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# Практикум з машинного перекладу

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Даний практикум з курсу машинного перекладу призначений для студентів магістрів факультету іноземної філології за спеціальністю 035.04 Філологія. Германські мови та літератури (переклад включно).
Метою практикуму є формування у студентів професійних компетенцій в області використання сучасних комп'ютерних технологій для оптимізації перекладацької діяльності.

**Методичні рекомендації для студентів**

Цей практикум розроблено для курсу машинного перекладу, якому в зв'язку з тим, що інформаційні технології стали невід'ємною частиною перекладацької діяльності, відводиться важливе місце серед дисциплін, що вивчаються студентами факультету іноземної філології, зокрема спеціальності Переклад.
Практикум призначений для студентів магістрів, що навчаються за спеціальністю 035.04 Філологія. Германські мови та літератури (переклад включно).
Метою практикуму є формування у студентів компетенцій у галузі застосування сучасних інформаційних технологій для оптимізації перекладацької діяльності та оптимальної стратегії перекладу.

У практикумі представлені індивідуальні завдання, які передбачають оригінал англійського тексту, за якими слід:
 зробити електронну копію (набір тексту/сканування+розпізнавання)
 перевести текст за допомогою систем машинного перекладу Promt / SDL TRADOS/ тощо
 відредагувати отриманий переклад, приділяючи особливу увагу стилістиці перекладу
 зробити висновок про доцільність застосування системи машинного перекладу для перекладу заданої тематики; проаналізувати лінгвістичні проблеми машинного перекладу.
Завдання підготувати в друкованому вигляді, дотримуючись правил верстки тексту (поля, колонтитули, номери сторінок і т.д.)
Загальний обсяг текстів для перекладу складає приблизно 20000 друкованих знаків з пробілами

**Методичні рекомендації для викладачів**

Практикум призначено для студентів-магістрів, що навчаються за спеціальністю 035.04 Філологія. Германські мови та літератури (переклад включно).

Призначення даного практикуму у формуванні у майбутнього фахівця такої необхідної на сучасному етапі складової перекладацьких компетенцій як володіння сучасними засобами автоматизації перекладацької діяльності відповідно до програмних вимог досліджуваного курсу.
Практикум допоможе студенту поєднувати основні навички перекладу з ефективним використанням комп'ютерного інструментарію для вироблення компетенцій правильної перекладацької стратегії.

Для підвищення мотивації студентів, крім запропонованих навчальних текстів передбачається використання автентичного матеріалу на різних мовах з вітчизняних і зарубіжних сайтів в Інтернеті.
Слід систематично вимагати точності у виконанні завдань і обов'язкового використання знань і умінь, придбаних при вивченні відповідної теми.

Орієнтовний вибір варіанту завдань для набору і перекладу представлений в таблиці. Номер варіанта відповідає номеру прізвища студента в журналі. Загальна кількість знаків для перекладу становить приблизно 20000 друкованих знаків з пробілами
Student‘s name Topics‘ no Signs in total

| *Прізвище студента* | *Номер тексту(текстів)* | *Загальна кількість символів* |
|---|---|---|
| 1 | 1,9,15 | 20174 |
| 2 | 2, 5, 12, 17 | 19930 |
| 3 | 3, 8, 10, 18 | 19305 |
| 4 | 4, 5, 7 | 19704 |
| 5 | 6, 13, 16, 19 | 20045 |
| 6 | 14,17 | 19577 |
| 7 | 8, 10, 11, 18 | 19465 |
| 8 | 1, 9, 15 | 20174 |
| 9 | 5, 12, 13,19 | 19969 |
| 10 | 2, 6, 11, 16 | 18864 |

## Частина І.

## Теоретичні відомості з курсу «Машинний переклад»

### Машинний переклад як напрям штучного інтелекту

1. Визначення машинного перекладу.
2. Короткі відомості про історію розвитку напрямку.
3. Стимули до розвитку досліджень.
4. Переваги машинного перевода.

*1. Визначення машинного перекладу.*

«Термин **машинний переклад** (МП) розуміється принаймні у двох смислах. Машинний переклад у вузькому сенсі – це процес перекладу деякого тексту з однієї природної мови на іншу, що реалізується комп'ютером повністю або майже повністю. В ході даного процесу подається текст, словесна частина якого не супроводжується ніякими додатковими вказівками, а на виході ми отримаємо текст на якоюсь іншою мовою, що є перекладом вхідного, причому перетворення вхідного тексту у вихідний відбувається без втручання людини (іноді допускається постредагування).

Машинний переклад в широкому сенсі – це галузь наукових досліджень, що знаходиться на стику лінгвістики, математики, кібернетики, і має на меті побудову систем, що реалізують машинний переклад в вузькому сенсі».

*2. Короткі відомості з історії розвитку напрямку.*

«Датою народження машинного перекладу як наукового напрямку прийнято вважати 1946 р коли Уоррен Уївер, директор відділення природничих наук Рокфеллерівського фонду, в листуванні з Ендрю Бутом і Норбертом Вінером вперше сформулював концепцію машинного перекладу, яку дещо пізніше (в 1949 р.) розвинув у своєму меморандумі "Translation", адресованому фонду.

У 1952 р відбулася перша конференція з МП в Массачусетському технологічному університеті, а в 1954 р в Нью-Йорку була представлена перша система МП – IBM Mark II, розроблена компанією IBM спільно з Джоржтаунського університетом (ця подія увійшла в історію як Джорджтаунський експеримент).

До початку 50-х років цілий ряд дослідницьких груп в США і в Європі працювали в області МП. У ці дослідження були вкладені значні кошти, однак результати дуже скоро розчарували інвесторів. Однією з головних причин невисокої якості МП в ті роки були обмежені можливості апаратних засобів: малий обсяг пам'яті при повільному доступі до міститься в ній інформації, неможливість повноцінного використання мов програмування високого рівня.

З розвитком обчислювальної техніки в кінці 70-х років (поява мікрокомп'ютерів, розвиток мереж, збільшення ресурсів пам'яті) машинний переклад увійшов в епоху "Ренесансу". При цьому дещо змістилися акценти: дослідники тепер ставили за мету розвиток "реалістичних" систем МП, які передбачали участь людини на різних стадіях процесу перекладу.

90-ті роки принесли з собою бурхливий розвиток ринку персональних комп'ютерів (від настільних до кишенькових) і інформаційних технологій, широке використання мережі Інтернет (яка стає все більш інтернаціональною та багатомовною). Все це зробило можливим, а головне затребуваним, подальший розвиток систем МП».

*3. Стимули до розвитку досліджень.*

Можна виділити два основних стимулу до розвитку робіт з машинного перекладу в сучасному світі. Перший – власне науковий; він визначається комплексністю та складністю комп'ютерного моделювання перекладу. Як вид мовної діяльності переклад зачіпає всі рівні мови – від розпізнавання графем (і фонем при перекладі усного мовлення) до передачі змісту висловлювання і тексту. Крім того, для перекладу характерний зворотний зв'язок і можливість відразу перевірити теоретичну гіпотезу про

будову тих чи інших мовних рівнів і ефективності пропонованих алгоритмів. Ця характеристична риса перекладу взагалі і машинного перекладу зокрема привертає увагу теоретиків, в результаті чого продовжують виникати все нові теорії автоматизації перекладу і формалізації мовних даних і процесів.

«Другий стимул - соціальний, і обумовлений він зростаючою роллю самої практики машинного перекладу в сучасному світі як необхідної умови забезпечення міжмовної комунікації, обсяг якої зростає з кожним роком. Інші способи подолання мовних бар'єрів на шляху комунікації – розробка або прийняття єдиної мови, а також вивчення іноземних мов – не можуть зрівнятися з перекладом за ефективністю. З цієї точки зору можна стверджувати, що альтернативи перекладу немає, так що розробка якісних і високопродуктивних систем машинного перекладу сприяє вирішенню найважливіших соціально-комунікативних задач».

*4. Переваги машинного перекладу.*

Висока швидкість перекладу. Використання системи машинного перекладу дозволяє значно скоротити час, необхідний для перекладу текстів.

Низька вартість перекладу. Вдаючись до послуг професійних перекладачів, ми змушені платити гроші за кожну сторінку перекладу. Однак часто необхідності в отриманні ідеального перекладу тексту немає, а потрібно швидко вловити сенс надісланого листа або змісту сторінки в інтернеті. В цьому випадку система перекладу, без сумнівів, стане надійним і ефективним помічником.

Конфіденційність. Багато користувачів регулярно використовують системи МП для перекладу особистих листів, адже далеко не кожна людина готова віддати сторонньому перекладачеві особисту переписку або довірити переклад фінансових документів.

Універсальність. Професійний перекладач, як правило, має спеціалізацію з перекладу текстів певної тематики. програма-перекладач впорається з перекладом текстів з найрізноманітніших галузей: для

правильного перекладу спеціалізованих термінів досить підключити необхідні настройки.

Переклад в режимі онлайн і переклад змісту Інтернет-сторінок. Переваги послуги онлайн-перекладу інформації очевидні. Сервіси онлайн-перекладу завжди під рукою і допоможуть в потрібний момент швидко перевести інформацію, якщо у вас немає програми-перекладача. Крім цього, сьогодні за допомогою систем перекладу можна переводити зміст Інтернет сторінок і запити пошукових систем.

## Види і стратегії машинного перекладу

1. Класифікація перекладів.
2. Типи машинного перекладу за ступенем автоматизації.
3. Стратегії машинного перекладу.

*1. Класифікація перекладів.*

Існують дві основні класифікації видів перекладу:

a) за характером текстів, що перекладаються (жанрово-стилістичні особливості оригіналу);

b) за характером мовних дій перекладача в процесі перекладу (форми перекладу).

**«Жанрово-стилістична** класифікація перекладів в залежності від жанрово-стилістичних особливостей оригіналу виділяє три функціональних виду перекладу: художній; суспільно-політичний; спеціальний.

Об'єктом **художнього** перекладу є художні твори. Основне завдання будь-якого художнього твору полягає в досягненні образно-емоційного та естетичного впливу на читача. З метою досягнення певного естетичного впливу у мові перекладу використовується величезна кількість різноманітних мовних засобів, від епітета (барвисте визначення) до ритмико-синтаксичного побудови фрази. така естетична спрямованість відрізняє художній переклад

від інших видів перекладу. Машинного перекладу із зазначених причин художні тексти піддаються найважче.

**Політичним** перекладом називається переклад текстів суспільно-політичного та публіцистичного характеру з пропагандистською або агітаційною установкою.

**Суспільно-політичний** переклад характеризується яскравим емоційним забарвленням з великою насиченістю різної термінології.

**Спеціальний** переклад обслуговує різні предметні галузі знань, що мають специфічну термінологічну номенклатуру. Об'єктом спеціального перекладу є матеріали, які відносяться до різних сфер людського знання і практики науки і техніки. Ці матеріали характеризуються гранично точним вираженням думки, отже, широким використанням термінології. Такий переклад найпростіше реалізується в машинному вигляді, оскільки спеціальні тексти характеризуються суворою логікою побудови тексту, жорсткою структурою речень, відсутністю емоційного забарвлення і підтексту.

Під формами перекладу розуміється спосіб, котрим здійснюється переклад:

- письмовий (письмово-письмовий, зорово-письмовий, письмовий переклад на слух);
- усний (усний переклад на слух, візуально-усний переклад або переклад з листа, т. е. усний переклад візуально сприйнятого вихідного письмового тексту).

Машинній реалізації простіше піддається письмовий переклад, оскільки усний вимагає рішення додаткової завдання – розпізнавання і синтезу усного мовлення.

*2. Типи машинного перекладу за ступенем автоматизації.*

В даний час виділяють типи машинного перекладу за ступенем автоматизації:

- повністю автоматичний;

• автоматизований машинний переклад за участю людини (з перед-, інтер або постредагуванням);

• переклад, здійснюваний людиною, з використанням комп'ютера (наприклад, з використанням електронних словників).

*3. Стратегії машинного перекладу.*

Перші системи МП характеризуються **стратегією прямого (послівного) перекладу**. Сутність цього підходу до побудови МП полягає в тому, що вихідний текст вхідною мовою поступово через ряд етапів перетворюється в текст вихідної мови. Перетворення зводяться до того, що слово (словосполучення) на вхідній мові замінюється на його словниковий еквівалент вихідному мовою. Зрозуміло, що в системах першого покоління, що використовують стратегію прямого перекладу, немає необхідності моделювати функціонування мовної системи в цілому. Для роботи таких систем виявляється цілком достатньо правил словникових відповідностей. У рідкісних випадках проводиться аналіз контексту для перекладу неоднословних виразів, знову-таки представлених в словнику системи.

Важливо мати на увазі, що стратегія прямого перекладу не робить відмінностей між розумінням (аналізом) і синтезом (породженням), оскільки вони фактично виключені з перетворень за правилами словникових відповідностей. Прямий переклад завжди прив'язаний до конкретної пари мов. Наприклад, неоднозначність виразів вхідної мови дозволяється тільки в тій мірі, в якій це виявляється необхідним для вихідного мови.

За часовими рамками системи першого покоління в основному створювалися в період з кінця 40-х до середини 60-х рр.

Істотна модифікація стратегії прямого перекладу виявляється в системах з **трансфером** – етапом міжмовних операцій, що не приводяться тільки до заміни лексем вхідної мови на словникові відповідності вихідної мови. Наявність етапу трансферу передбачає побудову «проміжного» або «внутрішнього» уявлення, яке далі «пристосовується» до структури речення вихідного мови. На відміну від першої стратегії, в архітектурі систем МП з

трансфером аналіз (розуміння) і синтез існують як особливі процедури і обслуговуються різними алгоритмами.

Розвиток ідеї трансферу призвів до появи **перекладу, заснованого на глибинному лінгвістичному аналізі**. Дана стратегія має на увазі аналіз вхідного тексту на всіх мовних рівнях (морфологічному, синтаксичному, семантичному, прагматичному), а також багаторівневий синтез вихідного тексту.

Критика стратегії прямого перекладу призвела до створення **стратегії мови-посередника (інтерлінгва)**. Головна особливість цієї стратегії полягає в тому, що між структурами вхідної мови та структурами вихідної мови знаходиться один або кілька проміжних мов, на які за відповідними правилами послідовно «переписуються» вислови вхідного мови. Аналіз і синтез при використанні мови-посередника принципово поділяються. Аналіз ведеться в категоріях вхідної мови, а синтез - в категоріях вихідного. В якості мови (мов)-посередників можуть виступати мови представлення синтаксичної і семантико-синтаксичної структури, чисто семантичні мови, мови глибинної семантики, що наближаються до концептуального поданням в категоріях теорії знань (фреймів, сценаріїв, планів).

Останнім часом набула розвитку **стратегія пам'яті перекладів**. Пам'ять перекладів – база даних, що містить набір раніше переведених текстів. Один запис в такій базі даних відповідає «одиниці перекладу», за яку зазвичай приймається одне речення (рідше – частина складносурядного речення, або абзац). Якщо речення вихідного тексту в точності збігається з реченням, що зберігається в базі, воно може бути автоматично підставлене в переклад. Нове речення може також злегка відрізнятися від того, що зберігається в базі. Таке речення може бути також підставлено в переклад, але перекладачу буде необхідно внести відповідні зміни».

**Алгоритм машинного перекладу, заснований на лінгвістичному аналізі**

*Крок 1. Отримання речення вихідного тексту з файлу або з буфера в пам'яті.*

*Крок 2. Розбиття речення на слова і визначення меж речення.*

*Крок 3. Морфологічний аналіз вихідного тексту – отримання всіх можливих лексичних кодів для кожного знайденого в словнику слова.*

*Крок 4. Синтаксичний аналіз вихідного тексту – угруповання однорідних прикметників і іменників, побудова дерева головних / залежних слів.*

*Крок 5. Семантичний аналіз вихідного тексту.*

*Крок 6. Здійснення перекладу побудованого дерева.*

*Крок 7. Здійснення узгодження перекладеного дерева - семантичний, синтаксичний і морфологічний синтез.*

*Крок 8. Запис перекладеного речення в файл або в буфер.*

**Структура систем машинного перекладу**

*1. Допоміжні програмні засоби.*

*2. Склад лінгвістичної бази даних.*

*3. Лінгвістичний процесор.*

*1. Допоміжні програмні засоби.*

«На етапі обробки вихідного тексту в системі машинного перекладу повинні бути присутніми певні допоміжні програмні засоби. Щоб перетворювати тексти з одного кодового представлення в інше, необхідні конвертори. Типовий конвертор підтримує підмножину кодових таблиць, що використовуються для символів конкретної мови. Так, для української актуальні кодування CP866, CP1251, Unicode.

При обробці документів виникає задача перетворення вихідного документа в звичайний текст (plain text), для подальшої його семантичної та синтаксичної обробки. При цьому на етапі перетворення необхідно зберегти корисну інформацію про структуру документа і його стильове оформлення, про взаємозв'язок між абзацами, про заголовки і т.д. У завдання преформатора входить розпізнавання різних форматів документів, що надходять, і виділення текстової інформації з цих документів зі збереженням її структури. Оскільки існує велика кількість різних форматів документів, то виникає необхідність написання преформатора для кожного з цих форматів. таке завдання є дуже трудоємким і, крім того, з появою нового формату документів, виникає необхідність написання окремого преформатора під новий формат. Щоб уникнути подібних проблем, на практиці, як правило, використовують преформатори, що перетворюють різні формати документів до одного, який, як правило, найбільш легко піддається структуризації. Зазвичай в якості такого формату вибирається HTML, XML і т.д. Далі створюється модуль аналізу вже одного, обраного в якості базового, формату, на виході якого виходить структурований текст з рядом обраних для заданої глибини аналізу тексту преформатора ознак. При появі ж нових форматів з'являється необхідність лише в створенні преформатора, що перетворює цей формат документів в базовий.

Окремим блоком можна виділити програми взаємодії з базами даних, які необхідні для повноцінного лінгвістичного аналізу вихідного тексту і синтезу тексту на мову перекладу.

Для зручної роботи з системою машинного перекладу необхідно забезпечити дружній інтерфейс, який оперує доступною для будь-якого користувача мовою управління завданнями. Саме за допомогою цього інтерфейсу користувач повинен мати можливість без програмування ввести, відредагувати і перевірити текст, зробити його переклад, вивести його на друк, провести статистичну обробку матеріалу, отримати потрібну довідку і т. п.

*2. Склад лінгвістичної бази даних.*

Лінгвістична база даних для системи машинного перекладу включає в себе накопичені лінгвістичні дані, з текстами, картотеками, словниками, граматиками і іншими лінгвістичними джерелами. Типовий склад лінгвістичної бази даних можна обмежити наступними компонентами:

а) Лексико-граматичний класифікатор властивостей вихідного мови і мови перекладу (система морфологічного кодування). при аналізі вихідного тексту кожне слово в ньому має отримати відповідні морфологічні характеристики: ознака частини мови, рід, відмінок, число і ін. Система кодування повинна бути єдиною для конкретної системи машинного перекладу.

б) Базовий двомовний морфологічний словник. У цьому словнику встановлюється послівна відповідність кожної словоформи вихідного мови словоформам мови перекладу.

в) Словник скорочень і абревіатур. Словник використовується на етапі розбиття вихідного тексту на слова і речення. Скорочення і абревіатури повинні бути по можливості розшифровані, так як вони можуть бути членами речення, отже, їх необхідно враховувати при синтаксичному і семантичному аналізі.

г) Словник ідіом. Даний словник застосовується до синтаксичного аналізу, оскільки дуже часто ідіома є одним членом речення і розглядається як єдине ціле; при перекладі ідіома мовою оригіналу може відповідати одному слову мови перекладу.

д) Термінологічні словники за предметними галузями. Додаткові словники підключаються при необхідності перекладу спеціалізованих текстів.

е) Синтаксичний словник. В даному словнику повинна міститися інформація про синтаксичну сполучуваність членів речення як в мові оригіналу, так і в мові перекладу, а також синтаксичні відповідності, необхідні при перекладі.

ж) Семантичний словник (тезаурус, онтологія). Даний компонент містить інформацію про семантичну сполучуваність лексем, про лексико-семантичні поля, які застосовуються на етапі побудови семантичної графи речення.

з) Корпус паралельних текстів. Корпус містить тексти мовою оригіналу і їх переклади на іншу мову. При знаходженні речення або його фрагмента в корпусі паралельних текстів в текст перекладу вставляється його відповідник мовою перекладу. На використанні корпусу текстів побудована технологія пам'яті перекладів.

*3. Лінгвістичний процесор.*

Лінгвістичний процесор призначений для повного лінгвістичного аналізу тексту мовою оригіналу, а також синтезу тексту на мові перекладу. Лінгвістичний процесор включає наступні компоненти:

а) Програма розбиття тексту на речення і слова.

б) Програма розпізнавання стійких словосполучень. Ідіоми повинні аналізуватися і перекладатися як неподільне ціле.

в) Програма розшифровки скорочень і абревіатур.

г) Програма морфологічного анотування вихідного тексту.

д) Програма синтаксичного аналізу та побудови дерева залежностей.

е) Програма семантичного аналізу та побудови семантичної графи кожного речення вихідного тексту.

ж) Програма вибору відповідності з двомовного словника або корпусу паралельних текстів.

з) Програма семантичного синтезу тексту мовою перекладу.

і) Програма побудови синтаксичної структури речення і визначення порядку слів в синтезованих реченнях.

к) Програма морфологічного синтезу словоформ в перекладеному тексті».

## Лінгвістичні проблеми машинного перекладу

*1. Проблема багатозначності при машинному перекладі.*

*2. Синтаксичні трансформації в машинному перекладі.*

*3. Переклад фразеологічних поєднань в системах машинного перекладу.*

*1. Проблема багатозначності при машинному перекладі.*

«Проблема вирішення лексичної багатозначності є однією з найскладніших прикладних задач, пов'язаних з лексичним значенням. Завдання автоматичного (рідше напівавтоматичного) вирішення лексичної багатозначності була вперше сформульована в рамках напрямку науки і технології, пов'язаного зі створенням систем машинного перекладу. Надалі проблема вирішення лексичної багатозначності стала однією з ключових не тільки при створенні систем машинного перекладу, а й систем обробки текстів природною мові інших призначень (пошук, класифікація).

**Полісемія** (від грец. Polysemos - багатозначний) (багатозначність) – наявність у одиниці мови більш одного значення – двох або декількох. Часто, коли говорять про полісемію, мають на увазі багатозначність слів як одиниць лексики. **Лексична полісемія** – здатність одного слова служити для позначення різних предметів і явищ дійсності. **Граматична полісемія** – збіг різних граматичних форм однієї лексеми.

Реалізацію того чи іншого значення слова здійснює контекст або ситуація, загальна тематика мови. Точно так же, як контекст обумовлює конкретне значення багатозначного слова, в певних умовах він може створювати семантичну диффузность, тобто сумісність окремих лексичних значень, коли їх розмежування не проводиться (і не представляється необхідним). Деякі значення проявляються тільки в поєднанні з визначальним словом; в деяких поєднаннях значення багатозначного слова представлено як фразеологічно пов'язане.

Не тільки лексична сполучуваність і словотворчі особливості характеризують різні значення слів, але також ряд випадків і особливостей граматичної сполучуваності.

У прикладних задачах комп'ютерної лінгвістики не робиться відмінності між омонімічними і полісемічними значеннями слова. Це пов'язано з тим, що в переважній більшості прикладних задач важлива не стільки етимологія слова, скільки його семантика. Розпізнавання і поділ груп омонімічних значень також входить в завдання вирішення лексичної багатозначності, так як іноді може виявитися корисним з практичної точки зору.

Проблема багатозначності вважається вирішеною, якщо для слова вибрано його регулярне значення або якщо знайдений синонімічний еквівалент у вигляді регулярного значення для метафоричного використання.

Відомо, що при вирішенні багатозначності існує ряд самостійних завдань. Зокрема, можна виділити найбільш великі, «класичні» завдання:

1) Завдання приписування відомого значення відомій лексемі.

2) Завдання приписування відомого значення новій лексемі.

3) Завдання виявлення нового значення для відомої лексеми.

4) Завдання виявлення нового значення для нової лексеми.

Розрізняють два основні класи механізмів вирішення багатозначності.

1 клас. Це механізми автоматичні, які передбачають повністю комп'ютерне рішення цього завдання.

2 клас. Це механізми інтерактивні (діалогові, напівавтоматичні), які передбачають спільне рішення задачі людиною і комп'ютером, і зводяться до того, що комп'ютер надає користувачу набір альтернатив, з якого він повинен вибрати один варіант.

Одним з автоматичних методів розв'язання багатозначності є фільтри, тобто методи, які не виявляють точного значення, але в явному вигляді накладають обмеження на їх спектр.

*2. Синтаксичні трансформації в машинному перекладі.*

Дієслівно-іменникові трансформації – центральне питання формування структури перекладного висловлювання. Новий зміст проблемі мовних трансформацій надають сучасні реалії: необхідність проектувати і розвивати навчальні компоненти систем машинного перекладу й редагування текстових знань на основі вже існуючих і знову створюваних корпусів паралельних текстів.

На сучасному етапі лінгвістичних досліджень і розробок необхідно синергетичне поєднання функціонального і рівневого підходів. Функціональний підхід інтегрує мовні засоби (синтаксичні, лексичні, словотворчі і словозмінні), що належать різним рівням мови, на основі їх функціонально-семантичних характеристик.

Під трансформаціями розуміються, перш за все, перетворення предикаторов в імена і імен в предикатори: бігти – біг, вчитель – вчителювати, при цьому зберігається часткова тотожність форма – корінь або основа слова і певна тотожність семантики.

Трансформації постійно виступають як одне з двох головних засобів – поряд з перифразами – створення висловлювань.

*3. Переклад фразеологічних поєднань в системах машинного перекладу.*

Проблема машинного перекладу ідіом полягає в тому, що не завжди вдається дати точний переклад, керуючись звичайними правилами. Однак слід взяти до уваги, що ідіоми повинні бути виявлені на початковому етапі щоб уникнути їх втрати, і оброблятися вони повинні як одне слово.

Вирішення ідіоматичності є однією з формальних операцій, що забезпечують аналіз і синтез в системах машинного перекладу, і виробляються або за допомогою стандартних граматичних і лексичних програм аналізу тексту, що працюють спільно з автоматичним словником, або шляхом прямого співвіднесення вхідного і вихідного сегментів.

У другому випадку і вхідний, і вихідний сегменти розглядаються як неподільні звороти. Один або кілька вихідних зворотів або словоформ,

поставлених у відповідність кожному вхідному звороту, складають автоматичний словник зворотів.

В результаті аналізу ідіоматичним виразами приписується певний цифровий еквівалент, і вони виключаються з подальшого граматичного аналізу.

Складанню алгоритму пошуку і перекладу зворотів в тексті передує лінгвістичне дослідження їх дистрибуції. Слід з'ясувати за допомогою синтаксичного аналізу, чи є зворот цілісним і чи включає він у себе змінювані форми. Зворот вважається цілісним, якщо він має постійний склад і між його елементами можна вставити інші одиниці. Якщо зворот не є цілісним, слід враховувати це при складанні алгоритму. Таким чином, для обробки зворотів, розірваних іншими членами речення, необхідні дані синтаксичного аналізу.

При створенні систем машинного перекладу для текстів, що містять ідіоматичні вирази, необхідно керуватися наступними принципами:

1. Основними одиницями мови і мовлення, які слід включати в машинний словник, повинні бути фразеологічні одиниці (зокрема, ідіоматичні вирази). Окремі слова також можуть включатися в словник, але вони повинні використовуватися тільки в тих випадках, коли не вдається здійснити переклад, спираючись тільки на фразеологічні одиниці.

2. Поряд з ідіоматичними виразами, що складаються з безперервних послідовностей слів, в системах машинного перекладу слід використовувати і так звані "мовні моделі" - фразеологічні одиниці з "порожніми місцями", які можуть заповнюватися різними словами і словосполученнями, породжуючи осмислені відрізки мовлення.

3. Реальні тексти, незалежно від їх приналежності до тієї чи іншої тематичної галузі, зазвичай бувають політематичні, якщо вони мають чималий обсяг. І відрізняються вони один від одного не стільки словниковим складом, скільки розподілами ймовірностей появи в них різних слів з загальнонаціонального словникового фонду. Тому машинний словник,

призначений для перекладу текстів навіть тільки з однієї тематичної галузі, повинен бути політематичним, а для перекладу текстів з різних предметних галузей – тим більше.

4. Необхідні машинні словники великого обсягу. Такі словники повинні створюватися на основі автоматизованої обробки двомовних текстів, які є перекладами один одного, і в процесі функціонування систем перекладу.

5. Поряд з основним політематичним словником великого обсягу, в системах фразеологічного машинного перекладу доцільно використовувати також набір невеликих за обсягом додаткових тематичних словників. Додаткові словники повинні містити тільки ту інформацію, яка відсутня в основному словнику (наприклад, інформацію про пріоритетні перекладних еквівалентах словосполучень і слів для різних предметних галузей, якщо ці еквіваленті не збігаються з пріоритетними перекладними еквівалентами основного словника).

6. Поряд з перекладом текстів в автоматичному режимі, в системах фразеологічного машинного перекладу доцільно передбачити і інтерактивний режим їх роботи. У цьому режимі користувач повинен мати можливість втручатися в процес перекладу і налаштовувати додаткові машинні словники на тематику перекладаються текстів».

## Використання паралельних корпусів текстів в машинному перекладі. Пам'ять перекладів

*1. Види і структура паралельних корпусів текстів.*

*2. Технологія пам'яті перекладів.*

*3. Переваги та недоліки технології.*

*1. Види і структура паралельних корпусів текстів.*

«Багатомовний корпус текстів являє собою кілька аналогічних за структурою одномовних корпусів текстів. Для паралельних корпусів

виділяється ряд підтипів: тексти на мові А і їх переклади на мову В; тексти на мовах А і В і їх переклади відповідно на мови В і А; тільки перекладні тексти на мовах А, В, С, Х, якщо оригінальні тексти були написані на мові D. Крім того, до паралельних корпусів можна віднести діахронічні корпуси, які складаються з текстів на більш ранній формі мови і їх перекладів на сучасну мову, транскрипційні корпуси текстів, що включають тексти літературною мовою, прочитані носіями різних її діалектів. В якості підтипів можна виділити «галасливі» паралельні корпуси; з пропусками в перекладі, без точної відповідності між оригіналом і перекладом), «дзеркальні» паралельні корпуси, що складаються з текстів на мовах А і В і перекладів цих текстів відповідно на мови В і А.

Важливість паралельних корпусів обумовлена тим, що вони дозволяють об'єктивно встановити, як перекладачі на практиці долають труднощі, і використовувати ці дані для розробки моделей для початківців перекладачів, що відповідних реальності. Вони також відіграють важливу роль в дослідженні перекладацької норми в специфічних соціокультурних та історичних контекстах. Це робить багатомовні корпуси текстів у багатьох відношеннях привабливими для перекладачів-практиків. Паралельні корпуси залишаються незамінним джерелом даних для проведення досліджень в галузі прикладної лінгвістики (апробація систем автоматизованого перекладу, заповнення систем перекладацької пам'яті, розробка систем автоматичного пошуку перекладних еквівалентів і т.п.), так і для контрастивних і перекладознавчих досліджень (порівняння структури вихідного тексту і перекладу, визначення ступеня інформаційних втрат при перекладі, вивчення різних перекладацьких стратегій і т. п.)

При складанні паралельних корпусів, на відміну від одномовних і порівняльних корпусів текстів, слід враховувати фактор міжкультурних зв'язків. Безліч текстів вихідної мови складають лише ті тексти, які були переведені на іншу мову, і, якщо міжкультурні зв'язки повністю відсутні, отримання паралельного корпусу неможливо. Чим слабкіше міжнаціональні

та культурні зв'язки, тим менше перекладів виконується і тим більш проблематичним є складання повноцінного паралельного корпусу. Тексти на вихідній мові, хоча і є первинними, відбираються з урахуванням мови перекладу. Структура субкорпусу вихідного мови визначається наявністю або відсутністю перекладів на мову перекладу, а також тим, якого роду тексти перекладаються.

При складанні паралельних корпусів можуть використовуватися різноманітні мовні ресурси: спеціальні тексти, тексти ЗМІ, наукові тексти, художні тексти, тобто паралельний корпус повинен мати властивість репрезентативності.

Структурна організація корпусу може бути найрізноманітніша, в залежності від прагматичних цілей його автора:

- у вигляді традиційного тексту з посиланням на переклад;

- в табличній "дзеркальної" формі, що більш зручно для сприйняття і порівняння;

- у вигляді бази даних (структура, застосовна тільки при автоматичній обробці).

Важливим поняттям є вирівнювання тексту. Вирівнювання паралельного тексту – це ідентифікація відповідних один одному речень в обох половинах паралельного тексту. Вирівнювання паралельного корпусу на рівні речень є необхідною передумовою для різних аспектів лінгвістичних досліджень. В процесі перекладу речення можуть розділятися, зливатися, віддалятися, вставлятися або змінювати послідовність. У зв'язку з цим вирівнювання часто стає складним завданням.

Паралельні корпуси текстів-зразків (у вигляді бази даних) особливо корисні в тому випадку, коли перекладач працює зі строго нормованими текстами, жанрово-стилістичний і стилістичне оформлення таких текстів практично не допускає варіювання, відступу від певних соціокультурних норм. Це тексти ділової листування, тексти-рецепти, тексти-прогнози погоди, тексти-контракти та т.д. Тексти різних стилів розрізняються як словником

лексичних одиниць, що вживаються в певних текстах, так і граматичними і синтаксичними структурами речень.

Паралельні корпуси текстів-зразків і їх типологічні моделі-характеристики, складені на етапі перед перекладацького аналізу вихідного тексту, можуть служити для перекладача і студента таким же ефективним допоміжним засобом, як і різного роду словники.

*2. Технологія пам'яті перекладів.*

Ідея паралельного корпусу має багато спільного з концепцією пам'яті перекладів. Головна відмінність між ними в тому, що пам'ять перекладів являє собою базу даних, в якій сегменти тексту (відповідні один одному речення) розташовані таким способом, при якому вони не пов'язані з оригінальним контекстом, тобто оригінальна послідовність речень втрачається. Паралельний корпус ж зберігає початкову послідовність речень.

Пам'ять перекладів – база даних, що містить набір раніше переведених текстів. Одна запис в такій базі даних відповідає сегменту або «одиниці перекладу», за яку зазвичай приймається одне речення.

Якщо одиниця перекладу вихідного тексту в точності збігається з одиницею перекладу, що зберігається в базі, вона може бути автоматично підставлена в переклад. Новий сегмент може також злегка відрізнятися від того, що зберігається в базі. Такий сегмент може бути також підставлений в переклад, але перекладач буде повинен внести необхідні зміни. Крім прискорення процесу перекладу фрагментів і змін, внесених у вже перекладені тексти (наприклад, нових версій програмних продуктів або змін в законодавстві), системи пам'яті перекладів також забезпечують однаковість перекладу термінології в однакових фрагментах, що особливо важливо при технічному перекладі.

Основою функціонування будь-якої системи пам'яті перекладів є раніше перекладені тексти. Безліч цих текстів постійно поповнюється новими перекладами, внаслідок чого відсоток сегментів, що автоматично перекладаються, поступово зростає. Це означає, що для найбільш

ефективного використання пам'яті перекладів всі тексти повинні містити достатню кількість схожих фраз. Такий стан речей має місце в документації на різного роду продукти. Це обумовлено двома факторами. По-перше, документацію прийнято складати максимально простою мовою, лаконічно і в строгих термінах. По-друге, з появою нових версій і модифікацій продукту зміст документації змінюється лише в незначній мірі. Пам'ять перекладів в подібних випадках позбавляє перекладача від необхідності по кілька разів переводити ідентичні фрагменти тексту, що входять в різні документи».

*3. Переваги та недоліки технології.*

Переваги технології пам'яті перекладів:

- скорочення часу, необхідного для перекладу;
- скорочення обсягу роботи перекладача;
- поліпшення якості машинного перекладу, заснованого на правилах;
- підвищення якості послуг за рахунок збільшення точності перекладу термінів, особливо в спеціалізованих текстах.

Недоліки технології:

- часто відсутній зв'язок запропонованого речення / тексту з сусідніми реченнями і з текстом в цілому;
- одна помилка поширюється на весь проект;
- необхідно навчання самій програмі;
- підходить не всім видам текстів;
- висока вартість програм.

## Частина ІІ.

## Тексти для перекладу із застосуванням систем машинного перекладу

### №1. Anti-terrorism laws have ‘chilling effect’ on vital aid deliveries to Somalia

«Fear of prosecution under UK and US counter-terror laws hinders those trying to provide humanitarian assistance in areas held by Islamic militants

Strict British and US counter-terrorism laws are discouraging humanitarian organizations from delivering vital emergency assistance to millions of people facing starvation and fatal diseases in drought-hit Somalia.

Senior humanitarian officials say the laws, which target any individual or organization found to have materially assisted a terrorist group, exert a “chilling effect” on vital assistance in areas of Somalia controlled by Islamic militants from al-Shabaab, an al-Qaida affiliate.

The worst drought for 40 years in the unstable east African country threatens 6 million people with famine. Most of the worst hit – around 2 million people – live in areas run by al-Shabaab.

Humanitarian officials say it is almost impossible to guarantee that no aid will reach the extremists if they work there, and fear this means they will fall foul of the laws, exposing them to potential prosecution.

“US and UK terrorism financing laws are a significant discouragement to operating in al-Shabaab areas. At the very least, you could end up wasting a huge amount of time explaining yourself; at worst, if substantial amounts of aid were appropriated by al-Shabaab – as has happened to people in the past – you could end up in court with your organization shut down,” said the country director of one major international NGO working in Somalia.

Moving any aid by land in Somalia involves paying “taxes” at road blocks run by different armed groups, including al-Shabaab. UN experts estimated that at the height of its power in 2010 al-Shabaab imposed fees and taxes that totalled on average $90,000 (£70,200) per aid agency every six months.

Also, any access to al-Shabaab controlled areas for NGOs would have to involve negotiations with local community and clan elders, of whom some are likely to be connected to the insurgents.

Justin Brady, a senior UN humanitarian official responsible for overseeing the distribution of hundreds of millions of dollars of international assistance in Somalia, said the primary reason for NGOs avoiding areas run by al-Shabaab remained the security threat posed by the Islamic militants. But, he said, the US and UK laws were poorly understood and a disincentive.

"Once you get past [the security issues], that becomes a consideration and you have to figure out how you can work there … It has a chilling effect. I'm sure in Washington or London it's clear what [the laws] meant but here it is much more difficult," Brady said.

Senior UN officials in Somalia recently sought clarification from the US and the UK about potential prosecution. Unofficial advice to NGOs, given via the UN, is that "a blind eye" is being turned to any humanitarian operations in al-Shabaab controlled zones following legal changes to allow a "humanitarian exception" to the counter-terrorist laws.

British officials last week said the NGOs' anxiety is unfounded, and pointed out that no one has been prosecuted by the US or the UK under the legislation.

"The bottom line is that there is an emergency and the priority for everyone is getting aid to those who need it, wherever they are," said David Concar, the British ambassador to Somalia, in an interview with the Guardian in Mogadishu last week.

"We know some organizations are successfully getting aid through to communities in dire need of help in al-Shabaab controlled areas. [Counter terrorist] legislation is not intended to stop – and nor should it actually stop – any aid groups from working in such areas as long as they have the necessary controls in place and they're not deliberately supporting terrorists."

Despite the reassurances, deep anxiety remains among aid planners, who say they need clear guidance from the US and UK. This would be politically difficult, as it could be seen as sanctioning negotiations with terrorist organizations.

In 2011, during the last major famine, little aid made it into al-Shabaab held areas. One expert report, published after the emergency, listed "constraints on aid agencies related to counter-terrorism legislation" as important factors contributing to the death toll of more than 250,000.

The British government was forced to write off aid worth £480,000 following a series of thefts between November 2011 and February 2012 by al-Shabaab from the offices and warehouses of partner organizations.

In this new crisis, the Islamic militants have allowed women and children, and some men, to leave areas under their control to travel to government-held towns – such as Baidoa, 250km north-west of Mogadishu – where medical assistance, water and food is available.

The greatest obstacles to delivering desperately needed assistance to those who live in zones controlled, or at least contested, by al-Shabaab remain the potential for corruption and for direct attacks from the militants.

Senior NGO officials said the laws forced them to "think twice" before undertaking such operations – even if security was guaranteed. Any humanitarian activity is therefore "under the radar", thus ruling out major interventions.

"Everyone wants to turn a blind eye, but that means you're not going to get to scale. We are not going to put down a large cholera treatment centre which everyone can get to, for example, so we can't get quantity, and because we can't get technical experts in we can't get quality either," Brady said.

In September 2009, the Obama administration temporarily suspended shipments of US food aid to Somalia pending a policy review.

Experts say humanitarian agencies have a right under the Geneva conventions and international humanitarian law to negotiate with non-state parties to an armed conflict to access famine victims.

The concerns about possible prosecution underline the difficulties of delivering aid in the middle of a civil war, where communities in desperate need are in zones controlled by a proscribed terrorist organization.

The UN says it needs $4.4bn (£3.4bn) for humanitarian assistance to more than 20 million people facing famine in Somalia, South Sudan, Nigeria and Yemen in what officials have described as the biggest humanitarian emergency since the organization was founded in 1945.

Each of the four countries is deep in a conflict involving an array of local and regional actors. In three of them, Islamic militants, including al-Qaida and Islamic State, play a role, making access to vulnerable communities extremely difficult».

(6689 знаків)

## №2. Cryogenically frozen brains will be 'woken up' and transplanted in donor bodies within three years, claims surgeon

«Professor Sergio Canavero, Director of the Turin Advanced Neuromodulation Group, is aiming to carry out the first human head transplant within 10 months and then wants to begin trials on brain transplants.

If the procedures are successful, he believes that frozen brains could be thawed and inserted into a donor body.

Hundreds of people who are dying or paralysed have had their bodies or brains cryogenically preserved in the hope that medical science will be able to bring them back to life and cure their conditions.

Although many experts are sceptical that huge organs like the brain can be thawed without damage, Prof Canavero said he believes the first frozen head could soon be resurrected.

Speaking to the German magazine Ooom, he said he planned to awaken patients frozen by the Alcor Life Extension Foundation which is based in Arizona.

"We will try to bring the first of the company's patients back to life, not in 100 years. As soon as the first human head transplant has taken place, i.e. no later than 2018, we will be able to attempt to reawaken the first frozen head," said Prof Canavero.

"We are currently planning the world's first brain transplant, and I consider it realistic that we will be ready in three years at the latest.

"A brain transplant has many advantages. First, there is barely any immune reaction,which means the problem of rejection does not exist.

"The brain is, in a manner of speaking, a neutral organ. If you transplant a head with vessels, nerves, tendons and muscles, rejection can pose a massive problem. This is not the case with the brain."

However Prof Canavero admitted that there could be physical and psychological problems which come with putting a brain in an entirely different body.

"What many be problematic, is that no aspect of your original external body remains the same. Your head is no longer there; your brain is transplanted into an entirely different skull.

"It creates a new situation that will certainly not be easy."

However British scientists are skeptical about whether frozen organs as complex as the brain could ever be fully restored. When the High Court last year ruled that teenage girl could be cryogenically preserved, experts said the chances of revival were "infinitesimal".

Clive Coen, Professor of Neuroscience at King’s College London, said: “The advocates of cryogenics are unable to cite any study in which a whole mammalian brain, let alone a whole mammalian body, has been resuscitated after storage in liquid nitrogen.

“Even if reviving that body were possible - it isn't - all the complicated organs would have been wrecked from the start, and warming them up again would wreck them further.

“Irreversible damage is caused during the process of taking the mammalian brain into sub-zero temperatures. The wishful thinking engendered by cryogenics companies is irresponsible."

Prof Canavero is working with a Chinese team of doctors led by Dr Xiaoping Ren, of Harbin Medical Centre who helped perform the first successful hand transplantation in the US. The technology to carry out the world's first head transplant is expected to be in place by the end of the year, and then the team will then need to find a suitable donor body.

Although Russian computer scientist Valery Spiridonov, who suffers spinal muscular atrophy, had volunteered to become the first head transplant patient, the team have since said the first trial is likely to be carried out on someone who is Chinese, because the chance of a Chinese donor body will be higher. Prof Canavero said a 'high number' of people had volunteered for the transplant.

Last year, the team announced they had successfully carried out a head transplant on a monkey, and released images from the procedure.

Last year scientists claimed to have carried out the first head transplant using a monkey

Prof Canavero said if the human head transplant works, it could have fundamental implications for human consciousness and even religion.

"In a few months we will sever a body from a head in an umprecedented medical procedure. In this phase, there is no life activity, not in the brain, not anywhere else in the body.

"If we bring this patient back to life we will receive the first real account of what actually happens after death. The head transplant gives us the first insight into whether there is an afterlife, a heaven, a hearafter.

"If we are able to prove that our brain does not create consciousness, religions will be swept away forever. They will no longer be necessary, as humans no longer need to be afraid of death. We no longer need a Catholic Church, no Judaisim, and no Islam because religions in general will be obsolete.

"It will be a turning point in human history."

The exclusive interview can be read in full in Saturday's edition of Ooom». (4886 знаків)

## №3. Ex-Chad dictator's conviction for crimes against humanity upheld by Dakar court Judge in Senegal acquits Hissène Habré of a rape charge but upholds other charges including torture and murder

«An African court has rejected Hissène Habré's appeal against his conviction for crimes against humanity, which followed a decades-long fight for justice for his victims.

The former president of Chad was acquitted of a rape charge, but all the other charges against him – including torture and murder – were upheld.

Last year, Habré was sentenced to life in prison in Dakar, Senegal, for ordering the wrongful arrest, torture and killing of Chadian citizens throughout his tenure as president in the 1980s.

He was made to listen in court as 90 witnesses testified that he had thrown thousands of people into secret jails, where they had been tortured, executed or forced to endure horrific prison conditions.

"I have been fighting for this day since I walked out of prison more than 26 years ago. Today, I finally feel free," said Souleymane Guengueng, who almost died in one of Habré's jails and swore he would fight for justice if he ever got out. He did, and spent years collecting files full of victims' testimonies.

Some of the trial's most powerful testimony came from Khadidja Zidane, who accused Habré of raping her four times and whom his website described as a "crazy whore".

In an interview with the Guardian last year, Zidane said she would never be satisfied while Habré lived in a comfortable prison cell, but added: "At least I was able to face him. If I die today, I'll die in peace. I had the opportunity to tell the

whole world what he did to me. Thank Allah for that. He'll pay in the afterlife for what he did."

Although Ougadeye Wafi, the Malian judge who read out the verdict, said the court believed Zidane's account and found her a credible witness, he said he could not uphold the rape conviction as it was not on the original indictment. However, it makes no difference to the sentence.

Habré will continue to serve his life sentence in jail in Senegal, the country in which he took refuge after being ousted in a coup in 1990. It took 10 years for him to be arrested by Senegalese authorities and another 13 for the country, along with the African Union, to create the Extraordinary African Chambers, a court specially made to try Habré.

He was absent for the appeal, which was conducted for him by lawyers who had no contact with their client. Habré was ordered to pay more than £100m to his victims in reparations, and the court said a trust fund set up by the African Union should search for his assets to this end.

When the verdict was read out last May, scenes of high tension were followed by jubilation among his victims, along with the lawyers and human rights activists who had fought for justice for 26 years.

This time, the joy was more muted: quiet singing echoed around the chamber at Dakar's Palais de Justice, but there were no shouts of triumph, no tears, no defiant Habré shaking his fist.

"Today will go down in history as the day that a band of unrelenting survivors finally prevailed over their dictator," said the human rights defender Reed Brody, whose painstaking work, alongside the lawyer Jacqueline Moudeina and victims led by Guengueng, was central to the case.

Some have expressed worry that Habré could be given a pardon by the Senegalese president, Macky Sall, or his successor. However, Moudeina thought this unlikely.

"I don't believe that Senegal will undo all its wonderful work on this case by freeing Habré," she said. "A pardon would not only violate Senegal's treaty with

the African Union and its obligations under the UN torture convention, it would be a slap in the face to the victims after all they have been through."»
(3574 знака)

## №4. For a horrible glimpse into Australia's dark future, look to Trump's views on coal

«Every big step in the process of decarbonisation is marred by unshakeable ideological allegiances. This is the frustrating and tragic clockwork of climate action: there are always echoes of a plan, but they're buried underneath political posturing.

Renewable energy has broad bipartisan support. The shutdown of coal is a different story. There are no popular solutions for the ugly end of climate action. Can we thread a needle through the ever-shifting ethical challenges of surgically removing a technology that still forms a major part of our society?

The recent shutdown of the Hazelwood coal-fired power station isn't Australia's first coal closure, but the event activated the denial of coal's inevitable demise in those tasked with forward thinking. This pattern of denial is a haunting forecast of what we'll see when the closure of coal intensifies in Australia.

Coal's destiny isn't a secret. The European Union has pledged no new coal plants after 2020. China and India have seen a pointed decline in coal growth. The UK's last lump of coal will glow red in 2025. Though the International Energy Agency forecasts many more decades of coal, primarily in Asia, that's a testament to the strength of incumbency than any long-term viability.

Hazelwood's French owner, Engie, is "making climate a priority" – so much so that Hazelwood's closure was announced with only a few months' notice. It was Australia's oldest, dirtiest, most inefficient and expensive power station. It felt sudden, but that's because we have not been paying attention.

On the day of Hazelwood's closure, painted signs were hung alongside rows of helmets scrawled with messages of support, sentimentality and anger. "GOD HATES GREENIES", "FUCK THE GREENIES" and "SHUT DOWN BY GREENS + LABOR" all popped up in my Twitter feed on that day, alongside demands for the power station to be kept open.

Former prime minister Tony Abbott urged the government to intervene to meet these demands. The philosophy of government refusing to meddle in free energy markets was forgotten in the face of fewer fossil-fuelled electrons hurtling through the grid. The plea was rejected by the prime minister, but within days Malcolm Turnbull was blaming the closure of the power station on Victoria's Labor premier, Daniel Andrews, despite Hazelwood having been privatised under the Kennett government in the late 90s, before Engie's economic decision.

For the Labor party, there's no easy way to contextualise the deactivation of this historic, coal-powered machine within the frames of workers' rights and environmental protection. Celebrating the removal of such a profoundly significant source of emissions seems somewhat callous in the context of 750 humans being left without jobs in a town heavily dependent on the power station and coalmine.

Conversely, focusing solely on employment seems narrow and shortsighted, like odd disregard for the rest of us, breathing the same air and relying on the same atmospheric system. Hazelwood's contribution to total emissions was far greater than its contribution to generation of electrical power, but most discourse focused on the stability of the grid rather than emissions reductions.

Total facility-type electricity sector emissions and generation dataTotal facility-type electricity sector emissions and generation data from the National Greenhouse and Energy Reporting (NGER) database

The nuances and contradictions of coal closure don't fit neatly into any party's over-arching narrative. Nevertheless, the Greens initiated a Senate inquiry into the closure of coal-fired power stations, with the aim of investigating how a transition away from coal might be managed.

Even that exercise was split into ideological shards – the Greens (normally accused of runaway fanaticism) produced a level-headed final report, while Labor and the Liberal party produced dissenting reports that fractured any hope of a potential tripartisan pathway. Resounding retreat was the outcome.

For a horrible glimpse into a dark potential future for Australia, you need only glance at US president Donald Trump's views on coal-fired power, and the cruel system of false hope he's using to draw votes in US towns reliant on fossil fuels for employment.

As renewable energy and gas become cheaper in the US, Trump paints himself as the saviour of communities due to be hit hardest, promising a shining coal-powered future. The magnitude of this fantasy is not to be underestimated. Even the founder and chief executive of the largest privately held coal-mining firm in the US told Trump to tone it down, as Trump raised his executive pen to a slew of environmental regulations. It's the hulking momentum of the free market in the US that is shrinking demand for carbon-intensive fuels. Trump's promises go beyond lies. They are irresponsible, and they condemn thousands to a treacherous future.

Long-term plans to deal with the challenges of American coal decline are seen as political suicide in regions relying on the extraction and burning of a substance that has become politically, socially, economically and environmentally unviable.

Political flight, instead of political fight, isn't a uniquely Australian phenomenon. The major parties in Australia are yet to turn the echoes of a plan into reality, and so we're left vaguely toying with the immature fantasies of Trump.

We can't continue with a weather-beaten mess of policy that is being yanked daily in different directions by the minuscule attention span of political messaging. There is really only one way out of this: ditch the denials, accept reality, and make a serious plan for the inevitable demise of coal».

(5734 знака)

**№5. Gorillaz: Humanz review – a party album for a world gone mad**

«It is easy to forget that, on arrival in 2000, Gorillaz looked suspiciously like a self-indulgent novelty turn, the kind of project record labels feel impelled to let rock stars do when they've shifted so much product that "no" isn't really an option any more.

It was a Britpop frontman and his artist flatmate's sneery joke at the expense of manufactured pop, with cartoon figures replacing the hapless, manipulated band members and interviews conducted, a little wearyingly, in character. You would have got pretty long odds on it still existing 17 years on, longer odds still on their fifth album being a politically charged conceptual work that variously touches on the topics of racism (courtesy of rapper Vince Staples on apocalyptic choir-assisted opener Ascension), mental illness, the pernicious influence of the internet "echo chamber", western military intervention in the Middle East, the "alt-right" belief that China has fabricated global warming, and the importance of soul music in the Thatcherite heartlands of 80s Essex (the improbable latter topic surfaces on a lovely track called Andromeda, named after a defunct Colchester nightclub, which also finds Albarn ruminating on the deaths of both his partner's mother and Bobby Womack over a four-to-the-floor house beat and frail electronics).

And you would have been laughed out of the bookies had you suggested that it might feature among its stellar cast Noel Gallagher, a man keen to offer interviewers his considered critical appraisal both of Gorillaz's eponymous debut ("appalling – music for fucking 12-year-olds") and its mastermind, Damon Albarn ("That cunt is like, 'Is there a bandwagon passing? Park it outside my house.'") And yet, there he is, on Humanz's rousing closing track, the unlikeliness of the situation compounded further by the fact that he's singing: "We've got the power to be loving each other no matter what happens" in unison with his former nemesis.

But as Albarn would concede that things don't always turn out as you expect. He is, after all, currently promoting a Gorillaz album whose concept was based around conjuring up the dystopia that might ensue if Donald Trump became

US president. This was a notion that seemed so ridiculous and inconceivable it caused widespread hilarity in the studio when he announced it. Rather than a knowing joke, Gorillaz turned out to be the smartest artistic move of Albarn's career, emancipating him from the Britpop millstone, revealing him not as a bandwagon jumper, but as the one inarguable musical polymath that maligned era produced. It is possible that he might have gone on to work in Afrobeat and Syrian orchestral music and write operas based on Chinese folk music had Gorillaz not been a vast transatlantic success, but it's certainly harder to imagine.

Humanz demonstrates the pros and cons of Albarn's musical restlessness. As usual, he displays exquisite taste in collaborators – everyone from fast-rising rapper DRAM to dancehall singer Popcaan to old-school Chicago house legend Jamie Principle – and an impressive ability to get the best out of them by throwing them into unlikely circumstances. It's tempting to suggest that Submission is precisely the kind of out-and-out pop song that alt-R&B vocalist Kelela's career has thus far lacked. Grace Jones sounds particularly magnificent improvising a vocal around a post-punk-y distorted guitar line, with Albarn singing in blank-eyed cockney Syd Barrett mode on Charger, while the conjunction of De La Soul, a relentless distorted techno beat and synthesiser, courtesy of Jean-Michel Jarre, on Momentz is dazzling.

On the downside, it seems a little light on hooks, as if the business of experimenting with production and the excitement of juxtaposing incongruous musical bedfellows took precedence over writing hits. It is a shame, because when Albarn remembers to come up with melodies, his trademark languid melancholy is as affecting as ever: Hallelujah Money and Sex Murder Party offer particularly haunting examples. In addition, Humanz can feel a bit like a scattershot collection of tracks, rather than a coherent album. It is a state of affairs compounded by the fact that, as is usual with concept albums, the concept doesn't always hold up over the full 49 minutes. Some tracks fit the party-album-for-a-world-gone-mad concept, others are patently off-topic – and the spoken-word interludes, which reference everything from the Clash's London Calling album to the old crowd

shouting “Yes – we are all individuals!” joke from Monty Python’s Life of Brian, don’t make a vast amount of sense.

Then again, you could argue that is less a failing than evidence of Albarn’s ability to move with the times. After all, we live in an era where the world’s biggest stars refer to their new releases as playlists, rather than albums. And the one thing Humanz never does is suggest a decline in inspiration on the part of the man behind it. Quite the opposite: the ideas are still coming in such abundance, it seems to occasionally prove a struggle to marshal them. There are substantially worse problems for an artist to have than that».

(5194 знака)

## №6. Concepts of communication

««Communication is the key» is a quote that is often repeated. In every single relationship communication is essential. Especially among parents and children.Communication between parent and child has always been important.

Today, however, there is an even greater focus, especially in light of all the things children face at school and in everyday life. Without a parent knowing what is going on in the life and mind of their child, it is hard to really understand what they are going through. Communication is the starting point of understanding.

Children learn communication from their parents. Communication is not something that can be studied; it is something that people have to learn by doing. As a parent, good communication needs to be emphasized as they are talking and listening to the child. A child can tell when a parent is not really listening to them, and this can create a big problem in the relationship. Children who feel misunderstood or feel like they aren‘t being listened to will start to hold their feelings inside. This is the exact opposite of what good communication should be. Good communication is not merely talking; it is being with someone and relating that nothing else is more important at that time. So many times parents are doing

three or four tasks while their child is trying to communicate something to them. They may not even look up from the recipe or newspaper they are trying to read, as the child is desperately trying to get their attention. This displays a lack of interest in the child or what they are trying to convey to the parent. Lack of interest is one thing that will keep families from communicating. When someone doesn‘t feel worthy enough of attention, they will stop sharing all together. When children stop sharing with their parents, they go to places and people that will show them attention. This can lead to trouble. The child may look for other avenues of acceptance, which could be negative influences. This could easily be avoided if only the parent had shown an interest in the child‘s life. Part of effective communication with your children is being aware of their whereabouts. A child who is unsupervised or who has a parent that doesn‘t show an interest in her activities, is likely to shut down and internalize her feelings.

Parents also need to be aware of what is going on in a child‘s life. They need to talk with them and always know where they are going and what they are doing. Children, even though they may not show it, really thrive on acceptance from their parents. A parent who is involved in the child‘s life will be more likely to influence that child. When a child knows what standards that their parents have for them, they will more likely obey and want to please their parents. Respect for a child is also important. When listening to a child, make sure to respect what they are saying and really listen to them. Listening is sometimes hard when someone is saying something that the other person may not agree with. But a parent needs to just sit back and listen. And, in return, a parent who is aware of and respects their child‘s feelings, will promote greater communication from the child.

Listening is something that more parents need to work on. When a child approaches their parent, they are probably wanting to talk about or ask something important to them. Even if the topic isn‘t important to the parent or is something that is debatable between them, the child wants to be heard. Then when the child is done sharing and asks for input, the parent can tell them how they feel. Nothing is more aggravating than a parent who always wants to tell the child how they should

do things without even listening to what the child wants. So parents need to be sure to listen. Two-way interaction promotes confidence and security, and a secure child is one who will open up and communicate.

To gain respect from children, parents must also give in. Be firm in your household rules, but also give validity to their feelings. Encourage open and honest communication by holding family meetings where everyone has an equal chance of expressing himself. In these meetings, let the children know that they are allowed to voice their opinions without anyone criticizing them. This will open the door to open communication and make the child feel more comfortable by expressing their opinions.

Some tips for good communication between parents and children are:

1. When your children are talking, stop whatever else you‘re doing to listen to them.

2. Express interest in what they are saying without being intrusive.

3. Listen to your child‘s viewpoint, even if it‘s difficult to hear.

4. Let your child finish speaking before you respond.

5. Focus on your child‘s feelings rather than your own during the conversation.

6. Control strong emotional responses when you disagree with your child‘s point of view. The guide tells parents, «Controlling this response is one of the biggest gifts you can give your child.».

Stressing good communication skills is very essential in the development of children. Especially in Christian homes. As a Christian, communication is very important. It is the means that we have with our God. Prayer is our communication with God. Without that time of solitude and quiet time alone with God, there would not be a relationship. He also communicates to us through the bible, prayer, and even through other people. This is the same for all relationships. Without communication there is no relationship.

Communication is necessary for everything we do in life and we learn it while we are children. The communication skills learned by children from their

families will stick with them throughout their lives. in order to have a society of good communicators, it needs to start in the home. Parents need to start communicating with their children and need to show them how to communicate with others. This is a skill that will be valued all throughout life and is something that shouldn‘t be ignored. The skill of communication will be valued in every relationship throughout life. It is a necessity».

(3128 знаків)

## №7. Energy Crisis, Global Warning

«The most important source of our modern civilization is energy. Energy is in everything. It comes in different forms — heat (thermal), light (radiant), mechanical, electrical, chemical, and nuclear energy. The use of energy has been a key in the development of the human society by helping it to control and adapt to the environment. Managing the use of energy is inevitable in any functional society. In the industrialized world the development of energy resources has become essential for agriculture, transportation, waste collection, information technology, communications that have become prerequisites of a developed society. The increasing use of energy since the Industrial Revolution has also brought with it a number of serious problems, some of which, such as global warming, present potentially grave risks to the world.

In society and in the context of humanities, the word energy is used as a synonym of energy resources, and most often refers to substances like fuels, petroleum products and electricity in general. These are sources of usable energy, in that they can be easily transformed to other kinds of energy sources that can serve a particular useful purpose.All forms of energy are stored in different ways, in the energy sources that we use every day. These sources are divided into two groups — renewable (an energy source that can be replenished in a short period of time) and nonrenewable (an energy source that we are using up and cannot recreate in a short period of time). Renewable and nonrenewable energy sources can be

used to produce secondary energy sources including electricity and hydrogen. Renewable energy sources include solar energy, which comes from the sun and can be turned into electricity and heat. Wind, geothermal energy from inside the earth, biomass from plants, and hydropower and ocean energy from water are also renewable energy sources.However, we get most of our energy from nonrenewable energy sources, which include the fossil fuels — oil, natural gas, and coal. They‘re called fossil fuels because they were formed over millions and millions of years by the action of heat from the Earth‘s core and pressure from rock and soil on the remains (or ―fossils‖) of dead plants and animals. Another nonrenewable energy source is the element uranium, whose atoms we split (through a process called nuclear fission) to create heat and ultimately electricity.

We use all these energy sources to generate the electricity we need for our homes, businesses, schools, and factories. Electricity ―energizes‖ our computers, lights, refrigerators, washing machines, and air conditioners, to name only a few uses. Oil is one of the most important of all these energy sourses. Oil that we use these days comes from a meterial called Crude oil. Crude oil is a smelly, yellow-to black liquid and is usually found in underground areas called reservoirs. Scientists and engineers explore a chosen area by studying rock samples from the earth. The amount of crude oil produced has been getting smaller each year. However, the use of products made from crude oil has been growing, making it necessary to bring more oil from other countries.

As the supply of these crude oil is decreasing with the increasing demand we call it a Energy crisis.More precisely an energy crisis is any great bottleneck (or price rise) in the supply of energy resources to an economy. It usually refers to the shortage of oil and additionally to electricity or other natural resources. An energy crisis may be referred to as an oil crisis, petroleum crisis, energy shortage, electricity shortage or electricity crisis. As we live in the age of oil, but it is drawing to a close. The worlds‘ most widely respected geologists, physicists, bankers, and investors in the world are absolutely terrified by a phenomenon known as global ―Peak Oil.

Peak oil is the point in time when the maximum rate of global petroleum extraction is reached, after which the rate of production enters terminal decline. The concept is based on the observed production rates of individual oil wells, and the combined production rate of a field of related oil wells. The aggregate production rate from an oil field over time appears to grow exponentially until the rate peaks and then declines, sometimes rapidly, until the field is depleted. It has been shown to be applicable to the sum of a nation‘s domestic production rate, and is similarly applied to the global rate of petroleum production. It is important to note that peak oil is not about running out of oil, but the peaking and subsequent decline of the production rate of oil.

If 2005 was the year of global Peak Oil, worldwide oil production in the year 2030 will be the same as it was in 1980. However, the world‘s population in 2030 will be both much larger (approximately twice) and much more industrialized (oil dependent) than it was in 1980. Consequently, worldwide demand for oil will outpace worldwide production of oil by a significant margin. As a result, the price will skyrocket, oil dependant economies will crumble, and resource wars will explode.

The issue is not one of ―running out‖ so much as it is not having enough to keep our economy running. In this regard, the ramifications of Peak Oil for our civilization are similar to the ramifications of dehydration for the human body. An oil based economy such as ours doesn‘t need to deplete its entire reserve of oil before it begins to collapse. A shortfall between demand and supply as little as 10 to 15 percent is enough to wholly shatter an oil-dependent economy and reduce its citizenry to poverty.The effects of even a small drop in production can be devastating. For instance, during the 1970s oil shocks, shortfalls in production as small as 5% caused the price of oil to nearly quadruple. The same thing happened in California a few years ago with natural gas: a production drop of less than 5% caused prices to skyrocket by 400%.Fortunately, those price shocks were only temporary.

The coming oil shocks won‘t be so short lived. They represent the onset of a new, permanent condition. Once the decline gets under way, production will drop (conservatively) by 3% per year, every year. War, terrorism, extreme weather and other ―above ground‖ geopolitical factors will likely push the effective decline rate past 10% per year, thus cutting the total supply by 50% in 7 years. These estimate comes from numerous sources, many of which believe global oil production will peak and go into terminal decline within the next five years, if it hasn‘t already.

Many industry insiders think the decline rate will far higher . Andrew Gould, CEO of the giant oil services firm Schlumberger, for instance, recently stated that ―An accurate average decline rate of 8% is not an unreasonable assumption.‖ Some industry analysts are anticipating decline rates as high as 13% per year. Source A 13% yearly decline rate would cause global production to drop by 75% in less than 11 years. If a 5% drop in production caused prices to triple in the 1970s, what do you think a 50% or 75% drop is going to do? Estimates coming out of the oil industry indicate that this drop in production has already begun. The consequences of this are almost unimaginable.

People tend to think of ―alternatives to oil‖ as somehow independent from oil. In reality, the alternatives to oil are more accurately described as ―derivatives of oil.‖ It takes massive amounts of oil and other scarce resources to locate and mine the raw materials (silver, copper, platinum, uranium, etc.) necessary to build solar panels, windmills, and nuclear power plants. It takes more oil to construct these alternatives and even more oil to distribute them, maintain them, and adapt current infrastructure to run on them.

If oil production remains constant, there is enough to last 42 years. That figure is 61 years for natural gas and 133 years for coal. Oil and gas wells produce less as they become depleted which is just one reason production will not stay constant. Everyone realizes oil and gas will become scarce and expensive within the life times of living humans. Inevitably, there will be a transition to sustainable energy sources. The transition may be willy-nilly or planned–the choice is ours.

Because of our numbers and our technology, we humans greatly influence the ecology of Earth. Yet Earth does not come with an operating manual and we need to look to science to create one. The new era of limited and expensive energy will be very difficult for everyone on Earth but it will be even more difficult if it is not anticipated. It is of utmost importance that the public and especially policymakers understand the global energy crisis and the underlying science».

(8776 знаків)

## №8. World Trade Organisation

«Changes in the political environment and the technological development are factors that both have changed the opportunity for countries to trade services and products. It is easier for us to transfer information and transport the services and products around the world.

Fisher slightly describes advantages and disadvantages of globalization. He talks about different benefits and changes such as the new technology and its effects in the business world of today, and he also mentions that the markets are more open than before. He describes that the opponents of globalization claims different disadvantages, such as companies moving their production to countries where it is easier for them to produce without caring about labour laws, and that WTO and other organizations are undemocratic and that underprivileged people‘s interests are neglected.

One section in Australia that has benefited by the globalization is the wine industry. It is a huge business and Australia is famous all over the world for the different wines the domestic companies produce. Since Australian wine is as popular as it is, the industry is benefited when the trade barriers and tariffs are reduced. It is easier for the different wine companies to enter new markets and to increase the sales. According to facts from the Australian government website Australia is ―one of the top wine-producing countries in the world‖. They exported almost the double volume of wine compared to what was sold

domestically. The government helps the entire wine industry in Australia in forms of reducing barriers of trade. Countries that Australia exported the largest volumes of wine to 2006/2007 were United Kingdom and United States but also Canada, Germany and New Zealand were all large markets.

A section that has been disadvantaged by the globalization could be all the workers in the different domestic industries that choose to move the production overseas. If Australian companies expand overseas and move their production these workers will compete evenmore when it comes to all the jobs available within the country. The domestic supply of labour will be higher than the companies demand and this will increase the unemployment. According to Homan domestic companies will look at the opportunities overseas and come to establish their production in other countries. The wages domestically will decrease since there are fewer jobs than usual for the workers to apply».

(2464 знака)

## №9. World's Largest Wind Turbine Would Be Taller Than the Empire State Building

«Massive, flexible blades would bend with storm winds like the palm trees that inspired them

Wind energy is soaring in the U.S.; the nation's renewable energy capacity has more than tripled in the past nine years, and wind and solar power are largely responsible. Now businesses want to harness even more wind energy, at a cheaper price—and one of the best ways to lower cost is to build bigger turbines. That's why an alliance of six institutions led by researchers at the University of Virginia are designing the world's largest wind turbine at 500 meters tall—almost a third of a mile high, and about 57 meters taller than the Empire State Building.

Turbines are already noticeably larger than they were 15 or 20 years ago. Size varies, but today's typical wind farm towers stand around 70 meters tall, with

blades about 50 meters long. Their power output depends on size and height, but it generally ranges between one and five megawatts—on the upper end, that's enough to power about 1,100 homes. "There's this motivation to go to larger wind turbines, and the reason is pretty much economics," explains John Hall, an assistant professor of mechanical and aerospace engineering at the University at Buffalo, S.U.N.Y. One reason giant turbines are more cost-effective is that wind blows stronger and more steadily at greater altitudes. Thus, "you capture more energy" with a taller structure, says Eric Loth, project leader of the massive turbine project, which is funded by the U.S. Department of Energy's Advanced Research Projects Agency–Energy (ARPA–E).

Another reason wind experts say bigger is better: longer turbine blades also catch the wind more efficiently, and taller towers enable lengthier blades. A turbine's power is directly related to its "swept area"—the circular area covered by the blades' rotation—explains Christopher Niezrecki, a professor of mechanical engineering and director of the Center for Wind Energy at the University of Massachusetts Lowell. And this relationship is not linear—if blade length doubles, a system can produce four times as much energy, Niezrecki explains. He notes that bigger turbines also have a lower "cut-in" speed, the wind speed at which they can start generating energy.

Loth's team wants to design a 50-megawatt system with blades 200 meters long, much larger than today's wind turbines. If the researchers succeed, they believe the turbine would be 10 times more powerful than existing equipment. But the scientists do not intend to simply supersize conventional designs; they are fundamentally changing the turbine structure. The ultralarge machine will have two blades instead of the usual three, lowering the weight of the structure and cutting costs. Loth says that reducing the number of blades would ordinarily make a turbine less efficient, but his team is using an advanced aerodynamic design that he says largely makes up for those losses.

The team also envisions these gigantic structures standing at least 80 kilometers offshore, where winds tend to be stronger and where people on land

cannot see or hear them, according to Loth. But powerful storms hit such places—off the U.S. east coast in the Atlantic Ocean, for example—so Loth's team faced the quandary of creating something massive that is also relatively lightweight and still resilient in the face of hurricanes. To tackle the problem, the researchers looked to one of nature's own design solutions: palm trees. "Palm trees are really tall but very lightweight structurally, and if the wind blows hard, the trunk can bend," Loth says. "We're trying to use the same concept—to design our wind turbines to have some flexibility, to bend and adapt to the flow."

In the team's design the two blades are located downwind of the turbine's tower, rather than upwind as they are on traditional turbines. The blades also change shape with the wind's direction, similar to a palm tree. "When the blades bend back at a downwind angle, you don't need to build them as heavy or strong, so you can use less material," Loth explains. This design also lessens the possibility that strong winds will bend a spinning blade toward its tower, potentially knocking the whole structure down. "The blades will adapt to high speeds and start to fold in, so there are less dynamic forces on them," Loth says. "We'd like our turbines to be able to handle higher than 253-kilometer-per-hour winds" in nonoperating conditions. Above a wind speed of 80 to 95 kilometers per hour the system would shut down and the blades would bend away from the wind, so they could withstand violent gusts, Loth adds.

The 500-meter turbine still faces challenges—there are good reasons no one has yet built one close to this size: "How do you make 200-meter blades? How do you put them together? How do you erect such a tall tower? Cranes only go so high. And with offshore wind, [there are] additional complications," Niezrecki says. The team's design includes a segmented blade that could be assembled from pieces on site, but Niezrecki notes the wind industry has not quite figured out how to segment the blades just yet. "There are lots of research questions to be addressed," he says. "It's definitely high risk, but there's also potential for high reward as well. I don't think those problems are insurmountable." Hall also questions whether such a massive turbine is the optimal size. "We are figuring out

that bigger is better. The question is, how much bigger? We need to find that sweet spot," he says. "We're going to learn a lot from this project."

Loth and his team have yet to test a prototype; they are currently designing the turbine's structure and control system, and this summer they are building a model much smaller than the real thing—about two meters in diameter. Next summer they plan to construct a larger version with two 20-meter-long blades, which will produce less than a megawatt of power and will be tested in Colorado. Loth himself is not 100 percent certain his team's mammoth turbine will become a reality but he is sure it is worth trying. "This is a very new concept, so [there are] definitely no guarantees it will work," he says. "But if it does, it will revolutionize offshore wind energy"».

(6282 знака)

## №10. Israel Tests Wireless Charging Roads for Electric Vehicles

«New technology could power buses and cars on the go, but will it be cost-effective?

Electric vehicles have long been a promising option for sustainable transportation. They come with practical headaches like expensive, bulky batteries that often need recharging, however. Israel is tackling those hurdles by investing in roads that power electric buses—as they ride down the street. The government is collaborating with Israeli start-up ElectRoadto install a public bus route in Tel Aviv, using an under-the-pavement wireless technology that eliminates the need for plug-in recharging stations.

Although still in its infancy, the technology could clear the three biggest hurdles—cost, weight and range—that have held back the widespread adoption of battery-powered vehicles for more than a century. First, though, ElectRoad will have to demonstrate that its "inductive charging" technology can be scaled up cheaply enough to be adopted on roadways worldwide. "It's exciting because it's charging without wires," says Tim Cleary, director of BATTERY, an energy-

storage research laboratory at The Pennsylvania State University, who is not involved in the project. “But unless it’s affordable and cost-effective it’s not going to take off.”

ElectRoad is betting it will. Wireless charging means the electric buses can carry a light, inexpensive battery instead of a bulky, costly one—and never have to stop for recharging. And once a roadway is outfitted with the technology, it can continuously power properly equipped vehicles. “You only need to pave for the infrastructure one time, and that’s it. You can use it for all kinds of vehicles, so that’s a big advantage,” says Oren Ezer, chief executive and co-founder of the four-year-old company.

So far, the firm’s only proving ground has been an 80-foot test route at its headquarters in Caesarea. But the technology performed well enough for the company to win a $120,000 grant from Israel’s Ministry of Transport and Road Safety and approval to outfit a portion of a Tel Aviv bus route with their technology, says Shay Soffer, chief scientist at the ministry. The route will be around half a mile long and is slated to open in 2018. If all goes well, the government plans to deploy the technology more widely, starting with an 11-mile shuttle between the city of Eilat and the Ramon International Airport. “Tel Aviv is the biggest city [in Israel], like New York on a small scale. If it will work in Tel Aviv, it will work anywhere,” Soffer says.“I think in 10 years you’ll see a lot of solutions like ElectRoad in our transportation.”

ElectRoad’s Ezer declined to give the price of the Tel Aviv project but says the total cost of construction will be shared by the transport ministry, the city and the company. The cost per kilometer of roadway will be a crucial factor in future years as the company attempts to scale up. Israel joins a growing number of nations exploring the technology. South Korea, for example, already has several wireless bus routes around the country. The European Union is studying the feasibility of widespread wireless charging, too. ElectRoad’s technology is different, Ezer says, because the transformers are less expensive and the installation process is faster and more efficient.

Inductive charging has been around since the 1890s, when inventor Nicola Tesla first discovered he could wirelessly power lightbulbs. Since then it has been used in an array of devices ranging from phones to toothbrushes—but only recently on the scale of a 13-ton bus. The buses are charged and propelled by power from the interaction of two electromagnetic fields. Inverters installed along the side of the road provide power to plates of copper embedded in the road. Similar copper plates are installed on the bus's underside. As the vehicle passes over the charged roadway, the two fields interact and generate power.

ElectRoad says it can install the technology in an existing road with minimal disruption, using two tractors that can fully equip one kilometer of roadway in a single night. Each bus still needs a small onboard battery for a couple of reasons: The first is to accelerate, because the jolt of energy required to propel a stationary bus is far more than the energy it needs to coast down the street. The second is to provide power on short stretches of road that are not fitted with the technology. ElectRoad's buses can travel off the charging road for about three miles.

The biggest advantages of wireless charging are that it allows for significantly smaller batteries or the ability to travel longer distances with a larger battery. Both are convenient, says Burak Ozpineci, who works on wireless technologies at Oak Ridge National Laboratory in Tennessee. However, the cost of the infrastructure and materials, especially copper, will likely be expensive, he says. Currently, the metal costs about $2.60 per pound. In addition to costing more, wireless power might not be as straightforward as simply plugging into a socket—the bus could stray from the main strip, becoming misaligned and delivering less power, according to Penn State's Cleary.

In addition, the advantages of ElectRoad's technology may become less important as electric vehicle batteries get cheaper, lighter and more efficient. Breakthroughs in engineering and chemistry have made batteries much more cost-efficient over the past 15 years, says Dustin Grace, director of battery engineering at Proterra, an electric bus company. A few years ago a typical electric vehicle battery cost about $1,000 per kilowatt hour. But now many companies are down to

$200 to $300 per kilowatt hour, and a few, including Tesla, General Motors and Nissan, are even lower, according to Grace. “I’m in the camp where I see the cost of lithium ions and energy storage just plummeting,” Grace says. “What these auto manufacturers are finding when they’re getting into the $100-to-$200-per-kilowatt-hour range is these vehicles are really on parity with other vehicles. They’re no longer looking at batteries as this challenge that has to be solved.”

Ezer acknowledges battery prices are falling but emphasizes ElectRoad’s solution is not for individual vehicles but for all-encompassing infrastructure that can eventually serve entire cities. That’s where the savings are, he says. And remember that small, light battery onboard? It is only used about 6 percent of the time the vehicle is running, and thus can last as long as 25 years, Ezer asserts. By contrast, conventional batteries in electric buses, like those made by Proterra, last around six years.

Despite the challenges of scaling up, ElectRoad is optimistic about the growing synergies between its vehicles and electric grids that are transitioning to renewable energy sources like solar and wind, instead of fossil fuels. Eventually, the company even hopes to make wireless charging a two-way street: not only from road to bus but vice versa with the energy generated from braking, according to Ezer.

And down the road, the start-up’s dreams are even bigger, Ezer says. “We plan to start with buses, of course, but we believe in revolutionizing the entirety of transportation.”»

(7223 знаки)

## №11. Wind and Solar Growth Outpace Gas

«More than half of electricity generation capacity added to the U.S. grid in 2016 came from renewable resources

More than half of the roughly 24,000 megawatts of electricity generation capacity added to the U.S. grid in 2016 came from renewable resources, according to new findings from the U.S. Energy Information Administration.

The agency estimates that 60 percent of all utility-scale generation capacity additions for the year were from wind and solar resources, while roughly 3 percent came from hydropower, biomass, landfill gas and other sources.

Among fossil fuels, natural gas accounted for the largest share of new electricity capacity in 2016, with an estimated 7,700 MW of new gas-fired power coming online (32 percent of all new capacity), while nuclear capacity grew by 1,347 MW (5.6 percent), officials confirmed.

Utility-scale renewables have accounted for an increasingly large share of total capacity additions over the past several years, rising from 40 percent of new capacity in 2013 to 66 percent in 2015.

While the number of solar arrays and wind farms continued to rise overall in 2016, EIA noted that increased capacity does not necessarily translate into larger shares of renewable power generation. That's because renewables like wind and solar are intermittent and not available all the time, officials said.

The agency did report figures for monthly renewable energy generation over the 12-month period.

In particular, EIA found that seasonal rains and melting snowpack in Western states led to a surge in hydropower production last March; it was sustained into April and May. The 2016 boost in hydropower from Western dams came as the region recovered from drought conditions in 2014 and 2015, EIA said.

A windy winter, spring and fall also helped drive strong wind energy production in 2016, although wind power and other renewable power production was more evenly distributed both seasonally and geographically, the agency found. Solar saw modest increases in output during the summer months and peaked in July.

According to its most recent “Short-Term Energy Outlook,” also released yesterday, EIA expects total renewable fuels used in the electric power sector to

dip in 2017 before jumping by 7.3 percent in 2018. Consumption of non-hydro renewable energy is forecast to grow by 1.3 percent in 2017 and by 9.8 percent in 2018.

EIA reported that most renewable generation comes from Western states, which accounted for 63 percent of all U.S. hydroelectric power and 77 percent of all solar generation in 2016. Roughly 72 percent of the nation's wind power came from the Midwest and the South, notably Texas, while 24 percent came from Western states.

In contrast to the growth in renewable energy, EIA this week also reported that U.S. coal is expected to fall to its lowest level in nearly 40 years, at 743 million short tons. That vast majority of U.S. coal is burned to generate electricity.

Projected coal production for 2016 is down 17 percent from 2015, and it continues an eight-year tumble from peak coal production in 2008. Coal's decline last year was affected by a number of factors, including competition from low-cost natural gas, higher-than-normal temperatures during the 2015-16 winter, retirements of U.S. coal-fired power plants and reduced demand for U.S. coal exports, the agency said.

In 2016, natural-gas-fired power generation surpassed coal-fired generation for the first time, accounting for an estimated 34 percent of total electricity generation, compared with coal's 30 percent share. EIA's most recent “Short-Term Energy Outlook” forecasts that power-sector coal consumption in 2016 will be roughly 681 million short tons, the lowest level since 1985».

(3734 знаки)

## №12. Ukraine Embraces the Renewables Revolution

«Wind and solar power are wallflowers in oil- and gas-rich Russia. Not so in neighbouring Ukraine. With fears about Russian hegemony at a peak, the former Soviet republic is ready to join the renewables revolution.

“Energy independence has become a matter of national security for Ukraine,” says Sergiy Savchuk, head of the state agency on energy efficiency and energy saving in Kiev. “That’s why renewable-energy development is now a priority issue for the Ukrainian government.”

In July, Ukrainian environment minister Ostap Semerak unveiled plans to build a large solar power plant and a biogas facility in the wasteland around the former Chernobyl reactor.

The announcement came just two weeks after parliament reopened the state-owned exclusion zone around the shuttered nuclear site to development for business and science.

The Chernobyl energy project will cost around US$1.1 billion, a sum that means substantial foreign investment is required. It is part of Ukraine’s broader ambition to step up renewable-energy capacity. According to the National Renewable Energy Action Plan adopted in 2014, the government aims to almost triple capacity for electricity production, transport and heating by 2020—from its current level of around 9.3 gigawatts to more than 26 gigawatts. Renewables would then supply about 11% of all energy consumed in Ukraine.

Despite the traumatic Chernobyl reactor meltdown in 1986, which contaminated large parts of Europe and tempered Ukraine’s nuclear ambitions, the country continues to produce about 50% of its electricity from a fleet of 15 Soviet-built nuclear reactors.

Ukraine also depends heavily on oil and natural gas imported from Russia. But political turmoil over Russia’s annexation of the Crimean peninsula in 2013 and ongoing pro-Russian unrest in the eastern Donbas region led to the strategic rethink. Already, Ukraine has reduced its reliance on Russian fossil fuels, cutting consumption of natural gas by about one-third since 2013.

Ukraine has significant untapped renewable-energy potential, finds a 2015 report by the International Renewable Energy Agency (IRENA) in Abu Dhabi, United Arab Emirates—enough to support the 2014 plan. The largest country to lie entirely within Europe (Turkey and Russia are mostly in Asia), it gets more

sunshine than Germany, where photo-voltaic solar power now exceeds 40 gigawatts.

Ukraine also has good grid infrastructure, including high-voltage transmission lines between Chernobyl and Kiev, says Dolf Gielen, director of IRENA's Innovation and Technology Center in Bonn, Germany.

But the economic environment is less favourable, Gielen says. Electricity demand has declined in the years since the conflict with Russia escalated, and is mostly met by existing nuclear and fossil-fuel sources. More-over, the exceedingly high cost of investment in the politically unstable country might discourage potential backers. As the first phase of implementing the 2014 action plan, Ukraine is scheduled to build 51 solar-power and 15 wind-power projects—an endeavour that will cost an estimated $7 billion.

"Financing renewables in Ukraine is comparable to investing in parts of Africa," Gielen says. "Investors such as the European Bank for Reconstruction and Development might still be interested, but the Chernobyl solar plant certainly can't be a purely commercial project."

In Russia, things are different. Solar plants on the annexed sunny Crimean peninsula have some 300 megawatts of capacity. But elsewhere, utility-scale wind and solar plants are almost non-existent.

The Russian government does aim to tap the renewable-energy potential afforded by the country's Arctic regions, which are sun-drenched during northern summers, and its warm, windy southern steppes. Hydropower already provides 17% of Russian electricity, but by 2020, other renewables will supply 4.5%, up from less than 1% currently, according to the Kremlin's energy strategy.

Yet experts doubt the target is achievable. "Manufacturing limitations mean that Russia produces almost no wind turbines and solar panels," says Deger Saygin, a programme officer for IRENA in Bonn. Foreign capital has been in short supply, because economic sanctions imposed by the European Union and the United States in response to Moscow's seizure of the Crimea unsettled potential investors.

In the short term, Saygin says, small, off-grid renewable-energy systems in Siberia and Far Eastern provinces such as Kamchatka—where scattered communities, mines and small industries have long relied on diesel generators—are Russia's prime opportunity in the clean-energy market. There are currently 13 solar plants operating in Yakutia, including the largest solar plant north of the Arctic Circle, and some wind farms in Kamchatka. "Renewable energy in Russia," says Saygin, "is mainly driven by Siberia's distance from the national grid."»

(4974 знаки)

## №13. Dispelling 3 Myths about the Markets and Economy

«Several myths have taken hold among market watchers lately. They relate to the state of the economy, the attractiveness of various asset classes and how the Federal Reserve (Fed) should be judged in meeting its policy goals. Dispelling these myths—with the help of economic facts, reliable financial measures and an understanding of big-picture secular dynamics—can help investors better discern the direction of the economy and markets.

**Myth #1: The U.S. is suffering through a weak and disappointing recovery that has resulted in a sluggish economy overall.**

This myth fails to appreciate much about the character of the current economic cycle, including that after a couple years of meager growth post-crisis, the U.S. labor market has displayed considerable strength in recent years. In fact, according to Bureau of Labor Statistics data as of June 2017, the U.S. has employed roughly 16.4 million people since the beginning of 2010. Furthermore, since 1970, the U.S. economy has only produced an unemployment rate of less than 4.3% about 4% of the time (from March 1999 to February 2001), and we are likely to again find ourselves in that range during the next few months.

This labor market recovery appears all the more impressive when it's considered in the context of structurally lower economic growth due to population aging trends, as well as the technological disruptions being experienced by many

industries. Demographic trends have shifted dramatically in the U.S. over the past half century toward an older population, and hence potential growth has to be structurally lower today, even as we hire great numbers of people (to say nothing of deploying ever greater numbers of robots).

**Myth #2: Investors will likely reduce fixed income exposure, as it looks less attractive today and as additional supply is set to push yields higher.**

This notion may make sense at a basic level, but it simply misses the massive need for yielding assets in the current investment landscape, and the dearth of available supply. In fact, nearly $200 billion has flowed into fixed income funds year-to-date through the end of May, according to EPFR Global. And this year alone, central banks are likely to buy roughly $1.4 trillion of fixed income assets on only $1.9 trillion in net supply. This dynamic has resulted in a very significant supply/demand imbalance within fixed income markets that is likely to take quite some time to resolve.

**Myth #3: Lower levels of unemployment always drive higher wage growth and inflation.**

Finally, there has been a widespread misunderstanding about how the Phillips Curve has been operating during this cycle, with excessive faith placed in the historic relationship between lower levels of unemployment driving higher wage growth and inflation. Some evidence from Evercore ISI suggests that U.S. states with the lowest unemployment rates have above-average rates of wage growth, and vice versa. But in the aggregate, the relationship between unemployment and inflation appears less strong now. Broad inflation will likely follow unemployment much more slowly during this cycle than it has historically, and it may well not dramatically overshoot the Fed's 2% inflation target for a long time.

This is thanks to technology-related deflationary pressures, including efficiencies in employment sourcing and implementation, as well as robotic or artificial intelligence substitution. Fascinatingly, the modern smartphone replaces dozens of previously purchased products, and it does so today at a price point that

is remarkably low. When you consider this substitution effect, along with the dramatically reduced need for infrastructure, middlemen, shipping and logistics attached to the replacement of hard goods by virtual ones, it's abundantly clear how technology is reshaping our economy.

The bottom line: Pervasive myths such as those above hold little importance for the ultimate trajectory of the economy and the performance of asset markets».

(4019 знаків)

## №14. 9 Common Effects of Inflation

«If you believe the hype, the Trump era could be defined by a return to inflation after a long post-crisis stint of disinflation and, in some instances, outright deflation. Since investors haven't seen significant price rises in years, it's worth brushing up on the most common effects of inflation.

1. Erodes Purchasing Power

This first effect of inflation is really just a different way of stating what it is. Inflation is a decrease in the purchasing power of currency due to a rise in prices across the economy. Within living memory, the average price of a cup of coffee was a dime. Today the price is closer to two dollars.

Such a price change could conceivably have resulted from a surge in the popularity of coffee, or price pooling by a cartel of coffee producers, or years of devastating drought/flooding/conflict in a key coffee-growing region. In those scenarios, the price of coffee would rise, but the rest of the economy would carry on largely unaffected. That increase would not qualify as inflation, since the only the most caffeine-addled consumers would experience significant depreciation in their overall purchasing power.

Inflation requires prices to rise across a "basket" of goods and services, such as the one that comprises the most common measure of price changes, the consumer price index (CPI). When the prices of goods that are non-discretionary and impossible to substitute – food and oil – rise, they can affect

inflation all by themselves. For this reason, economists often strip out food and fuel to look at "core" inflation, a less volatile measure of price changes.

2. Encourages Spending and Investing

A predictable response to declining purchasing power is to buy now, rather than later. Cash will only lose value, so it is better to get your shopping out of the way and stock up on things that probably won't lose value.

For consumers, that means filling up gas tanks, stuffing the freezer, buying shoes in the next size up for the kids, and so on. For businesses, it means making capital investments that, under different circumstances, might be put off until later. Many investors buy gold and other precious metals when inflation takes hold, but these assets' volatility can cancel out the benefits of their insulation from price rises, especially in the short term.

Over the long term, equities have been among the best hedges against inflation. At the beginning of 1962, a share of the Walt Disney Co. (DIS) cost $37.22 in current dollars. According to Yahoo Finance, that share would be worth $1,623.08 at close on November 18, 2016, after adjusting for dividends and stock splits. The Bureau of Labor Statistics' (BLS) CPI calculator gives that figure as $202.78 in 1962 dollars, implying a real (inflation-adjusted) gain of 445%, or just over 8% per year.

Say you had buried that $37.22 in the backyard instead. The nominal value wouldn't have changed when you dug it up, but the purchasing power would have fallen to $4.65 in 1962 terms; that's about an 88% depreciation, or roughly 1.6% per year. (Of course not every stock would have performed as well as Disney: you would have been better off burying your cash in 1962 than buying and holding a share of Houston Natural Gas, which would merge to become Enron.)

3. Causes More Inflation

Unfortunately, the urge to spend and invest in the face of inflation tends to boost inflation in turn, creating a potentially catastrophic feedback loop. As people and businesses spend more quickly in an effort to reduce the time they hold their depreciating currency, the economy finds itself awash in cash no one particularly

wants. In other words, the supply of money outstrips the demand, and the price of money – the purchasing power of currency – falls at an ever-faster rate.

When things get really bad, a sensible tendency to keep business and household supplies stocked rather than sitting on cash devolves into hoarding, leading to empty grocery store shelves. People become desperate to offload currency, so that every payday turns into a frenzy of spending on just about anything so long as it's not ever-more-worthless money.

From 1913 to December 1923, an index of the cost of living in Germany rose by 153.5 trillion percent.

The result is hyperinflation, which has seen Zimbabwean consumers hauling around wheelbarrow-loads of million- and billion-Zim dollar notes (2000s), Germans papering their walls with the Weimar Republic's worthless marks (1920s), Peruvian cafes raising their prices multiple times a day (1980s), and Venezuelan thieves refusing even to steal bolívares (2010s).

4. Raises the Cost of Borrowing

As these examples of hyperinflation show, states have a powerful incentive to keep price rises in check. For the past century in the U.S. the approach has been to manage inflation using monetary policy. To do so, central banks rely on the relationship between inflation and interest rates. If interest rates are low, companies and individuals can borrow cheaply to start a business, earn a degree, hire new workers, or buy a shiny new boat. In other words, low rates encourage spending and investing, which generally stoke inflation in turn.

By raising interest rates, central banks can put a damper on these rampaging animal spirits. Suddenly the monthly payments on that boat, or that corporate bond issue, seem a bit high. Better to put some money in the bank, where it can earn interest. When there is not so much cash sloshing around, money becomes more scarce. That scarcity increases its value, although as a rule, central banks don't want money literally to become more valuable: they fear outright deflation nearly as much as they do hyperinflation (see section 7). Rather, they tug on interest rates in either direction in order to maintain inflation close to a

target rate (generally 2% in developed economies and 3% to 4% in emerging ones).

A more theoretical way of looking at central banks' role in controlling inflation is through the money supply. If the amount of money is growing faster than the economy, money will be worth less and inflation will ensue. That's what happened when Weimar Germany fired up the printing presses to pay its World War I reparations, and when Aztec and Inca bullion flooded Habsburg Spain in the 16th century. When central banks want to raise rates, they generally cannot do so by simple fiat; rather they sell government securities and remove the proceeds from the money supply. As the money supply decreases, so does the rate of inflation.

5. Lowers the Cost of Borrowing

When there is no central bank, or when central bankers are beholden to elected politicians, inflation will generally lower borrowing costs.

Say you borrow $1,000 at a 5% annual rate of interest. If inflation is 10%, the real value of your debt is decreasing faster than the combined interest and principle you're paying off. When levels of household debt are high, politicians find it electorally profitable to print money, stoking inflation and whisking away voters' obligations. If the government itself is heavily indebted, politicians have an even more obvious incentive to print money and use it to pay down debt. If inflation is the result, so be it (once again, Weimar Germany is the most infamous example of this phenomenon).

Politicians' occasionally detrimental fondness for inflation has convinced several countries that fiscal and monetary policymaking should be carried on independently. While the Federal Reserve has a statutory mandate to seek maximum employment and steady prices, it does not need a congressional or presidential go-ahead to make its rate-setting decisions. That does not mean the Fed has always had a totally free hand in policy-making, however. Former Minneapolis Fed president Narayana Kocherlakota wrote on November 15 that the

Fed's independence is "a post-1979 development that rests largely on the restraint of the president."

6. Reduces Unemployment

There is some evidence that inflation can push down unemployment. Wages tend to be sticky, meaning that they change slowly in response to economic shifts. John Maynard Keynes theorized that the Great Depression resulted in part from wages' downward stickiness: unemployment surged because workers resisted pay cuts and were fired instead (the ultimate pay cut). The same phenomenon may also work in reverse: wages' upward stickiness means that once inflation hits a certain rate, employers' real payroll costs fall, and they're able to hire more workers

That hypothesis appears to explain the inverse correlation between unemployment and inflation — a relationship known as the Phillips curve – but a more common explanation puts the onus on unemployment. As unemployment falls, the theory goes, employers are forced to pay more for workers with the skills they need. As wages rise, so does consumers' spending power, leading the economy to heat up and spur inflation; this model is known as cost-push inflation

7. Increases Growth

Unless there is an attentive central bank on hand to push up interest rates, inflation discourages saving, since the purchasing power of deposits erodes over time. That prospect gives consumers and businesses an incentive to spend or invest. At least in the short term, the boost to spending and investment leads to economic growth. By the same token, inflation's negative correlation with unemployment implies a tendency to put more people to work, spurring growth.

This effect is most conspicuous in its absence. In 2016, central banks across the developed world found themselves vexingly unable to coax inflation or growth up to healthy levels. Cutting interest rates to zero and below did not work; neither did buying trillions of dollars' worth of bonds in a money-creation exercise known as quantitative easing. This conundrum recalls Keynes's liquidity trap, in which central banks' ability to spur growth by increasing the money supply (liquidity) is rendered ineffective by cash hoarding, itself the result of economic actors' risk

aversion in the wake of a financial crisis. Liquidity traps cause disinflation, if not deflation

In this environment, moderate inflation was seen as a desirable growth-driver, and markets welcomed the increase in inflation expectations due to Donald Trump's election.

8. Reduces Employment and Growth

Wistful talk about inflation's benefits is likely to sound strange to those who remember the economic woes of the 1970s. In today's context of low growth, high unemployment (in Europe) and menacing deflation, there are reasons think a healthy rise in prices – 2% or even 3% per year – would do more good than harm. On the other hand, when growth is slow, unemployment is high *and* inflation is in the double digits, you have what a British Tory MP in 1965 dubbed "stagflation."

Economists have struggled to explain stagflation. Early on, Keynesians did not accept that it could happen, since it appeared to defy the inverse correlation between unemployment and inflation described by the Phillips curve. After reconciling themselves to the reality of the situation, they attributed the most acute phase to the supply shock caused by the 1973 oil embargo: as transportation costs spiked, the theory went, the economy ground to a halt. In other words, it was a case of cost-push inflation. Evidence for this idea can be found in five consecutive quarters of productivity decline, ending with a healthy expansion in the fourth quarter of 1974. But the 3.8% drop in productivity in the third quarter of 1973 occurred before Arab members of OPEC shut off the taps in October of that year.

The kink in the timeline points to another, earlier contributor to the 1970s' malaise, the so-called Nixon shock. Following other countries' departures, the U.S. pulled out of the Bretton Woods Agreement in August 1971, ending the dollar's convertibility to gold. The greenback plunged against other currencies: for example, a dollar bought 3.48 Deutsche marks in July 1971, but just 1.75 in July 1980. Inflation is a typical result of depreciating currencies.

And yet even dollar devaluation does not fully explain stagflation, since inflation began to take off in the mid-to-late 1960s (unemployment lagged by a few

years). As monetarists see it, the Fed was ultimately to blame. M2 money stock rose by 97.7% in the decade to 1970, nearly twice as fast as gross domestic product (GDP), leading to what economists commonly describe as "too much money chasing too few goods," or demand-pull inflation.

Supply-side economists, who emerged in the 1970s as a foil to Keynesian hegemony, won the argument at the polls when Reagan swept the popular vote and electoral college. They blamed high taxes, burdensome regulation and a generous welfare state for the malaise; their policies, combined with aggressive, monetarist-inspired tightening by the Fed, put an end to stagflation.

9. Weakens (or Strengthens) the Currency

High inflation is usually associated with a slumping exchange rate, though this is generally a case of the weaker currency leading to inflation, not the other way around. Economies that import significant amounts of goods and services – which, for now, is just about every economy – must pay more for these imports in local-currency terms when their currencies fall against those of their trading partners. Say that Country X's currency falls 10% against Country Y's. The latter doesn't have to raise the price of the products it exports to Country X for them to cost Country X 10% more; the weaker exchange rate alone has that effect. Multiply cost increases across enough trading partners selling enough products, and the result is economy-wide inflation in Country X.

But once again, inflation can do one thing, or its polar opposite, depending on the context. When you strip away most of the global economy's moving parts it seems perfectly reasonable that rising prices lead to a weaker currency. In the wake of Trump's election victory, however, rising inflation expectations drove the dollar higher for several months. The reason is that interest rates around the globe were dismally low – almost certainly the lowest they've been in human history – making markets likely to jump on any opportunity to earn a bit of money for lending, rather than paying for the privilege (as the holders of $11.7 trillion in sovereign bonds were doing in June 2016, according to Fitch).

Because the U.S. has a central bank, rising inflation generally translates into higher interest rates. The Fed has raised the federal funds rate three times following the election, from 0.5%-0.75% to 1.0%-1.25%. Even so, the dollar's rise was short-lived, and at the time of writing it has fallen below its pre-election level».

(14701 знак)

## №15. Molecular Technology Today

«One dictionary definition of a machine is "any system, usually of rigid bodies, formed and connected to alter, transmit, and direct applied forces in a predetermined manner to accomplish a specific objective, such as the performance of useful work." Molecular machines fit this definition quite well.

To imagine these machines, one must first picture molecules. We can picture atoms as beads and molecules as clumps of beads, like a child's beads linked by snaps. In fact, chemists do sometimes visualize molecules by building models from plastic beads (some of which link in several directions, like the hubs in a Tinkertoy set). Atoms are rounded like beads, and although molecular bonds are not snaps, our picture at least captures the essential notion that bonds can be broken and reformed.

If an atom were the size of a small marble, a fairly complex molecule would be the size of your fist. This makes a useful mental image, but atoms are really about 1/10,000 the size of bacteria, and bacteria are about 1/10,000 the size of mosquitoes. (An atomic nucleus, however, is about 1/100,000 the size of the atom itself; the difference between an atom and its nucleus is the difference between a fire and a nuclear reaction.)

The things around us act as they do because of the way their molecules behave. Air holds neither its shape nor its volume because its molecules move freely, bumping and ricocheting through open space. Water molecules stick together as they move about, so water holds a constant volume as it changes shape.

Copper holds its shape because its atoms stick together in regular patterns; we can bend it and hammer it because its atoms can slip over one another while remaining bound together. Glass shatters when we hammer it because its atoms separate before they slip. Rubber consists of networks of kinked molecules, like a tangle of springs. When stretched and released, its molecules straighten and then coil again. These simple molecular patterns make up passive substances. More complex patterns make up the active nanomachines of living cells.

Biochemists already work with these machines, which are chiefly made of protein, the main engineering material of living cells. These molecular machines have relatively few atoms, and so they have lumpy surfaces, like objects made by gluing together a handful of small marbles. Also, many pairs of atoms are linked by bonds that can bend or rotate, and so protein machines are unusually flexible. But like all machines, they have parts of different shapes and sizes that do useful work. All machines use clumps of atoms as parts. Protein machines simply use very small clumps.

Biochemists dream of designing and building such devices, but there are difficulties to be overcome. Engineers use beams of light to project patterns onto silicon chips, but chemists must build much more indirectly than that. When they combine molecules in various sequences, they have only limited control over how the molecules join. When biochemists need complex molecular machines, they still have to borrow them from cells. Nevertheless, advanced molecular machines will eventually let them build nanocircuits and nanomachines as easily and directly as engineers now build microcircuits or washing machines. Then progress will become swift and dramatic.

Genetic engineers are already showing the way. Ordinarily, when chemists make molecular chains - called "polymers" - they dump molecules into a vessel where they bump and snap together haphazardly in a liquid. The resulting chains have varying lengths, and the molecules are strung together in no particular order.

But in modern gene synthesis machines, genetic engineers build more orderly polymers - specific DNA molecules - by combining molecules in a particular

order. These molecules are the nucleotides of DNA (the letters of the genetic alphabet) and genetic engineers don't dump them all in together. Instead, they direct the machine to add different nucleotides in a particular sequence to spell out a particular message. They first bond one kind of nucleotide to the chain ends, then wash away the leftover material and add chemicals to prepare the chain ends to bond the next nucleotide. They grow chains as they bond on nucleotides, one at a time, in a programmed sequence. They anchor the very first nucleotide in each chain to a solid surface to keep the chain from washing away with its chemical bathwater. In this way, they have a big clumsy machine in a cabinet assemble specific molecular structures from parts a hundred million times smaller than itself.

But this blind assembly process accidentally omits nucleotides from some chains. The likelihood of mistakes grows as chains grow longer. Like workers discarding bad parts before assembling a car, genetic engineers reduce errors by discarding bad chains. Then, to join these short chains into working genes (typically thousands of nucleotides long), they turn to molecular machines found in bacteria.

These protein machines, called restriction enzymes, "read" certain DNA sequences as "cut here." They read these genetic patterns by touch, by sticking to them, and they cut the chain by rearranging a few atoms. Other enzymes splice pieces together, reading matching parts as "glue here" - likewise "reading" chains by selective stickiness and splicing chains by rearranging a few atoms. By using gene machines to write, and restriction enzymes to cut and paste, genetic engineers can write and edit whatever DNA messages they choose.

But by itself, DNA is a fairly worthless molecule. It is neither strong like Kevlar, nor colorful like a dye, nor active like an enzyme, yet it has something that industry is prepared to spend millions of dollars to use: the ability to direct molecular machines called ribosomes. In cells, molecular machines first transcribe DNA, copying its information to make RNA "tapes." Then, much as old numerically controlled machines shape metal based on instructions stored on tape,

ribosomes build proteins based on instructions stored on RNA strands. And proteins are useful.

Proteins, like DNA, resemble strings of lumpy beads. But unlike DNA, protein molecules fold up to form small objects able to do things. Some are enzymes, machines that build up and tear down molecules (and copy DNA, transcribe it, and build other proteins in the cycle of life). Other proteins are hormones, binding to yet other proteins to signal cells to change their behavior. Genetic engineers can produce these objects cheaply by directing the cheap and efficient molecular machinery inside living organisms to do the work. Whereas engineers running a chemical plant must work with vats of reacting chemicals (which often misarrange atoms and make noxious byproducts), engineers working with bacteria can make them absorb chemicals, carefully rearrange the atoms, and store a product or release it into the fluid around them.

Genetic engineers have now programmed bacteria to make proteins ranging from human growth hormone to rennin, an enzyme used in making cheese. The pharmaceutical company Eli Lilly (Indianapolis) is now marketing Humulin, human insulin molecules made by bacteria».

(7203 знаки)

## №16. Existing Protein Machines

«These protein hormones and enzymes selectively stick to other molecules. An enzyme changes its target's structure, then moves on; a hormone affects its target's behavior only so long as both remain stuck together. Enzymes and hormones can be described in mechanical terms, but their behavior is more often described in chemical terms.

But other proteins serve basic mechanical functions. Some push and pull, some act as cords or struts, and parts of some molecules make excellent bearings. The machinery of muscle, for instance, has gangs of proteins that reach, grab a "rope" (also made of protein), pull it, then reach out again for a fresh grip;

whenever you move, you use these machines. Amoebas and human cells move and change shape by using fibers and rods that act as molecular muscles and bones. A reversible, variable-speed motor drives bacteria through water by turning a corkscrew-shaped propeller. If a hobbyist could build tiny cars around such motors, several billions of billions would fit in a pocket, and 150-lane freeways could be built through your finest capillaries.

Simple molecular devices combine to form systems resembling industrial machines. In the 1950s engineers developed machine tools that cut metal under the control of a punched paper tape. A century and a half earlier, Joseph-Marie Jacquard had built a loom that wove complex patterns under the control of a chain of punched cards. Yet over three billion years before Jacquard, cells had developed the machinery of the ribosome. Ribosomes are proof that nanomachines built of protein and RNA can be programmed to build complex molecules.

Then consider viruses. One kind, the $T_4$ phage, acts like a spring-loaded syringe and looks like something out of an industrial parts catalog. It can stick to a bacterium, punch a hole, and inject viral DNA (yes, even bacteria suffer infections). Like a conqueror seizing factories to build more tanks, this DNA then directs the cell's machines to build more viral DNA and syringes. Like all organisms, these viruses exist because they are fairly stable and are good at getting copies of themselves made.

Whether in cells or not, nanomachines obey the universal laws of nature. Ordinary chemical bonds hold their atoms together, and ordinary chemical reactions (guided by other nanomachines) assemble them. Protein molecules can even join to form machines without special help, driven only by thermal agitation and chemical forces. By mixing viral proteins (and the DNA they serve) in a test tube, molecular biologists have assembled working $T_4$ viruses. This ability is surprising: imagine putting automotive parts in a large box, shaking it, and finding an assembled car when you look inside! Yet the $T_4$ virus is but one of many self-assembling structures. Molecular biologists have taken the machinery of the

ribosome apart into over fifty separate protein and RNA molecules, and then combined them in test tubes to form working ribosomes again.

To see how this happens, imagine different $T_4$ protein chains floating around in water. Each kind folds up to form a lump with distinctive bumps and hollows, covered by distinctive patterns of oiliness, wetness, and electric charge. Picture them wandering and tumbling, jostled by the thermal vibrations of the surrounding water molecules. From time to time two bounce together, then bounce apart. Sometimes, though, two bounce together and fit, bumps in hollows, with sticky patches matching; they then pull together and stick. In this way protein adds to protein to make sections of the virus, and sections assemble to form the whole.

Protein engineers will not need nanoarms and nanohands to assemble complex nanomachines. Still, tiny manipulators will be useful and they will be built. Just as today's engineers build machinery as complex as player pianos and robot arms from ordinary motors, bearings, and moving parts, so tomorrow's biochemists will be able to use protein molecules as motors, bearings, and moving parts to build robot arms which will themselves be able to handle individual molecules».

(4116 знаків)

## №17. Designing with Protein

«How far off is such an ability? Steps have been taken, but much work remains to be done. Biochemists have already mapped the structures of many proteins. With gene machines to help write DNA tapes, they can direct cells to build any protein they can design. But they still don't know how to design chains that will fold up to make proteins of the right shape and function. The forces that fold proteins are weak, and the number of plausible ways a protein might fold is astronomical, so designing a large protein from scratch isn't easy.

The forces that stick proteins together to form complex machines are the same ones that fold the protein chains in the first place. The differing shapes and

kinds of stickiness of amino acids - the lumpy molecular "beads" forming protein chains - make each protein chain fold up in a specific way to form an object of a particular shape. Biochemists have learned rules that suggest how an amino acid chain might fold, but the rules aren't very firm. Trying to predict how a chain will fold is like trying to work a jigsaw puzzle, but a puzzle with no pattern printed on its pieces to show when the fit is correct, and with pieces that seem to fit together about as well (or as badly) in many different ways, all but one of them wrong. False starts could consume many lifetimes, and a correct answer might not even be recognized. Biochemists using the best computer programs now available still cannot predict how a long, natural protein chain will actually fold, and some of them have despaired of designing protein molecules soon.

Yet most biochemists work as scientists, not as engineers. They work at predicting how natural proteins will fold, not at designing proteins that will fold predictably. These tasks may sound similar, but they differ greatly: the first is a scientific challenge, the second is an engineering challenge. Why should natural proteins fold in a way that scientists will find easy to predict? All that nature requires is that they in fact fold correctly, not that they fold in a way obvious to people.

Proteins could be designed from the start with the goal of making their folding more predictable. Carl Pabo, writing in the journal Nature, has suggested a design strategy based on this insight, and some biochemical engineers have designed and built short chains of a few dozen pieces that fold and nestle onto the surfaces of other molecules as planned. They have designed from scratch a protein with properties like those of melittin, a toxin in bee venom. They have modified existing enzymes, changing their behaviors in predictable ways. Our understanding of proteins is growing daily.

In 1959, according to biologist Garrett Hardin, some geneticists called genetic engineering impossible; today, it is an industry. Biochemistry and computer-aided design are now exploding fields, and as Frederick Blattner wrote in the journal Science, "computer chess programs have already reached the level

below the grand master. Perhaps the solution to the protein-folding problem is nearer than we think." William Rastetter of Genentech, writing in Applied Biochemistry and Biotechnology asks, "How far off is de novo enzyme design and synthesis? Ten, fifteen years?" He answers, "Perhaps not that long."

Forrest Carter of the U.S. Naval Research Laboratory, Ari Aviram and Philip Seiden of IBM, Kevin Ulmer of Genex Corporation, and other researchers in university and industrial laboratories around the globe have already begun theoretical work and experiments aimed at developing molecular switches, memory devices, and other structures that could be incorporated into a protein-based computer. The U.S. Naval Research Laboratory has held two international workshops on molecular electronic devices, and a meeting sponsored by the U.S. National Science Foundation has recommended support for basic research aimed at developing molecular computers. Japan has reportedly begun a multimillion-dollar program aimed at developing self-assembling molecular motors and computers, and VLSI Research Inc., of San Jose, reports that "It looks like the race to bio-chips [another term for molecular electronic systems] has already started. NEC, Hitachi, Toshiba, Matsushita, Fujitsu, Sanyo-Denki and Sharp have commenced full-scale research efforts on bio-chips for bio-computers."

Biochemists have other reasons to want to learn the art of protein design. New enzymes promise to perform dirty, expensive chemical processes more cheaply and cleanly, and novel proteins will offer a whole new spectrum of tools to biotechnologists. We are already on the road to protein engineering, and as Kevin Ulmer notes in the quote from Science that heads this chapter, this road leads "toward a more general capability for molecular engineering which would allow us to structure matter atom by atom."»

(4876 знаків)

## №18. Second-Generation Nanotechnology

«Despite its versatility, protein has shortcomings as an engineering material. Protein machines quit when dried, freeze when chilled, and cook when heated. We do not build machines of flesh, hair, and gelatin; over the centuries, we have learned to use our hands of flesh and bone to build machines of wood, ceramic, steel, and plastic. We will do likewise in the future. We will use protein machines to build nanomachines of tougher stuff than protein.

As nanotechnology moves beyond reliance on proteins, it will grow more ordinary from an engineer's point of view. Molecules will be assembled like the components of an erector set, and well-bonded parts will stay put. Just as ordinary tools can build ordinary machines from parts, so molecular tools will bond molecules together to make tiny gears, motors, levers, and casings, and assemble them to make complex machines.

Parts containing only a few atoms will be lumpy, but engineers can work with lumpy parts if they have smooth bearings to support them. Conveniently enough, some bonds between atoms make fine bearings; a part can be mounted by means of a single chemical bond that will let it turn freely and smoothly. Since a bearing can be made using only two atoms (and since moving parts need have only a few atoms), nanomachines can indeed have mechanical components of molecular size.

How will these better machines be built? Over the years, engineers have used technology to improve technology. They have used metal tools to shape metal into better tools, and computers to design and program better computers. They will likewise use protein nanomachines to build better nanomachines. Enzymes show the way: they assemble large molecules by "grabbing" small molecules from the water around them, then holding them together so that a bond forms. Enzymes assemble DNA, RNA, proteins, fats, hormones, and chlorophyll in this way - indeed, virtually the whole range of molecules found in living things.

Biochemical engineers, then, will construct new enzymes to assemble new patterns of atoms. For example, they might make an enzyme-like machine which will add carbon atoms to a small spot, layer on layer. If bonded correctly, the

atoms will build up to form a fine, flexible diamond fiber having over fifty times as much strength as the same weight of aluminum. Aerospace companies will line up to buy such fibers by the ton to make advanced composites. (This shows one small reason why military competition will drive molecular technology forward, as it has driven so many fields in the past.)

But the great advance will come when protein machines are able to make structures more complex than mere fibers. These programmable protein machines will resemble ribosomes programmed by RNA, or the older generation of automated machine tools programmed by punched tapes. They will open a new world of possibilities, letting engineers escape the limitations of proteins to build rugged, compact machines with straightforward designs.

Engineered proteins will split and join molecules as enzymes do. Existing proteins bind a variety of smaller molecules, using them as chemical tools; newly engineered proteins will use all these tools and more.

Further, organic chemists have shown that chemical reactions can produce remarkable results even without nanomachines to guide the molecules. Chemists have no direct control over the tumbling motions of molecules in a liquid, and so the molecules are free to react in any way they can, depending on how they bump together. Yet chemists nonetheless coax reacting molecules to form regular structures such as cubic and dodecahedral molecules, and to form unlikely-seeming structures such as molecular rings with highly strained bonds. Molecular machines will have still greater versatility in bondmaking, because they can use similar molecular motions to make bonds, but can guide these motions in ways that chemists cannot.

Indeed, because chemists cannot yet direct molecular motions, they can seldom assemble complex molecules according to specific plans. The largest molecules they can make with specific, complex patterns are all linear chains. Chemists form these patterns (as in gene machines) by adding molecules in sequence, one at a time, to a growing chain. With only one possible bonding site per chain, they can be sure to add the next piece in the right place.

But if a rounded, lumpy molecule has (say) a hundred hydrogen atoms on its surface, how can chemists split off just one particular atom (the one five up and three across from the bump on the front) to add something in its place? Stirring simple chemicals together will seldom do the job, because small molecules can seldom select specific places to react with a large molecule. But protein machines will be more choosy.

A flexible, programmable protein machine will grasp a large molecule (the workpiece) while bringing a small molecule up against it in just the right place. Like an enzyme, it will then bond the molecules together. By bonding molecule after molecule to the workpiece, the machine will assemble a larger and larger structure while keeping complete control of how its atoms are arranged. This is the key ability that chemists have lacked.

Like ribosomes, such nanomachines can work under the direction of molecular tapes. Unlike ribosomes, they will handle a wide variety of small molecules (not just amino acids) and will join them to the workpiece anywhere desired, not just to the end of a chain. Protein machines will thus combine the splitting and joining abilities of enzymes with the programmability of ribosomes. But whereas ribosomes can build only the loose folds of a protein, these protein machines will build small, solid objects of metal, ceramic, or diamond - invisibly small, but rugged.

Where our fingers of flesh are likely to bruise or burn, we turn to steel tongs. Where protein machines are likely to crush or disintegrate, we will turn to nanomachines made of tougher stuff».

(6044 знаки)

## №19. No, We Can't Control Hurricanes from Space

«As Hurricane Irma winds down – and a message from a Florida sheriff – saying that shooting guns at the storm would not turn it aside – brings to mind the

question of why we can't control hurricanes. The short answer is that we can't control weather at any scale, and hurricanes are no exception.

"We have no real idea how to control weather in the sense of a hurricane," John Moore, a scientist at Beijing Normal University, told Space.com. "All that realistically can be done is changing the thermodynamics of the system, which largely means changing the sea-surface temperatures."

Moore is the head of geoengineering at his institution — a discipline devoted to the concept of using technology on a wide scale to change the Earth's environment. Usually, the term is used in connection with mitigating the effects of climate change. Ideas include spraying aerosols in the stratosphere and using satellites to alter weather patterns. The latter is the premise of the upcoming movie "Geostorm," in which a villain decides to try and use hurricanes as a weapon.

Some of the more conspiracy-minded web sites have posited that Irma was the result of government experiments. The problem with that idea is that there isn't any realistic way to control weather with satellites, Moore said. Reducing the ocean surface temperature would cut down the number and intensity of hurricanes, but "there is no physical model of how hurricanes evolve from birth, models are statistical generated, and the same with the tracks they follow," he said. Such a generalized model would be needed to control hurricanes.

The closest thing that anyone has come up with is to surround the Earth with mirrors or shades that would reflect away light. Various proposals have been floated over the years — James Early, in the late 1980s, proposed such an orbiting shade that would sit between Earth and the sun at a stable point between the two; he estimated it would cost $10 trillion. But that would just lower the temperature; it wouldn't offer direct control of hurricanes.

Weather control has been a dream for decades. In 1996, the U.S. Air Force commissioned a report called "Weather as a Force Multiplier, Owning the Weather in 2025," which studied the idea of controlling weather to use it against adversaries. The report describes inducing storms to impair the enemy's ability to fly planes and creating muddy conditions, making it hard to move troops. But even

that report describes using satellites as more of a surveillance and measurement tool rather than to directly control weather.

Many people have heard of seeding clouds to make rain; there are companies that do it, notably Weather Modification, based in Fargo, North Dakota. Even that, however, is imprecise. A story in Bloomberg in 2015 cited studies that showed cloud seeding increased snowfall from 5 to 15 percent. Rainfall is harder to measure exactly, but seeding clouds remains an uncertain business, according to the scientists quoted by Bloomberg. Hurricanes, in any case, occur over a much larger area than the rain clouds that a plane would seed.

Meanwhile, besides using satellites, spraying sulfur aerosols in the atmosphere might be another method of reducing ocean temperatures. Moore said that that is the best-understood method, and there is some data to show sulfur might cool the planet down, since that's what happens when really large volcanoes erupt. NASA's Earth Observatory noted in 2001 that global temperatures dropped by 0.6 degrees Celsius (1 degree Fahrenheit) over about 15 months after Mount Pinatubo in the Philippines erupted in 1991. That won't control a hurricane, though. Meanwhile, there's the possibility that the sulfur aerosols will come back to the ground with rainfall, and the effects of that are unpredictable, though the amount of sulfur used would be dwarfed by what's emitted by power plants, Moore said.

Could a satellite create a hurricane? Not with current technology. According to NOAA, hurricanes form when the ocean surface is heated by the sun in late summer. To do the equivalent, one would need some way to get energy to water -- perhaps something like a huge laser or microwave generator. Further, it would have to be spread over a very large area. Even a billion-watt laser would be very weak when the beam is spread over hundreds of square miles, and an array of lasers would require hundreds of satellites.

Michael Mann, director of the Earth System Science Center at Pennsylvania State University, wrote an editorial in the Guardian stating that climate change, which is driven largely by human emissions of fossil fuels, has made hurricanes

more intense, because there is more warm water in the ocean to feed them. Harvey was just one example. (Other factors in the greater destructive nature of hurricanes include more people moving to hurricane-prone areas: When a hurricane hit Galveston in 1900, the island was destroyed and thousands died; Houston, 50 miles northwest, had about 45,000 people. The city now has 2 million, according to the U.S. Census, with the attendant housing and infrastructure.)

To keep hurricanes manageable, Moore said humans will probably just have to reduce carbon emissions or get the carbon dioxide out of the atmosphere.

"There needs to be active removal of CO2 from the atmosphere as well as declining emissions," he said. "That is crucial for our survival as a civilization. Geoengineering is just an emergency method, e.g., to prevent collapse of the ice sheets raising sea level several meters, or large numbers of heat deaths and depopulation of regions such as the Middle East. A few hurricanes are fairly small beer in comparison with those issues — though obviously catastrophic for those affected."»

(5782 знаки)

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**Зміст**