 1998: 135).

The portrayal of the old courts in *Craii de Curtea-Veche* is not simply an exercise in nostalgia but a sophisticated reflection on the cyclical nature of history and the eternal tension between human ambition and divine will. Mateiu's characters, who frequent these sacred ruins, are constantly reminded of their own fleeting existence in the shadow of something grander and more enduring. They embody a melancholic awareness of their temporal insignificance, yet they are irresistibly drawn to the decayed grandeur around them. The poetic evocation of these ruins suggests a metaphysical dimension to Mateiu's critique of modernity, where the fall of the aristocratic world is not just a political event but a spiritual loss. The "rakes" of the old court exist in a liminal space, balancing between the sacred and the profane, embodying both the decayed nobility of the past and the spiritual yearning for a return to divine order (Streinu, 1968: 155).

Mateiu's poetic reflection on the old courts carries with it a deep theological subtext, where the melancholy of decayed glory is imbued with a sense of divine purpose. His writing suggests that the fall of great empires and noble lineages is part of a larger cosmic order, where human pride inevitably gives way to divine justice. In *Craii de Curtea-Veche*, the ruins of the old court are not merely physical remnants of the past; they are spiritual signifiers of the inevitable decline of all worldly power. Mateiu's characters, who seem to drift aimlessly through these sacred spaces, are engaged in an existential search for meaning within this decayed framework. The divine melancholy that pervades the old courts is thus not just a reflection of the past but a commentary on the nature of human existence itself, where all glory is ultimately fleeting in the face of divine eternity (Cioculescu, 1998: 142).

In *Sub pecetea tainei* (*Under the Seal of Mystery*), Mateiu delves deeper into the mystical significance of historical ruins, suggesting that the old courts are not merely physical places but metaphysical spaces where time and eternity intersect. His characters' obsession with the past and their pursuit of lost genealogies reflect a broader spiritual quest for redemption through the recovery of historical memory. For Mateiu, the ruins of the old courts serve as both reminders of human frailty and as symbols of divine permanence. The sacred ruins represent a point of contact between the temporal and the eternal, where the decay of human institutions paradoxically reveals the enduring presence of the divine (Zamfir, 1999: 160).

The theme of transience, which pervades Mateiu's work, is not only a reflection on the impermanence of human achievement but also a meditation on the deeper spiritual truths that lie beneath the surface of history. The ruins of the old courts, which seem to embody both decadence and divinity, are symbolic of the complex relationship between human glory and divine will. In *Craii de Curtea-Veche*, Mateiu's characters grapple with the tension between their desire for worldly power and their awareness of its ultimate futility. This tension is most vividly expressed in the contrast between the decayed aristocracy and the lingering sense of spiritual grandeur that pervades the old courts. The poetic melancholy that Mateiu evokes in these spaces is thus not merely a reflection of historical decline but a deeper theological inquiry into the nature of human existence, where the transience of power serves as a reminder of the divine order that underpins all of history (Cioculescu, 1998: 148).

Mateiu's meditation on the sacred ruins of Romanian history reveals a profound awareness of the limitations of human ambition and the ultimate sovereignty of the divine. His characters, who wander through the ruins of the old courts, are haunted by the specter of their own mortality and the inevitability of their eventual fall from grace. Yet within this melancholic reflection, Mateiu discovers a form of spiritual beauty, where the decay of human institutions becomes a testament to the enduring presence of the divine. In *Craii de Curtea-Veche*, the sacred ruins are not merely symbols of a lost past but active participants in the spiritual drama of history, where the transience of human glory serves as a reminder of the eternal nature of divine justice (Raicu, 1978: 164).

The divine melancholy that pervades Mateiu's work is thus not simply a reflection of personal or historical nostalgia but a broader philosophical inquiry into the nature of time, power, and the divine. His poetic meditation on the old courts reveals a deep theological engagement with the concept of transience, where the decay of noble lineages and the fall of empires are viewed not as tragedies but as part of a larger cosmic order. For Mateiu, the ruins of Romanian history are sacred because they reveal the limits of human ambition and the inevitability of divine justice. The characters in *Craii de Curtea-Veche* and *Sub pecetea tainei* are thus not merely witnesses to historical decline but participants in a metaphysical journey, where the sacred ruins of the past serve as guides to understanding the divine truths that govern the world (Cioculescu, 1998: 152).

Through his exploration of the sacred ruins of Romanian history, Mateiu I. Caragiale offers a poetic and theological reflection on the nature of human existence. His works suggest that the fall of great aristocracies and the decay of noble courts are not merely political events but spiritual phenomena, where the transience of human power reveals the eternal nature of divine justice. The sacred ruins of the old courts thus serve as metaphysical symbols of the larger cosmic order, where the decay of worldly glory is a testament to the enduring presence of the divine. Mateiu's poetic meditation on these ruins offers a vision of Romanian history as a spiritual landscape, where the past is not merely remembered but revered as a sacred text to be interpreted and understood in light of divine providence (Lovinescu, 1971: 170).

Historical allegory and spiritual legacy: Mateiu's literary homage to Romania's sacred past

Mateiu I. Caragiale's works, particularly *Craii de Curtea-Veche* (*The Rakes of the Old Court*), stand as rich allegories that intertwine Romania's historical consciousness with its spiritual legacy. Through his complex narrative, Mateiu delves deep into the ruins of Romania's aristocratic past, turning decayed palaces and forgotten genealogies into symbols of a broader, almost sacred, historical decline. This blending of history and spirituality allows him to elevate his portrayal of the past to a level where historical allegory and spiritual reflection merge into one cohesive literary homage. His characters navigate the remnants of Romanian history, not merely as passive observers of decay, but as seekers of a lost spiritual grandeur that transcends their present limitations (Mincu, 1990: 175).

Mateiu's obsession with lineage and nobility is palpable throughout *Craii de Curtea-Veche*, where the crumbling old court becomes a metaphor for the spiritual decay that has afflicted not only the aristocracy but also the nation as a whole. The sacred past that Mateiu seeks to honor is not merely an idealized version of Romania's golden age but a spiritual state of being, in which the country's nobility once stood as moral exemplars. The noble bloodlines that his characters so desperately cling to are infused with an aura of sanctity, turning the pursuit of genealogical legitimacy into a quasi-religious quest. The decayed courts they inhabit are not just relics of a bygone era; they are spiritual markers of a world where human dignity was measured by one's alignment with divine principles (Marino, 1985: 160).

In *Sub pecetea tainei* (*Under the Seal of Mystery*), Mateiu continues to develop this spiritual allegory, embedding within his narrative a reverence for the sacredness of Romania's historical legacy. He presents a mystical vision of history, one that elevates the national past to a realm of spiritual significance. The sacred past is depicted as a source of divine inspiration, and its degradation mirrors the moral and spiritual decay of the present. Mateiu's characters, who often exhibit a melancholic attachment to the past, become metaphors for a broader cultural and national malaise. They are unable to move beyond their reverence for the old courts and noble titles, demonstrating how the past still holds an undeniable grip over the national consciousness (Călinescu, 1985: 180).

However, Mateiu's engagement with the past is far from simple nostalgia. His work is laced with a deep ambivalence, wherein the sacred past is simultaneously revered and critiqued. In *Craii de Curtea-Veche*, the rakes who roam the decaying palaces represent the paradox of Romania's historical legacy: they are both heirs to a grand spiritual tradition and symbols of its moral failure. The allegorical nature of Mateiu's narrative allows him to question whether the sacredness of the past can truly be reclaimed, or whether it is destined to remain a ruin, much like the decayed courts that his characters inhabit. This tension between reverence and critique elevates his work beyond mere historical fiction, transforming it into a theological inquiry into the nature of human history and divine justice (Manolescu, 2008: 165).

Mateiu's literary homage to Romania's sacred past is further enriched by his symbolic use of heraldic imagery, which imbues his characters with a sense of divine purpose linked to their noble lineage. In *Craii de Curtea-Veche*, coats of arms and family crests are not mere decorative elements; they are spiritual symbols of a deeper, ancestral connection to a divine order. The characters' obsession with maintaining their noble heritage reflects a longing for spiritual redemption, as though the recovery of lost titles and honors could restore not only their personal dignity but also the nation's spiritual standing. This focus on heraldic mysticism allows Mateiu to frame the decline of Romania's nobility as a loss of divine favor, turning his historical

narrative into a spiritual allegory of national redemption and fall (Vianu, 1982: 185).

At the heart of Mateiu's historical allegory lies a profound theological reflection on the nature of time and the role of the past in shaping spiritual identity. His works suggest that Romania's history is not merely a sequence of political events but a sacred narrative that holds the key to understanding the nation's spiritual destiny. The ruins of the old courts, with their crumbling facades and fading grandeur, are symbolic of a deeper spiritual reality: the inevitable decay of all human institutions in the face of divine judgment. Mateiu's characters, who wander through these ruins in search of meaning, are thus engaged in a spiritual quest that transcends their personal concerns. They are emblematic of a broader national journey toward understanding the divine will behind Romania's historical trajectory (Cioculescu, 1998: 170).

This interplay between historical allegory and spiritual legacy is also evident in Mateiu's depiction of the courts themselves, which serve as both literal settings and metaphorical landscapes. The courts are depicted not only as places where history was made but as sacred spaces where the divine and the temporal intersect. In this way, Mateiu's characters are constantly confronted with the spiritual implications of their actions, as the decayed courts remind them of the transient nature of human power and the eternal nature of divine justice. The spiritual legacy of Romania's noble past, as portrayed in *Craii de Curtea-Veche* and *Sub pecetea tainei*, is thus both a source of inspiration and a warning, urging the nation to reflect on the deeper spiritual truths that lie beneath its historical surface (Breazu, 1985: 175).

Through this complex interplay of historical allegory and spiritual reflection, Mateiu I. Caragiale crafts a literary homage to Romania's sacred past that transcends mere historical narrative. His works suggest that the true significance of the past lies not in its political achievements but in its spiritual legacy, which continues to shape the nation's identity long after the old courts have crumbled into dust. By framing Romania's history as a sacred narrative, Mateiu invites readers to reflect on the deeper theological questions that underpin the nation's trajectory, urging them to consider how the divine and the temporal are intertwined in the unfolding of human history (Tohăneanu, 2006: 180).

Conclusion

The writings of I. L. Caragiale and Mateiu I. Caragiale provide a rich tapestry of reflections on the relationship between Romania's spiritual identity and its historical evolution. While I. L. Caragiale's satire offers a piercing critique of the moral failures of Romania's political systems, it is also imbued with a deep sense of Christian moral inquiry. His works highlight the ethical challenges of navigating a corrupt and often morally bankrupt political landscape. Through the use of humor and irony, I. L. Caragiale exposes the deep flaws of Romanian society, illustrating how spiritual values are frequently undermined by human ambition.

On the other hand, Mateiu I. Caragiale's literary vision is more nostalgic, filled with a profound sense of loss for the spiritual and national glory that once defined Romania's aristocratic past. His works, particularly *Craii de Curtea-Veche* (*The Rakes of the Old Court*), transform decayed palaces and forgotten lineages into allegories of Romania's spiritual decline. Mateiu's portrayal of historical ruins and noble bloodlines reflects a broader meditation on the relationship between time, history, and spiritual identity. In his view, the sacredness of Romania's past cannot be reclaimed, and its ruins stand as reminders of the inevitable decay of all human institutions in the face of divine judgment.

Together, these two authors offer a profound exploration of the moral and spiritual dimensions of Romanian national identity. Their works challenge readers to reflect on the deeper implications of Romania's political, historical, and spiritual evolution, offering a literary discourse that transcends the boundaries of genre and era. By blending theological inquiry with literary criticism, this paper demonstrates how the Caragiale family's writings continue to resonate in the ongoing quest to define the Romanian soul. Through their exploration of the sacred and the secular, the past and the present, I. L. Caragiale and Mateiu I. Caragiale provide a unique window into the spiritual dilemmas that have shaped the course of Romanian history.

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PHYSICS

МАГНИТОСОПРОТИВЛЕНИЕ СПЛАВОВ СИСТЕМЫ $Gd_xSn_{1-x}Se$

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MAGNETORESISTANCE OF GdxSn1-xSe SYSTEM ALLOYS

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DOI: 10.5281/zenodo.13926559

Аннотация

Исследованы в зависимости магнитного сопротивления твердых растворов $Gd_xSn_{1-x}Se$ от содержания гадолиния, температуры и напряженности магнитного поля. Установлено, что с увеличением в составе количества элемента Gd абсолютное значение магнитного сопротивления увеличиватся, точка инверсии в твердых растворах SnSe с элементом Gd смещатся в область более высокой температуры. Изменение знака магнитного сопротивления обусловлено изменением механизма рассеяния за счет участия в процессе переноса заряда носителей заряда второго рода.

Abstract

The dependence of magnetic resistance of GdxSn1-xSe solid solutions on gadolinium content, temperature and magnetic field strength is investigated. It is established that with an increase in the amount of Gd element in the composition, the absolute value of magnetic resistance increases, the inversion point in SnSe solid solutions with Gd element shifts to the region of higher temperature. The change in the sign of magnetic resistance is due to a change in the scattering mechanism due to the participation of second-order charge carriers in the charge transfer process.

Ключевые слова: твердые растворы, носители заряда, гальваномагнитные свойства, магнитосопротивление, механизмы рассеяния.

Keywords: solid solutions, charge carriers, galvanomagnetic properties, magnetoresistance, scattering mechanisms.

1. Введение

Интерес к полупроводниковым соединением типа A^4B^6 обусловлен перспективностью использования их в полупроводниковом приборостроении. Так, например, SnS и SnSe используется в качестве базового материала для создания активных элементов, которые работают в инфракрасной области оптического спектра, в термодинамических преобразователях [1-2], поглощающего слоя в тонкопленочных преобразователях солнечной энергии [3–4], а также в качестве фотопроводников [5], полупроводниковых датчиков [6], микро-батарей [7]. Фундаментальные характеристики этих соединений - малая ширина запрещенной зоны, большая диэлектрическая проницаемость, относительно высокая радиационная стойкость, преобладание ионной связи еще более расширяют возможности их применения [8]. В последние годы большие усилия направлены на создание фотовольтаических приборов из экономически выгодных малотоксичных материалов низкой стоимости с простой технологией получения. В этом отношении весьма перспективными оказались полупроводниковые соединения SnSe благодаря низкой стоимости материала, которая обусловлена широким распространением олова и селена в природе.

Моноселенид олова имеет сложную ионно-ковалентную химическую связь и кристаллизуется в структуре типа NaCl . Одна из главных особенностей SnSe – наличие в нем в определенной степени дефектов [9]. Установлено, что наличие вакансий в обеих подрешетках и их взаимодействие вызвано антиструктурными $\sim 10^{17}$ см$^{-3}$дефектами. Высокая концентрация этих дефектов в SnSe приводит к образованию р-типа проводимости. Селенид олова является базовым материалом для создания активных элементов, которые работают в инфракрасной области оптического спектра, а также в термодинамических преобразователях [10, 11].

Легирование их примесями, создающими квазилокальные уровни, расширяет возможности их практического применения. Внесение элементов из редкоземельных металлов (РЗМ) в моноселенид олова вызывает возникновение ряда физических свойств, связанных с природой дефекта и взаимодействием дефектов. Поведение примесей РЗЭ в полупроводниках характеризуется некоторыми отличительными особенностями, например, сочетанием малой растворимости и способности РЗЭ производить ”очистку“ материала, при которой возможно значительное снижение концентрации фоновых примесей и дефектов [12].

Соответствующие исследования представляют особое значение в фундаментальной физике, а так же с точки зрения их применения. Вещества, полученные с участием редкоземельных металлов (РЗМ) широко используются при изготовлении некоторых преобразователей электрической энергии, различного рода терморезисторов, стойких к радиации, давлению и влажности. При неполном заполнении электронной структуры РЗМ уровня *4f,* происходит легкий переход к *4f-5d-6s*, и создание переменной валентности за счет подвижных электронов атомов уровня *4f* делает материалы, полученные с их участием интересным объектом исследования. С этой точки зрения, возможность получения новых перспективных материалов с требуемыми физическими свойствами на основе сплавов и соединений с участием РЗМ, делает их исследование особенно важным [13, 14]. Поэтому изучение взаимодействия между халькогенидами *SnSe* и *GdSe*, а также комплексное исследование галваномагнитые свойств образуемых твердых растворах представляет научный и практический интерес.

2. Методика эксперимента

Для синтеза сплавов системы *SnSe-GdSe* использовались начальные компоненты олова макри ”В4-000”, селен марки “ОС417-4” и химически чистый прозедиум (99,98 %). Синтез проводили в откаченных кварцевых ампулах, при давлении 0,1333 Па, методом непосредственного расплава компонентов в два этапа. На первоначальном этапе ампула вместе с веществом было нагрето до температуры плавления селена со скоростью 4-5 град/минута и выдерживалась при этой температуре 3-4 часа, затем температуру постепенно повышали в зависимости от состава до 950-1000 ^{0}C, и выдерживали 8-9 часов. Синтезированные образцы для комплексного физико-химического анализа и электрофизических исследований подвергали отжигу в течение 140- 210 часов в зависимости от состава: время отжига увеличивали с увеличением содержания *гадолиния*. Гомогенизирующий отжиг полученных однофазных образцов проводили в среде спектрально чистого аргона.

Взаимодействие в системе *SnSe-GdSe* изучали методами дифференциального-термического (ДТА), рентгенофазового (РФА), микроструктурного (МСА) анализов , а также измерением микротвердости, определением плотности. Для определения тепловых эффектов полученных образцов и фазовых переходов ДТА проведено на приборе Perkin Elmer Sinintltaneons Thermal Analgiyzer, STA 6000 (США).В качестве рабочего газа использовался азот со скоростью подачи 20 мл/сек, образец нагревается до плавления со скоростью нагрева 5 ^{0}C/мин.

Рентгеноструктурный анализ проводился на рентгеновском дифрактометремарки Miniflexфирмы RigakuCorporation", при режиме 30 кВ, 10 мА, излучении CuK_α (λ=1,5406 Å). Дифракционные отражения наблюдались при угле смещения 2θ в интервале 0–80°. Для исследования морфологии и микросостава поверхности образца использовался сканерный электронный микроскоп японского производства марки JEOL JSM6610-LV.

Были исследованы в широком температурном интервале гальваномагнитные свойства образцов разного состава полученные в области твердых растворов квазибинарного соединения $(SnSe)_{1-x}$ - $(GdSe)_x$, и провели анализ общей закономерности. Было измерено в температурном интервале 300÷650K удельная электропроводность (σ), коэффициент Холла (R) и относительное магнитное сопротивление ($\Delta\rho/\rho$) в постоянном магнитном поле в режиме постоянного тока [15]. Погрешность эксперимента не привышало 4,2%.

3. Результаты и их обсуждения

На кривых нагрева и охлаждения в термограммах полученных системы сплавов $Gd_xSn_{1-x}Se$ наблюдается острые пики, соответствующие плавлению и затвердеванию. Это позволяет утверждать, что в процессе синтеза образуются конгруэнтно плавящиеся сплавы. В бинарном соединении *SnSe* частичная замена атомов *Sn* на атомы *Gd* способствует снижению температуры плавления, что повидемому РЗМ в этих кристаллах выступают в роли смягчителей.

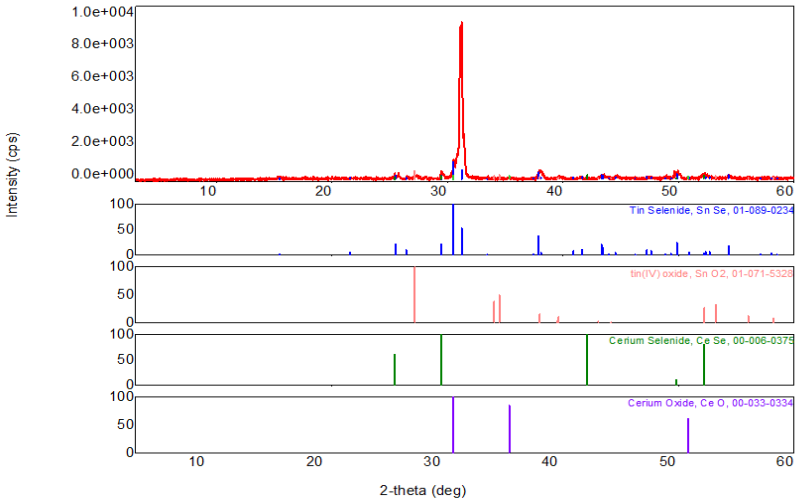

Рис1. Рентгенодифракционный спектр кристаллов GdxSn1-xSe 2- x=0,005

Анализ интенсивностей рентгеновских отражений показывает наличие в кристалле преобладающего направления, а также, что исследуемый образец состоит из одной фазы. Индексирование рентгенограмм показывает, что в области растворимости*Ce* на основе *SnSe* исследуемые сплавы кристаллизируются в орторомбической сингонии спространственной группой D_{2h}^{16}-P_{cmn} (Рис. 1). В рентгенограммах в интервале $0 \leq x \leq 0.02$ не наблюдаются сдвиги дифракционных линий, и только изменение их интенсивности в указанном интервале свидетельствует о том, что произошло образование твердых растворов на основе *SnSe*. В бинарном соединении *SnSe* в области растворения по причине замены атомов *Sn* частично атомами редкоземельных металлов большего радиуса уменьшается интенсивность рефлексов, и аддитивно увеличиваются параметры орторомбической элементарной ячейки решетки. В этой области рост решеточных параметров носит линейный характер и не наблюдается отклонение от закона Вегарда.

Из анализа рентгеноструктурных данных следует, что при введении селенида *гадолиния* наблюдается увеличение параметров элементарной ячейки *SnSe* по мере возрастания концентрации *Gd*, а также интенсивное рассеяние носителей «искажениями» решетки совпадающее с исследованиями теплопроводности сплавов [16]. С увеличением содержания *Gd* в сплаве плотность $Gd_xSn_{1-x}Se$ существенно не изменяется. Это подтверждает то, что введенные нами атомы *Gd* в сплав $Gd_xSn_{1-x}Se$ в первую очередь занимают междоузельное вакантное место в кристалле, т.е. дефектообразование происходит по Френкелю [17].

Наблюдаемый рост решеточных параметров, хорошее согласование частичного замещения атомов *Sn* атомами *Gd* большего радиуса и соблюдение закона Вегарда позволяет говорить об образовании твердых растворов замещения на основе *SnSe*. Исследование зависимости микростуктуры, микротвердости и плотности состава, также выявленного рентгенографическим и пикнометрическим методами, показывает, что область растворения *GdSe* в *SnSe* при комнатной температуре ограничивается 2 моль %.

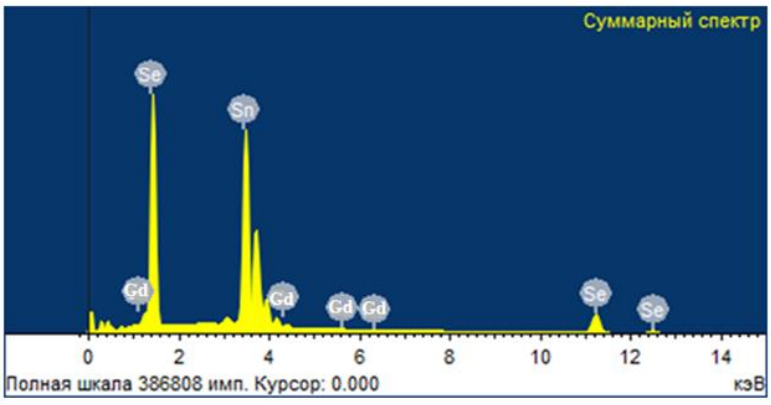

Рис2. Рентгеновский микроанализ поверхности кристаллов: GdxSn1-xSe 2- x=0,005

Результаты проведенных комплексных физико-химических анализов показывают, что система сплавов $Gd_xSn_{1-x}Se$, как и основное вещество *SnSe* кристаллизируется в орторомбической сингонии. С увеличением процентного содержания *GdSe*

в составе наблюдается слабый рост параметр*ов* элементарной ячейки кристаллической решетки**,**плотности и микротвердости, а теплоэффекты смещаются в область относительно более низких температур.

Количественным рентгеновским микроанализом определен состав фазы и распределение химических элементов на поверхности исследуемого образца (Рис 2). Анализ полученных результатов показывает однородности поверхности, но со изменением стехиометрии в пределах области гомогенности *SnSe* стороны избытка селена.

С увеличением в малых концентрациях количества *Gd* в системе сплавов $Gd_xSn_{1-x}Se$ уменьшается удельная электропроводность, а при $x>0.01$ наблюдается рост электропроводности. При концентрациях *Gd* $0\leq x\leq 0.01$ заполнение вакансий олова и изменение халькогенных антиструктурных дефектов приводит к уменьшению значений концентрации носителей заряда и удельной электропроводности. Можно сказать, что при последующем росте количества *GdSe* не происходит создания антиструктурных дефектов. Очень вероятно, что частичный рост удельной электропроводности, связан с появлением второго рода носителей заряда в результате воздействия донорных атомов *Gd*.

На рисунке 3 дана температурная зависимость магнитосопротивления системы расплава $Gd_xSn_{1-x}Se$ ($x=0;\ 0.005,\ 0.01$). Как видно из графика во всех исследуемых образцах наблюдается магнитное сопротивление и при температуре T=300K $\frac{\Delta\rho}{\rho}$ имеет максимальное значение. С увеличением температуры, за счет возникновения носителей заряда второго рода, то есть не основных носителей заряда, и их изменения в магнитном поле, служит причиной различного увеличения магнитного сопротивления.

Магнитное сопротивление в бинарном соединении SnSe при комнатной температуре составляет 3 %. С увеличением температуры абсолютное значение магнитного сопротивления уменьшается и после 420 K совешив инверсию меняет знак с положительного на отрицательный (Рисунок 3, кривая 1). С увеличением в составе количества элемента *Gd* абсолютное значение магнитного сопротивления $(\frac{\Delta\rho}{\rho})$ увеличиватся, однако их температурная зависимость изменяется схоже с бинарным соединением.

Точка инверсии в твердых растворах *SnSe* с элементом *Gd* смещатся в область более высокой температуры: для образцов состава x=0.005 точка инверсии происходит при температуре T=460K; а для образцов состава x=0.01 при температуре T=470K. В результате, за счет активизации носителей заряда второго рода, создаваемое ими магнитное сопротивление имеет большое значение.

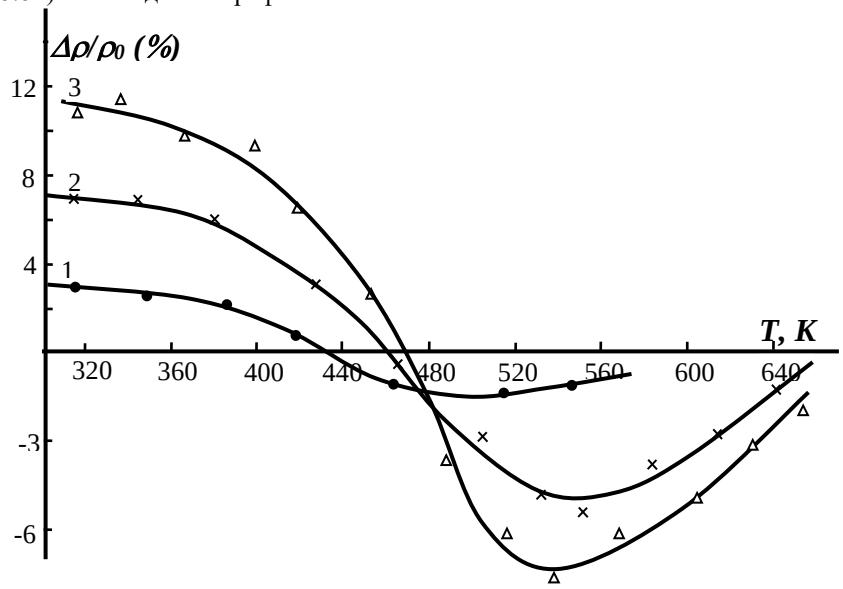

Рис.3. Температурная зависимость изменения отно-сительного магнитосопротивления твердого раство-ра системы GdxSn1-xSe.

При дальнейшем увеличении температуры знак $(\frac{\Delta\rho}{\rho})$ отрицательный и в интервале температур T=530-560K, пройдя через максимум, уменьшается.

Изменение знака магнитного сопротивления в данном температурном интервале, так же показывает изменение механизма рассеивания носителей заряда. Большое абсолютное значение $(\frac{\Delta\rho}{\rho})$ показывает наличие в составе носителей заряда второго рода [18].

Таким образом, было определено, что в изменении механизма рассеивания носителей заряда так же участвуют носители второго рода данного состава. Была исследована зависимость магнитного сопротивления от напряженности магнитного поля (H) около данной точки инверсии при температуре T=420K (Рис. 4).

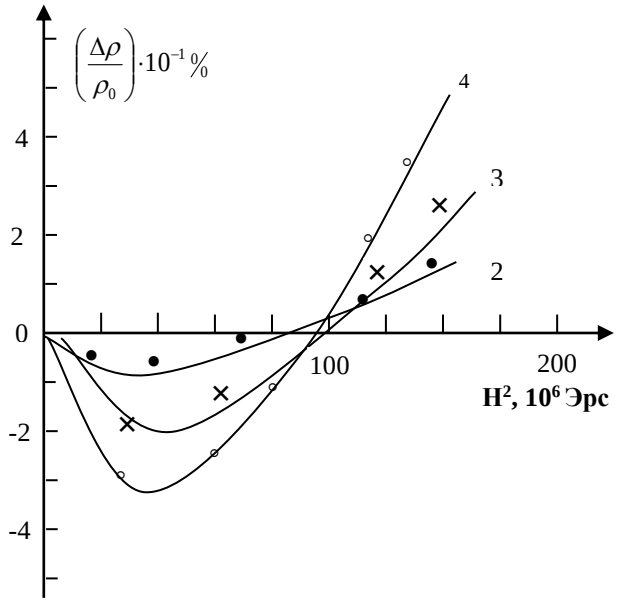

Рис.4. Зависимость магнитного сопротивления сплава (SnSe)1-x(GdSe)x от напряженности магнитного поля (T=420 K): 2- x=0.005; 3- x=0.01; 4- x=0.02.

Дана зависимость магнитосопротивления от напряженности магнитного поля в координатах $(\frac{\Delta\rho}{\rho}) = f(H)^2$. Из рисунка видно, что магнитное сопротивление $(\frac{\Delta\rho}{\rho})$ от напряженности магнитного поля изменяется не линейно. Это объясняется затратой дополнительной энергии на направление спинового упорядечевания «легких» и «тяжелых» электронов.

Исследование зависимости магнитного сопротивления от напряженности магнитного поля показывает, что при малых значениях напряженности магнитного поля в направлении поля Н затрачивается энергия на направление спинового упорядечевания как свободных, так и локализованных микроцентров. За счет увеличением напряженности магнитного поля и спина увеличивается количество общенных электронов, и затем при определенном значении Н магнитное сопротивление увеличивается линейно [19].

При относительно большом значении поля, с увеличением Н увеличение количества общенных электронов по спину наблюдается линейная зависимость $(\frac{\Delta\rho}{\rho}) = f(H)^2$. Здесь есть вероятность перехода частично локализованных микроферромагнитных центров в парамагнитные.

Из анализа литературного материала было определено, что если в данных образцах наблюдается магнитное сопротивление и их изменение, то такие вещества обладают сложной строением энергетической зоной. Вообщем, наблюдение в произвольном составе магнитного сопротивления и его большого значения показывает, как сложное строение энергетической зоны вещества, так и наличие носителей заряда второго рода. За счет активизации носителей заряда второго рода наблюдается возникновение большого значения магнитного сопротивления в образцах.

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STATE AND LAW

THE EVOLUTION OF THE CONCEPT OF PUBLIC SAFETY: FROM PHYSICAL PROTECTION TO GLOBAL SECURITY

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Abstract

Public safety is essential for the stability and well-being of any society, involving the protection of citizens from threats to social order and physical integrity. Over time, the concept of public safety has evolved from physical defense against criminals to a broader vision, encompassing economic, social, health, and political aspects. Institutions responsible for public safety, such as the police, gendarmerie, judiciary, and emergency services, play a crucial role in maintaining order and protecting citizens. Moreover, public safety addresses various issues, from physical and economic safety to cybersecurity and social security. Modern challenges such as terrorism, cybercrime, and climate change complicate the maintenance of safety. Active citizen involvement, through civic education and cooperation with authorities, is essential for the long-term success of public safety efforts.

Keywords: Public safety, Citizen protection, Social order, National security, Modern crises, Crime prevention.

1. The Concept of Public Safety

Public safety is a fundamental element in any society, directly linked to collective stability and well-being. This concept involves the protection of citizens from threats that affect social order and physical integrity, as well as maintaining a safe and peaceful environment in which individuals can develop harmoniously. The following sections will explore the significance of public safety, its historical evolution, the role of institutions in its maintenance, and current challenges in ensuring security in an increasingly complex world.

In Romania, public safety is regulated by a solid legislative framework consisting of laws, regulations, and national strategies aimed at protecting citizens and communities from threats to social order, individual security, and territorial integrity. The concept of public safety extends beyond crime prevention, including a comprehensive set of measures to ensure social, economic, and political stability.

In Romanian law, public safety is regulated by a series of fundamental laws and normative acts that clearly define the roles and responsibilities of state institutions. These include:

- The Constitution of Romania: The Constitution guarantees citizens the right to security and protection, establishing the legal basis for state intervention in maintaining public order and protecting fundamental rights. Article 22 ensures the right to life and physical and mental integrity, while Article 23 enshrines the inviolability of individual liberty.
- Law No. 218/2002 on the Organization and Functioning of the Romanian Police: This law governs the role of the Romanian Police in maintaining public safety and social order. The police are tasked with preventing and combating crime, responding to emergencies, and protecting citizens from various threats. The law also details the duties of local police, emphasizing collaboration with the community.
- Law No. 550/2004 on the Organization and Functioning of the Romanian Gendarmerie: The Gendarmerie plays a crucial role in maintaining public order, intervening in cases of social unrest, violent protests, and other threats that require a militarized force. The law establishes the structure and operation of the Gendarmerie, including in rural areas and high-risk zones.
- Law No. 51/1991 on National Security: This law regulates measures for protecting national security, including preventing and combating threats to the state. Public safety and national security are closely linked, as any threat to the state can directly affect the population.
- The Criminal Code: The Criminal Code establishes penalties for offenses that endanger public safety, including acts of terrorism, drug trafficking, and organized crime, contributing to the maintenance of social order and security.
- Emergency Ordinance No. 195/2002 on Road Traffic: This ordinance regulates road safety, an important aspect of public safety. It provides measures for ensuring traffic order, preventing accidents, and sanctioning violations of traffic rules.
- Law No. 272/2004 on the Protection and Promotion of Children's Rights: Public safety also includes the protection of vulnerable groups, such as children. This law provides special measures for protecting children in situations of risk, such as abuse or exploitation, contributing to the creation of a safe environment for them.

In conclusion, public safety represents an essential pillar in Romanian legislation, aiming to protect citizens from crimes, health risks, environmental hazards, and other threats. The Romanian legal and institutional system adopts an integrated approach to maintaining public order and stability in the face of modern challenges.

2. The Evolution of the Public Safety Concept

In the past, the concept of public safety was much narrower, focusing primarily on physical protection against immediate threats such as thieves, criminals, or external attacks. Especially in earlier historical periods, public safety was associated with the defense of cities and regions against armed bands or with maintaining order through local police structures or military units. As societies urbanized and modernized in the 19th century, this concept expanded to include not only crime prevention and control but also improving the quality of life through regulations and social policies.

As societies evolved, public safety became a more complex concept, integrating economic, social, health, and political dimensions. For example, in the 19th and 20th centuries, the rise of urban crime such as robberies, fraud, and labor revolts led to the need for more robust structures to maintain public order and security.

The concept of public safety is fundamental to maintaining order, stability, and prosperity within a society. The application of this concept is indispensable for several key reasons:

1. Protecting Life and Property

One of the main objectives of public safety is to protect citizens and their property. Without an organized framework for public safety, individuals would constantly be exposed to risks of violence, crime, or accidents, which would destabilize communities and severely impact the normal functioning of society.

2. Maintaining Order and Social Peace

Public safety plays a crucial role in ensuring respect for laws and preventing social unrest. Maintaining order guarantees a stable environment where citizens can carry out their daily activities without fear of conflict, crime, or disorder.

3. Crisis Prevention and Management

Modern threats such as terrorism, natural disasters, epidemics, or cybercrime require a solid public safety structure to anticipate and efficiently manage such crises. Prevention and rapid response are essential to minimize the impact of these threats on the population and infrastructure.

4. Strengthening Trust in Institutions

A well-organized and efficient public safety system increases citizens' trust in state institutions. People need to have the assurance that the government and authorities are capable of providing protection, and this sense of safety contributes to social cohesion and political stability.

5. Stimulating Economic Development

In the absence of public safety, investments and economic development would be severely affected. In an insecure environment, companies hesitate to invest, leading to economic stagnation. A safe community attracts investments, promotes economic development, and contributes to overall prosperity.

6. Promoting Social Progress and Community Cohesion

Public safety is not limited to physical protection but also includes social aspects. Reducing inequalities and promoting a fair environment are key elements in ensuring social cohesion. Creating a safe environment supports a united and progressive community, where individuals collaborate for the common good.

3. Why the Public Safety Concept is Less Utilized

The concept of public safety continues to be used and remains highly relevant in contemporary society, but it may sometimes seem less explicitly mentioned because it has become deeply integrated into the functioning of institutions and daily life. However, there are several reasons why the term may seem less visible in certain contexts:

Over time, the concept of public safety has expanded to include multiple dimensions, such as cybersecurity, public health, environmental protection, and economic security. These areas have become independent topics of discussion but are an integral part of public safety. In a modern world, these branches have gained their own identity, and the general term "public safety" may seem less used because the sectors contributing to it have diversified.

The concept of public safety has often been replaced in common usage by specific terms that more precisely define the various aspects of security. For example:

- Cybersecurity refers to protection against digital threats.
- National security includes protection against terrorist threats and external attacks.
- Public health refers to the prevention and management of diseases, a crucial dimension of public safety.
- Road safety refers to measures that ensure the reduction of traffic accidents.

Using specific terms makes discussions more precise, context-appropriate, and easier for the general public to understand.

The concept of security in general has evolved, and "public safety" can be perceived as part of a broader security concept. Institutions and authorities now use terms such as national security, collective security, or global security, which integrate the idea of public safety but at a broader level to reflect the complex and interdependent threats of the contemporary world.

In recent years, the focus has shifted from reactive public safety (maintaining order after a crisis) to a proactive approach, focused on prevention and resilience. Government authorities and international institutions emphasize the need to prevent threats before they materialize and to prepare society to respond effectively to crises, whether they are cyber, health-related, or natural disasters.

With globalization, public safety threats have become more complex and more challenging to manage at strictly national or local levels. Issues such as climate change, migration, international terrorism, and cyberattacks require international cooperation and a multilateral approach. In this context, public safety is integrated into a broader global security framework and is not always discussed in isolated terms.

In many countries, public safety concepts and measures have become an integral part of the daily activities of governments and local authorities. Thus, even though the term is not constantly mentioned, it is

embedded in the current activities of institutions that ensure the order, health, and well-being of communities.

In many countries, the concepts and measures related to public safety have become an integral part of the daily activities of governments and local authorities. Thus, even though the term may not be constantly mentioned, it is embedded in the current work of institutions that ensure the order, health, and well-being of communities.

Although the term "public safety" may seem to be used less frequently in certain contexts, the concept remains equally important. In reality, public safety is omnipresent and is integrated into various sectors and policies that protect individuals and societies from modern and complex threats. Adapting the language to specific fields and challenges makes public safety better understood and applied in practice.

The concept of public safety is essential for maintaining order, stability, and well-being in a society. Its application is necessary for several fundamental reasons:

1. Protecting Life and Property

The primary goal of public safety is to protect citizens and their belongings. Without an organized framework for public safety, individuals would face constant risks of violence, crime, or accidents, which would destabilize communities and significantly impact the normal functioning of society.

2. Maintaining Order and Social Peace

Public safety ensures the enforcement of laws and prevents social unrest. By maintaining order, a stable environment is created where citizens can go about their daily activities without fear of conflicts, crimes, or disorder.

3. Crisis Prevention and Management

Modern threats like terrorism, natural disasters, epidemics, or cybercrime require a strong public safety structure to anticipate and efficiently manage such crises. Prevention and rapid response are crucial to minimizing the impact of these threats on the population and infrastructure.

4. Building Trust in Institutions

A well-organized and efficient public safety system increases citizens' trust in state institutions. People need to know that the government and authorities can protect them, and this sense of safety contributes to social cohesion and political stability.

5. Promoting Economic Development

Without public safety, investments and economic development would be severely impacted. In an insecure environment, companies hesitate to invest, leading to economic stagnation. A safe community attracts investments, promotes economic development, and contributes to overall prosperity.

6. Fostering Social Progress and Community Cohesion

Public safety is not limited to physical protection; it also includes social security. Reducing inequalities and promoting a fair environment are key factors in ensuring social cohesion. Creating a safe environment supports a united and progressive community where individuals collaborate for the common good.

4. Institutions Responsible for Public Safety

Public safety is ensured by a network of government institutions, each with specific roles and responsibilities in maintaining order and protecting citizens. These institutions play a vital role in protecting citizens and ensuring order and stability in society.

In Romania, the main structures involved in maintaining public safety include:

1. The Romanian Police

- Role and responsibilities: The Romanian Police is the primary body responsible for maintaining public order and citizen safety. It focuses on preventing and combating crime, managing emergency situations, ensuring road safety, and protecting both public and private property.
- Specialized structures: The police are divided into several departments, such as the traffic police, judicial police, forensic services, and community policing, which work together to ensure a safe environment for communities.

2. The Romanian Gendarmerie

- Role and responsibilities: The Gendarmerie is a militarized force tasked with maintaining public order, especially in crisis situations, violent protests, or other social disturbances. It also protects strategic objectives and cooperates with other institutions to ensure security.
- Specialized interventions: The Gendarmerie intervenes in less accessible or rural areas and plays an important role in environmental protection and border security.

3. The Romanian Intelligence Service (SRI)

- Role and responsibilities: SRI focuses on preventing and combating threats to national security, such as terrorism, espionage, and organized crime. Although not directly involved in day-to-day public safety, its activities protect citizens by identifying and neutralizing major risks.
- Surveillance and collaboration: SRI conducts monitoring and analysis activities, collaborating with other agencies to prevent threats that could affect public safety.

4. Border Police:

- Role and responsibilities: It ensures security at Romania's borders by preventing and combating cross-border crimes such as smuggling, human trafficking, and illegal migration. The Border Police contributes to national security by strictly controlling the flow of people and goods.
- International cooperation: The Border Police cooperates with European and international organizations to effectively manage border security and prevent cross-border crimes.

5. The General Inspectorate for Emergency Situations (ISU):

- Role and responsibilities: ISU intervenes in case of fires, earthquakes, floods, and other natural or industrial disasters. They are also responsible for preventing such situations and saving lives and property in emergencies.
- Prevention and rescue: ISU conducts disaster prevention activities and educates the population about safety measures in such situations.

6. The Ministry of Internal Affairs (MAI):

o Role and responsibilities: MAI oversees all activities related to public safety through its subordinate institutions, such as the Police, Gendarmerie, ISU, and Border Police. It also develops national policies and strategies for public order and national security.

o Coordination: The Ministry coordinates public order institutions and ensures effective collaboration between them and other authorities.

7. The Judicial System (Prosecutor's Office and Courts of Law):

o Role and responsibilities: The judicial system enforces laws and sanctions criminals, contributing to maintaining social order and public safety. The courts play a crucial role in fighting crime through fair and transparent trials.

o Collaboration with law enforcement: Prosecutors work closely with the Police and other law enforcement agencies in investigating and prosecuting crimes.

8. The National Anti-Drug Agency (ANA):

o Role and responsibilities: ANA is responsible for preventing and combating drug trafficking and substance abuse. The agency carries out prevention and education campaigns in schools and vulnerable communities.

o Preventive activities: ANA collaborates with other institutions to limit the spread of drug use and its impact on society.

9. Local Authorities:

o Role and responsibilities: Local authorities contribute to public safety by working with Local Police and other agencies to maintain order in communities. They implement measures tailored to local needs and manage crime prevention initiatives.

o Support in communities: They conduct awareness campaigns and social programs to ensure a safe and protected environment for citizens.

10. The Directorate for Investigating Organized Crime and Terrorism (DIICOT):

o Role and responsibilities: DIICOT investigates and combats organized crime and terrorism, with extensive competence in areas such as drug trafficking, human trafficking, arms trafficking, and cyber fraud. The Directorate plays a crucial role in maintaining national public safety.

o International cooperation: DIICOT collaborates with other states and international organizations to counter transnational crime networks.

These institutions work collaboratively to maintain public safety and ensure a secure and stable environment for all citizens.

Institutions responsible for public safety in Romania have well-defined roles and collaborate to protect citizens and maintain social order. Each institution contributes through its competencies to the efficient management of modern risks and challenges, thus ensuring a safe environment for all.

5. Areas of Public Safety

Public safety is a complex and multidimensional concept that plays a central role in ensuring the stability and well-being of a society. This concept encompasses a range of interconnected areas that, together, contribute to protecting citizens and maintaining an environment of order and security. In an increasingly globalized and interdependent world, the challenges facing public safety are becoming more diverse, and effectively managing these threats is essential for the functioning of a modern society.

1. Physical Safety

Physical safety is one of the most fundamental and oldest dimensions of public safety, aimed at protecting citizens from violence, crime, and other forms of aggression. Typically, this type of safety is managed by law enforcement agencies and other institutions tasked with maintaining public order and responding quickly to any threat that could endanger individuals' physical integrity.

Over time, crime-fighting strategies have evolved from reactive responses to incidents to the implementation of prevention strategies. Authorities no longer just respond to critical situations but also adopt proactive measures, such as regularly patrolling risk-exposed areas, conducting awareness campaigns, and implementing community collaboration programs. These actions contribute to creating a safe and stable environment for all citizens.

Success in ensuring public safety largely depends on close cooperation between authorities and citizens. This cooperation facilitates both crime prevention and rapid intervention, while also strengthening trust between the public and law enforcement institutions. Active community involvement in identifying risks and threats thus becomes a key element in maintaining a climate of safety and stability.

2. Economic Safety

Economic safety is another essential area of public safety because a stable and functioning economy is crucial for maintaining order and social stability. People need access to jobs, decent wages, and opportunities for economic growth to feel secure and avoid engaging in illicit or violent activities due to a lack of alternatives.

Economic and financial institutions, together with governments, play a crucial role in protecting citizens from fraud, money laundering, tax evasion, and other economic crimes. Additionally, protection against poverty and economic insecurity through social assistance programs, education, and public health contributes to creating a safe and sustainable economic environment.

3. Health and Food Safety

An important aspect of public safety is protecting public health and ensuring the quality of food and water resources. In a globalized world where goods and people move rapidly from one region to another, public health becomes an essential area in ensuring the general safety of the population.

Epidemics, pandemics, and health crises, such as the COVID-19 pandemic, have shown how vulnerable a society can be to health threats. Protecting public health through disease prevention measures, ensuring access to healthcare services, and safeguarding food safety are essential to maintaining public safety.

4. Cybersecurity

With the development of technology and the increasing digitalization of daily life, cybersecurity has

become a major priority for governments and institutions. Cybercrime, such as hacking attacks, online fraud, identity theft, and compromising critical infrastructures, poses major threats to public safety.

Protecting critical infrastructure, such as financial, energy, and communication systems, is essential to prevent major disruptions in society's functioning. Additionally, safeguarding citizens' personal data and protecting it from cyberattacks are central elements of public safety in the digital age.

Governments, cybersecurity agencies, and private companies collaborate to develop solutions to prevent cyberattacks and to protect citizens and infrastructure from such threats. By forming rapid response teams for cyber incidents and educating the public on the importance of cybersecurity, society's overall protection can be improved.

5. Social Safety

Social safety refers to the stability and cohesion within a community. Creating a safe environment where individuals have access to resources, jobs, and social services is essential for preventing social unrest and conflicts. Economic and social inequalities can create tensions in communities, leading to revolts or increased crime.

Social programs that support education, health, housing, and social assistance contribute significantly to reducing social risks. Additionally, preventing social exclusion and promoting the integration of minorities and vulnerable groups are essential measures for ensuring social safety. Ensuring equal access to resources and opportunities for all citizens helps prevent social instability and promotes a safer and more united society.

6. Road safety

Road safety is another essential area of public safety, having a direct impact on the daily life of citizens. Traffic accidents are a major threat to people's lives and health, and prevention of these strict regulations, adequate infrastructure and road education is crucial. "In some states in the European Union, criminal legislation includes severe offenses regarding leaving the scene of an accident, with the aim of strengthening the liability of drivers and reducing the number of fatal road incidents" (Tical & Chiruta, 2019, p. 45).

Governments and local authorities are responsible for implementing measures to ensure road safety. These measures include proper road signage, the construction of modern infrastructure and campaigns to educate citizens about responsible traffic behavior. The traffic police also play a central role in monitoring and enforcing traffic laws, thus reducing the risks of accidents.

7. Environmental safety

Environmental protection is crucial for maintaining long-term public safety, given that climate change, pollution and ecosystem degradation threaten not only natural resources, but also the social and economic stability of affected regions. Extreme climate change may lead to an intensification of regional conflicts over access to natural resources, especially in already vulnerable areas.

Moreover, "lack of access to clean water and basic resources is a trigger for forced migration and international conflict" (Lavanya Rajamani, p. 87). In this context, the development of environmental protection policies and the sustainable use of resources are essential. Johnson points out, in Sustainable Resource Management (Harvard Press, 2020), that "implementing sustainable energy policies and protecting vulnerable ecosystems is the basis of long-term public safety" (p. 154).

8. Demographic safety

Demographic safety involves the proper management of population changes and their impact on public safety. Changes such as migration, population aging and rapid population growth in certain regions can cause economic and social tensions that affect overall stability. For example, "uncontrolled migration can disrupt the capacity of health and education systems in host countries, putting pressure on these infrastructures and creating social imbalance" (Smith, 2020, p. 58). Thus, these pressures can lead to social instability and conflict.

In order to maintain a social balance, it is necessary to implement effective policies that address these demographic transformations. "Managing migration requires structured integration programs that support both migration and host communities" (Johnson & Martinez, 2019, p. 45). At the same time, supporting young people in areas affected by unemployment and migration is crucial, because they can become or valuable resource for social stability if they are integrated into the community.

9. Legal security and citizens' rights

Public safety cannot exist without protection of the fundamental rights of citizens. An efficient, fair and accessible judicial system is essential for maintaining order and ensuring citizens' trust in state institutions. Legal certainty involves the application of laws in a fair and transparent manner, so that they are protected against abuses and violations of their rights.

The authorities must ensure that all citizens have access to a fair legal system that protects human rights and applies sanctions fairly in cases of crime. Also, preventing corruption and ensuring the integrity of the justice system are essential to maintaining public safety.

10. Security against terrorism and extremism

In an increasingly globalized and interconnected world, terrorism and extremism are major threats to public safety. Terrorist attacks can have a devastating impact on communities and destabilize societies. Preventing radicalization and countering extremist groups is essential to maintaining public safety.

Governments and international agencies work together to develop strategies to prevent terrorism, including by monitoring suspicious activities, preventing terrorist financing, and running programs to rehabilitate and reintegrate radicalized individuals.

Public safety is a vast and multidimensional concept that includes many interconnected fields, each essential to protecting citizens and maintaining social stability. From physical and economic security to cyber, health and environmental security, all these areas contribute to creating a safe and stable environment in

which individuals can live and thrive. In an increasingly complex and challenging world, collaboration between governments, institutions and citizens becomes essential to effectively respond to threats to public safety and to ensure the long-term well-being of society.

6. Contemporary challenges in the field of Public Safety

Today's public safety challenges are multiple and complex as the world becomes increasingly interconnected and new technologies, climate change, global migration and other emerging phenomena impact social and economic stability. In this context, the challenges are no longer just local or national, but often have a global dimension. In the following, we will present the most significant contemporary challenges in the field of public safety.

1. Cybercrime

In the digital age, cybercrime has become one of the biggest threats to public safety. “Increasing reliance on technology exposes individuals and institutions to unprecedented cyber risks, putting critical infrastructure and sensitive information at risk” (Smith, 2020, p. 14). With an increasing reliance on technology and the Internet, individuals, businesses and governments are becoming increasingly vulnerable to cyber attacks. Major challenges include:

- Ransomware attacks: Hackers encrypt data and demand rewards for unlocking it, affecting critical institutions such as hospitals, schools and government agencies. Miller Sarah explains that “ransomware is becoming increasingly sophisticated, targeting critical institutions and blocking access to vital information until a reward is paid” (Miller, 2019, p. 46).
- Identity theft and online fraud: These crimes affect millions of people globally, and protecting personal data is becoming a priority. "Online fraud and identity theft are among the most common forms of cybercrime, affecting individuals and companies alike" (Popescu, 2020, p. 72).
- Attacks on critical infrastructure: In an interconnected world, attacks on energy, financial or transportation systems can paralyze economic and social activities.

Preventing cybercrime and developing effective defense systems against attacks are major challenges for governments and organizations.

2. Terrorism and violent extremism

Terrorism remains a significant global threat to public safety. As Smith John states "direct terrorist attacks on the civilian population have been used as methods to induce fear and chaos, targeting crowded public spaces and state institutions" (Smith, 2018, p. 52). Extremist groups continue to pose a major risk, particularly through:

- Direct attacks on the population: These can take place in crowded public spaces or in state institutions, affecting both innocent citizens and structures of national importance.
- Online radicalization: The Internet and social media are often used to recruit new members to terrorist groups or to spread extremist ideologies. As Sarah Miller observes in "Digital Extremism and Online Radicalization," "online platforms are powerful tools in the hands of terrorist groups, facilitating the recruitment of young people and the rapid spread of extremist messages" (Miller, 2019, p. 34).
- Ideological struggles and domestic extremism: In many countries, violent extremism comes not only from external sources, but also from within local communities, fueling social tensions and conflicts. In this regard, Andrei Popescu notes that "internal radicalization, supported by economic and social tensions, represents a serious challenge for the internal stability of European states" (Popescu, 2020, p. 87).

Preventing and combating terrorism involves close international cooperation as well as strong domestic measures to prevent radicalization and rehabilitate individuals vulnerable to extremist ideologies.

3. Climate change and natural disasters

Climate change presents one of the greatest global challenges, with direct effects on public safety. "The frequency and intensity of natural disasters have increased significantly in recent decades, affecting billions of people and essential infrastructures" (Ionescu, 2020, p. 45). Extreme weather events such as hurricanes, wildfires, floods and severe droughts put pressure on emergency response systems and critical infrastructure.

Challenges include:

- Increasing frequency and intensity of natural disasters: "Extreme climatic phenomena, such as droughts and floods, endanger food security and water supply, which can trigger conflicts over limited resources" (Popescu Andreea, 2019, p. 78). These crises can generate international tensions and mass migrations.
- Massive population displacements: "Climate change is gradually transforming certain regions of the globe into uninhabitable areas, forcing millions of people to migrate, and this mass displacement brings significant pressure on the infrastructure and resources of the destination regions" (Dumitrescu Maria, 2021, p . 112).

Disaster management and climate change adaptation require a robust resilience plan and proactive measures to minimize long-term risks.

4. Organized crime

Organized crime continues to pose a major threat to public safety globally. "Cross-border criminal groups not only destabilize local economies, but also contribute to the spread of violence and corruption in public institutions" (Popescu, 2019, p. 34). These groups are involved in a range of illegal activities, including drug, arms and human trafficking.

Challenges include:

- Drug trafficking: "Drug cartels cause real social and economic crises, fueling a vicious circle of corruption and violence that undermines the authority of the state" (Ionescu Radu, 2020, p. 58). The destabilizing impact of these cartels is felt in many communities globally.
- Trafficking in human beings: "The exploitation of human beings is one of the cruelest and most

profitable activities of criminal groups, which take advantage of the economic and social vulnerabilities of the victims" (Dumitrescu Elena, 2018, p. 72). This form of crime seriously affects human rights and social order.

- Corruption and infiltration of state institutions: Criminal groups corrupt government institutions and legal systems, thereby undermining citizens' trust in law enforcement and state authority.

Combating organized crime requires strong international cooperation and rigorous law enforcement at the national level.

5. Public health crises

Pandemics and other public health crises pose a major challenge to public safety globally. "Pandemics like COVID-19 have highlighted the critical vulnerabilities of health systems, showing how quickly they can be overwhelmed by the massive demand for medical resources and services" (Popescu Andrei, 2021, p. 34). The COVID-19 pandemic has demonstrated how vulnerable a society can be to rapidly spreading health threats.

Challenges include:

- Limited capacity of health systems: Pandemics can quickly overload health systems, putting pressure on limited resources and medical staff.
- Management of vaccines and medical resources: "The unequal distribution of vaccines during the pandemic accentuated social and economic disparities, underscoring the need for more equitable international policies in the distribution of medical resources" (Popescu Andrei, 2021, p. 58).
- Economic and social impact: Public health crises can have devastating effects on economies and social stability, affecting jobs, education systems and international relations.

To effectively manage these crises, governments must invest in the resilience of health systems and create robust pandemic management plans.

6. Migration and humanitarian crises

Forced migration due to conflict, economic crises or climate change is a major challenge to public safety globally. "Forced migration increases the risk of social destabilization in destination regions, especially when the number of migrants exceeds the absorption capacity of host societies" (Țical George, 2020, p. 45). While migration can be a positive phenomenon, when not managed properly, it can create social, economic and political tensions.

Challenges include:

- Refugee crises: Millions of people are forced to flee their homes due to war, persecution or natural disasters, putting pressure on the resources and infrastructure of host countries.
- Social and economic integration: The integration of migrants into the host society is often a difficult process, requiring effective policies and ample resources to prevent social exclusion and cultural conflicts.
- Illegal migration and human trafficking: "Organized crime networks take advantage of the vulnerability of illegal migrants, turning them into victims of human trafficking or other forms of exploitation" (Țical George, 2020, p. 67).

Managing migration requires a global approach, with an emphasis on international cooperation, sustainable development and the protection of migrants' fundamental rights.

7. Food security and access to resources

Access to food and water is a growing problem in many regions of the world, especially in the context of climate change and armed conflict. According to the Food and Agriculture Organization of the United Nations (FAO), “climate change will continue to adversely affect agriculture and food production, endangering global food security” (FAO, 2020). Food insecurity is also exacerbated by land degradation and extreme climatic conditions.

Food safety challenges include:

- Food insecurity: Climate change, drought and agricultural land degradation affect food production and access to food for millions of people.
- Wars and conflicts over resources: In many regions, conflicts over control of natural resources such as water or oil can lead to violence and instability. "Prolonged armed conflicts, especially in areas with limited natural resources, exacerbate food insecurity and contribute to humanitarian crises" (World Food Programme, 2021).
- Water crises: Lack of access to potable water and adequate irrigation resources is a critical problem in many parts of the world, generating forced migration and international tensions.

Managing natural resources in a sustainable and just way is essential to prevent conflict and ensure long-term stability.

Today's public safety challenges are diverse and complex, affecting all aspects of modern life, from health and the economy to the environment and national security. In the face of these threats, governments and societies must take a holistic and collaborative approach to protect citizens and ensure long-term stability. The ability to anticipate and respond effectively to contemporary challenges is critical to maintaining public safety in an increasingly unpredictable world.

7. The role of citizens in ensuring Public Safety

Public safety is not exclusively the responsibility of government institutions, but also of every citizen. In a modern society, citizens have a crucial role in crime prevention, actively involved in maintaining order and helping to reduce security risks. By promptly reporting crimes, obeying the law, and working closely with authorities, they can help create a safe and secure environment.

Civic education and risk awareness are essential for citizens to be prepared to respond to security challenges. By being actively involved in the community and adopting responsible behavior, they can make a significant contribution to maintaining public safety. The role of citizens is complemented by the activity of state institutions and has a direct impact on the creation of a safe and stable environment.

A primary way citizens support public safety is by promptly reporting suspicious activity or crime, thereby allowing authorities to intervene quickly and

prevent untoward events. Co-operation with the police, gendarmerie and other public order institutions is also essential, either by attending community meetings or assisting with investigations.

Participating in local crime prevention programs, such as neighborhood watches, helps reduce risk and creates a sense of safety. Adherence to laws and social norms is also crucial to maintaining order.

Another key element is education. Citizens can help prevent crime by informing themselves about cyber safety, preventing domestic violence or avoiding financial fraud. Involvement in community initiatives, such as clean-up campaigns or the rehabilitation of vulnerable areas, strengthens social cohesion and reduces crime.

In the digital age, citizens must play an active role in maintaining online safety by protecting personal data and avoiding the spread of false information. Also, their contribution to reducing social inequalities supports the stability of communities and prevents social unrest.

Citizen involvement in public safety is essential to creating a stable and safe society. From reporting crimes to active participation in the community, collaboration between citizens and authorities ensures a safe and harmonious living environment for all.

Conclusion

Public safety is a fundamental pillar of a society's stability and well-being. Its concept has evolved over time, becoming increasingly complex as new challenges and threats have emerged on the global landscape. Today, public safety includes not only protection against crime, but also ensuring economic stability, public health, cyber security and strong social cohesion.

Government institutions, from the police to local authorities, play a critical role in maintaining safety, but citizen involvement is equally important to the long-term success of policing efforts. In an increasingly interconnected and challenging world, cooperation between institutions and citizens becomes essential to face the complex challenges that threaten public safety.

The concept of public safety is vital to the functioning of any modern society. By protecting citizens, preventing unrest, and effectively managing crises, public safety supports stability, economic development, and trust in state institutions. In the absence of this concept, societies would become vulnerable to chaos, violence and poverty, compromising overall well-being and progress.

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№88, 2024
Slovak international scientific journal

The journal has a certificate of registration at the International Centre in Paris – ISSN 5782-5319.
The frequency of publication – 12 times per year.
Reception of articles in the journal – on the daily basis.
The output of journal is monthly scheduled.
Languages: all articles are published in the language of writing by the author.
The format of the journal is A4, coated paper, matte laminated cover.
Articles published in the journal have the status of international publication.

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