

**МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ
НАЦІОНАЛЬНИЙ ТЕХНІЧНИЙ УНІВЕРСИТЕТ
«ХАРКІВСЬКИЙ ПОЛІТЕХНІЧНИЙ ІНСТИТУТ»**

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**АНОТУВАННЯ ТА РЕФЕРУВАННЯ
АНГЛІЙСЬКОГО ТЕКСТУ**

**Навчально-методичний посібник з англійської мови
для студентів, магістрів та аспірантів усіх спеціальностей**

**ANNOTATING AND ABSTRACTING
THE ENGLISH TEXT**

**Textbook of English
for students, masters and PhD students of all specialties**

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Навчально-методичний посібник містить ряд науково-популярних і технічних текстів, правила написання анотацій і рефератів до них, граматичні завдання, завдання для самостійної роботи студентів.

Призначено для студентів, магістрів та аспірантів усіх спеціальностей

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Textbook contains a number of popular and technical texts, rules of writing abstracts and annotations to them, grammatical tasks, tasks for independent work.

Designed for students, masters and PhD students of all specialties

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ВСТУП

Даний посібник призначений для аспірантів, магістрів і студентів, що бажають навчитися складати англійською мовою анотації і реферати до статей за своєю спеціальністю.

Мета посібника – навчити студентів і аспірантів розуміти зміст науково-популярних і технічних текстів і викладати зміст прочитаного у вигляді реферату або анотації. А також навчити їх користуватися лексико-синтаксичними кліше, найбільш характерними для мови певної галузі.

Посібник складається з трьох розділів і словника, включаючи дієслова-оператори, стійкі словосполучення і ключові моделі для складання анотацій і рефератів. У I і II розділах дається загальна характеристика понять «анотація і реферування», а також пропонуються тексти російською і англійською мовами, анотації і реферати до них як приклади. III розділ містить пояснення, приклади і завдання, які сприяють розвиненню навичків користування відповідними лексико-синтаксичними і граматичними структурами, і їх творчого вживання для складання анотацій і рефератів, а також завдань для самостійної роботи студентів і аспірантів.

При підборі матеріалу використовувалися оригінальні науково-популярні тексти, англійські і американські журнали і їх переклади на рідну мову, зроблені фахівцями, а також переклади з російських журналів, зроблені фахівцями – носіями англійської мови.

1. АНОТУВАННЯ ТЕКСТУ

(Abstract)

Анотація – досить стислий виклад змісту статті або іншого першоджерела без формулювань, висновків, оцінок, пояснень суті явищ і так далі – дає уявлення лише про тему першоджерела і полегшує пошук необхідної інформації за даною темою.

Оптимальним розміром анотації є текст, що складається з 3–5 речень. Таку анотацію умовно можна назвати інформативною. Існують також і індикативні анотації, які найчастіше складаються з одного речення.

Анотацію зазвичай складають читачі своїми словами. Висока міра компресії наводить до того, що виникає необхідність гранично узагальнювати і абстрагувати зміст.

При складанні анотації необхідно дотримуватися деяких вимог:

- анотації мають бути складені так, щоб їх зміст був доступний для засвоєння при читанні і одночасно відображати найбільш важливі моменти першоджерела;
- анотації мають бути науково грамотними, не містити оцінки якості першоджерела і не відображати суб'єктивних поглядів автора;
- анотації мають бути написані лаконічною, точною і одночасно звичною мовою, не використовуючи складних синтаксичних конструкцій;
- анотація повинна розкривати, а не повторювати своїми словами заголовки джерела інформації;
- джерело (тобто слово «стаття» або інше) має бути використане лише один раз;
- *мова анотацій* має ряд особливостей, як в російській, українській, так і в англійській мовах, що виявляються як в області термінології, так і в області граматики. У термінологічному плані – це часте вживання дієслів типу to present, to provide, to describe, to analyze, to propose, etc.

У граматичному плані – перевага віддається вживанню цих дієслів у пасивному стані.

Послідовність складання анотації:

1. Прочитати назву статті і спробувати сформулювати тему статті. (Пам'ятайте, що інколи назва може бути заплутаною, і ви можете повністю зрозуміти зміст лише після ознайомлення зі статтею).
2. Прочитати статтю і зрозуміти головну думку автора.
3. Прочитати уважно першоджерело, в кожному абзаці знайти головну думку.
4. З'ясувати, чи є додаткові деталі, які також можуть бути важливими.
5. Виключити неістотні деталі (власні коментарі, приклади, ілюстрації, дані і т. д.).
6. Записати основну думку як можна простіше.
7. Дотримуйтеся однієї тимчасової форми викладання, теперішнього або минулого часу.
8. Констатувати основну думку автора, не додаючи власні думки.
9. Констатувати найбільш суттєві авторські роздуми, які супроводжують основну думку статті, також без виправлень і не зупиняючись на деталях.
10. Написати анотацію своїми словами, а не цитувати текст. Інколи фрази в першоджерелі можуть бути особливо цікавими, це можуть бути нові терміни, в цьому випадку їх потрібно узяти в лапки.
11. Не давайте коментарів і не висловлюйте власну точку зору. Анотація повинна передавати лише думки автора статті.
12. Написати анотацію згідно з її визначенням (див. с. 4).

Приклад:

For example: Compare Ukrainian and English versions of the abstract to the article 'Modern Nanotechnologies'

Таблиця 1.1 – Зразки анотації

Анотація	Abstract
Аналізуються сучасні нанотехнології, які мають справу з найдрібнішими об'єктами. Також описуються фантастичні особливості на зразок нанороботів, які лікуватимуть нас зсередини.	Modern nanotechnologies dealing with the tiny objects are analyzed. Fantastic possibilities like nanorobots to be treated us inside are described as well.
Наводиться широке вживання наночастинок, включаючи косметику, медицину, фізику, металургію, і так далі. Більш того, проводиться робота над створенням наночастинок, які при нагріванні знищуватимуть ракові клітини. Необхідно відзначити, що на пограничному світі наночастинок діють незвичайні фізичні закони, тобто властивості речовини залежать від розміру його часток. Крім того, наводиться порівняння сучасних і середньовічних нанотехнологій.	The wide use of nanoparticles, including cosmetics, medicine, physics, metallurgy, etc. is stated. Moreover the work is done on creating nanoparticles which when heating will kill cancer cells. Also the comparison of present-day nanotechnologies with the medieval ones is made. One should note that in the boundary nanoparticle world there work unordinary physical laws, i.e. substance properties depend on the size of its particles.

Read the text and the abstract to it:

ЭЛЕКТРИЗАЦИЯ ГРОЗОВЫХ ОБЛАКОВ

Хотя уже двести лет известно, что молния – один из видов электрического разряда, микрофизические процессы, приводящие к зарядке грозовых облаков, остаются предметом споров.

Из всех явлений природы молния – одно из наиболее распространенных и зрелищных. В течение двух веков – с тех пор как Б. Франклин доказал, что рассекающие небо вспышки есть не что иное, как мощные электрические разряды, молнии и грозы продолжают интенсивно изучаться. Но несмотря на обилие новых приборов и методов исследования, разгадка истинной природы молнии и механизма, обуславливающего электризацию грозовых облаков, ускользает от ученых.

Сложность проблемы объясняется тем, что значения физических параметров, характеризующих молнию и грозу, изменяются на 15 порядков величины. Рассматривая явления атомных масштабов, вызывающие электризацию грозового облака, приходится иметь дело с расстояниями порядка 10^{-13} км; движения же воздуха во всем грозовом облаке, которые завершают процесс заряда, могут охватывать расстояния в десятки и сотни километров. Основные физические процессы этих предельных масштабов еще не познаны.

Сам Франклин, возможно, не подозревая, обнажил одну из основных трудностей. В 1752 г. он писал, что «облака в грозе, как правило, несут отрицательный электрический заряд, но иногда и положительный». Ответ на вопрос, связана ли эта неопределенность с некорректностью наблюдений или она присуща грозовым облакам, был получен совсем недавно. Тем не менее, с тех самых пор, когда Франклин написал приведенные выше слова, принято считать, что молния – это перенос либо положительных, либо отрицательных электрических зарядов от одной зоны облака к другой или между облаком и землей. Для того чтобы такой перенос стал возможным, облако должно быть наэлектризовано, т. е. положительные или отрицательные заряды должны быть разделены. Как же происходит разделение зарядов?

Из дальнейшего читатель увидит, что на этот вопрос можно ответить лишь частично. В предметах, с которыми мы имеем дело в повседневной жизни, будь то чашки или телефоны, количество положительных и отрицательных зарядов одинаково; более того, эти заряды в предмете распределены равномерно, что позволяет говорить о нем как об электрически нейтральном, или незаряженном. Однако многие микрофизические процессы могут привести к разделению зарядов и тогда в предмете, который в целом остается электрически нейтральным, образуются участки, где будут преобладать положительные или отрицательные заряды. В таком случае говорят, что данный предмет заряжен, или наэлектризован. Разделение зарядов приводит к появлению разности потенциалов, которую можно выражать в вольтах (В); чем больше зарядов разделено, тем больше разность потенциалов. Когда вы прохаживаетесь по комнате, то в целом комната остается электрически нейтральной, но вследствие трения подошвы о покрытие пола и подошвы, и покрытие могут приобрести заряды противоположного знака. В этом случае разность потенциалов на расстоянии нескольких сантиметров может стать равной 100000 В, что вы и ощутите, если возьметесь за ручку двери.

Обычная молния возникает при разности потенциалов в несколько сот миллионов вольт, при этом суммарный заряд, переносимый к земле, может достигать 10 кулон (К) и более, что соответствует примерно 10^{20} электронов. Перенос заряда в 1 К за 1 с по принятому определению соответствует току в один ампер (А). Молния представляет собой ток значительно больше 10 А, так как её длительность намного меньше 1 с. Грозовые облака умеренных размеров «производят» несколько вспышек в минуту – каждая мощностью несколько сот мегаватт, что эквивалентно мощности небольшой атомной электростанции. Выяснить, каковы точное распределение зарядов и физический механизм, создающий разряд такой силы, – вот главная задача физиков, занимающихся изучением грозowych явлений. Исторически сложилось так, что исследования в этой области концентрировались на электрической структуре облаков.

Исходя из наблюдений Франклина, было естественно предположить, что распределение зарядов в грозовом облаке соответствует простейшей схеме: положительные заряды скапливаются в одной части облака, а отри-

цательные – в другой. Такое распределение зарядов называется диполем. Пытаясь объяснить структуру грозовых облаков, ученые разработали две принципиально различные модели: в одной ключевая роль отдается атмосферным осадкам, в другой – конвекции.

Осадки или конвекция?

«Гипотеза осадков», впервые сформулированная немецкими физиками Ю. Эльстером и Х. Гейтелем в 1885 г., основана на явлении, которое можно наблюдать при работе садового разбрызгивателя: крупные капли воды быстро падают на землю, в то время как мелкие капельки остаются в воздухе и уносятся ветром. Как предполагается в гипотезе осадков, капли дождя, снежная крупа и крупные (до сантиметра в диаметре) градины в грозовом облаке падают на землю под действием силы тяжести сквозь массу мелких капель воды и кристалликов льда, которые находятся в атмосфере во взвешенном состоянии. Полагают, что при столкновениях крупных падающих частиц с мелкими взвешенными первым передается отрицательный заряд (подобно тому как заряд с коврового покрытия переносится на обувь), а вторым – в силу закона сохранения заряда – положительный заряд. Если падающие частицы становятся отрицательно заряженными, нижняя часть облака будет накапливать отрицательный заряд, а верхняя часть – положительный. Такое пространственное разделение зарядов, когда положительный полюс находится вверху, называется положительным диполем.

«Гипотеза конвекции», сформулированная независимо Г. Гренстом из Парижского университета в 1947 г. и Б. Воннегутом из Нью-Йоркского университета в Элбани в 1953 г., несколько сложнее. В качестве аналога в данном случае можно взять генератор Ван-де-Граафа. В этом устройстве положительные или отрицательные заряды наносятся на движущуюся ленту из диэлектрика, доставляющую эти заряды (ноны) к высоковольтному электроду. Модель конвекции основана на допущении, что первоначально электрические заряды в облаке образуются благодаря двум внешним источникам. Первый – это космические лучи, которые сталкиваются с молекулами воздуха над облаком и ионизируют их (в результате происходит разделение положительных и отрицательных зарядов).

Таблиця 1.2 – Зразки анотації статті

Анотація	Abstract
<p>У даній статті наводяться процеси мікрофізики, що приводять до зарядки грозових хмар. Вважають, що розгадка дійсної природи блискавки і механізму, що обумовлює електролізацію грозових хмар, має велике значення. Пояснюються основні складнощі і труднощі даної проблеми. Більш того, детально описаний процес розділення зарядів. Досліджена електрична структура хмар і розроблені дві принципово різні моделі для її пояснення. Крім того, порівнюються дві гіпотези, а саме – гіпотеза опадів і гіпотеза конвекції.</p>	<p>The article under consideration deals with some microphysical processes resulting in thunderstorm cloud charging. The solution of the real lightning nature and the mechanism causing thunderstorm cloud electro- lization is considered to be of great importance. Main problem difficulties and complexities are given. Furthermore the process of charge partitioning is described in detail. Electrical cloud structure has been investigated and two principally different models for its explanation have been developed. In addition two hypotheses, namely the one of fall out and the one of convection are compared.</p>

Task 1. Read, translate and analyze the abstracts given below. See Key Patterns after the part II:

QUANTITATIVE DETERMINATION OF ANISOTROPIC DOMAIN SIZE IN MESOPHASE PITCH

The optical texture of the carbonaceous mesophase is related to the nature of the pitch precursor, the mesophase viscosity and mode of preparation. The anisotropic domain size, represented by the distance between extinction lines, has been a useful parameter for characterizing mesophase pitches. A procedure for quantitative determination of mesophase domain size, utilizing annealing techniques and image analysis, is described and applied to several different mesophase pitch systems.

Dynamic Modeling in Behavioral Ecology

This book describes a powerful and flexible technique for the modeling of behavior, based on evolutionary principles. The technique employs stochastic dynamic programming and permits the analysis of behavioral adaptations wherein organisms respond to changes in their environment and in their own current physiological state. Models can be constructed to reflect sequential decisions concerned simultaneously with foraging, reproduction, predator avoidance, and other activities. The authors show how to construct and use dynamic behavioral models.

Marc Mangel is Professor of Zoology and Director, Center for Population Biology at the University of California, Davis. Colin W. Clark is Professor of Applied Mathematics at the University of British Columbia.

Helping and Communal Breeding in Birds

This work is an overview of the extensive and frequently controversial literature on communally breeding birds developed since the early 1960s, when students of evolution began to examine sociality as a product of natural selection. Jerram L. Brown provides original data from his own theoretical and empirical studies and summarizes the wide array of results and interpretations made by others.

Theoretical Studies on Sex Ratio Evolution

This book deals with a key area of population genetics: the ratio of the sexes in a population or the allocation of resources to male versus female reproductive function. Samuel Karlin and Sabin Lessard establish the formal theoretical aspects of the evolution of sex ratio within the constraints of genetic mechanisms of sex determination. Their results generalize and unify existing work on the topic, strengthening previous conceptions in some cases and, in other instances, offering new directions of research.

A Neotropical Companion

A Neotropical Companion introduces armchair travelers, field naturalists, and conservationists to the tropics of Central and South America. In recent years the neotropics have been more and more frequently visited by those interested in

rain forests and the exotic birds, mammals, insects, and plants of these ecosystems. At the same time scientific knowledge of the neotropics has burgeoned. A primer for the student and for the scientific amateur, this well-illustrated volume presents a general and up-to-date view of some of the world's most complex natural environments. In addition, it provides the Neotropical specialist with a broad look at the entire field of Neotropical biology.

John C. Kricher is Jennings Professor of Biology at Wheaton College in Norton, Massachusetts.

Task 2. Look through the abstracts below and say what field of investigation they describe:

Abstract: Carbon pick-up is determined mainly by the composition of the charge materials and by the metal tapping temperature. However, carbon pickup is also affected by other cupola design and operating variables which should be controlled if consistency in metal composition is to be achieved and particularly, if maximum carbon pick-up is required to obtain reduction in costs by (he substitution of pig iron by steel scrap. These additional variables include well depth, slag depth, fluxing practice, the seclction of charge materials and the properties of the cokes used.

Abstract: The paper deals with the life, the wear of single crystal diamond tools and their effects on the micro-roughness and the residual stress of the surface layers, under various machining conditions. Three kinds of diamond tools, having different nose radii, were used for mirror finishing of aluminum alloy workpieces. Cutting tests were carried out untill the cutting distance of a tool reached to 900 Km. Despite of tool wear,the roughness of diamond-turned surface remains almost constant due to the burnishing effects. The micro-roughnesses are more or less varied by the feed rate and the nose radius of the cutting edge. Also the micro-roughness relate closely with the thrust forces. X-ray diffraction analysis was also conducted to determine the residual stress for each process. In the mirror finishing process, compressive stress of about 60 MPa remains on the surface layers. The thickness of the work-affected layer is merely on the order of submicrometers.

Abstract: Composites of copper reinforced with 0.003 in. diam continuous tantalum filaments have been fabricated up to 0.38 volume fraction using the infiltration technique. Their elastic modulus, ultimate tensile strength, and yield strength have been found to be linear functions of the volume fraction of the filaments (V_f). The filaments elongated continuously until fracture occurred at the ultimate tensile strength of the composite given by $S_c = S_f V_f + O''m (1 - V_f)$ where $O''m$, is the flow stress of the matrix at the fracture strain of the composite and S_f is the ultimate tensile strength of the filament. It has been shown that the tensile strength of not only Ta-Cu but other ductile filament-ductile matrix systems can also be closely predicted.

Abstract: The optical texture of the carbonaceous mesophase is related to the nature of the pitch precursor, the mesophase viscosity and mode of preparation. The anisotropic domain size, represented by the distance between extinction lines, has been a useful parameter for characterizing mesophase pitches. A procedure for quantitative determination of mesophase domain size, utilizing annealing techniques and image analysis, is described and applied to several different mesophase pitch systems.

Abstract: The catalytic activity of supported silver for the oxidation of ethylene to ethylene oxide and to carbon dioxide has been investigated as a function of support. Significant changes in activity with time of use of catalyst have been observed: these changes depend on the nature of the support. It is shown that the initial changes in activity are not connected with catalyst sintering nor with crystallite size changes. Electron spectroscopy reveals that impurities, originating from the support and from adsorption of organic material, concentrate at the surface of the silver. A tentative explanation of the changes in activity pattern is proposed in terms of the modification of the surface by these impurities.

2. РЕФЕРУВАННЯ ТЕКСТУ

Abstract (Précis)

Реферат – стисле викладання змісту книги, статті, патенту, який може включати висновки, оцінки і так далі, найбільш важливі з точки зору автора.

Призначення реферату – ознайомити читача взагалі зі змістом оригіналу і таким чином замінити його. Це дає можливість зекономити час і робить реферат одним з основних інформативних документів.

Послідовність написання реферату

1. Уважно прочитати документ, аби зрозуміти хід думок автора, розміщення матеріалу.

2. Прочитати уривок ще раз, виділити і записати основну думку кожного абзацу, звернути увагу на те, які факти в статті або в іншому реферованому документі, зв'язані один з одним

3. Ще раз прочитати текст, підкреслити ключові пропозиції, слова, фрази.

4. Перефразувати матеріал, якщо це необхідно для вашого реферату.

5. Перерахувати всі важливі факти, які ви збираєтеся використовувати. Записати їх своїми словами, не змінюючи думок автора і не додаючи власної точки зору.

6. Написати план реферату, звертаючи увагу на перерахування фактів тексту і на спосіб їх розміщення. Це допоможе вам більш докладно відображувати думку статті власними словами.

7. Дотримуйтеся однієї тимчасової форми, теперішнього або минулого часу.

8. Перевірте, що ви виключили власні думки, правильно констатували головні думки оригіналу, не втратили нічого важливого, а повідомили про щось другорядне.

9. Пам'ятайте, що обсяг реферату має бути не більше, ніж 1/3 оригіналу.

Навчальному тексту середніх розмірів (15–20 абзаців) відповідає середній розмір рефератів, у якому число пропозицій приблизно відповідає

кількості абзаців в оригіналі (13–15 речень). Це так званий інформативний (Precis) (тобто повний) реферат. У деяких випадках можна звести об'єм реферату до 7–8 речень шляхом виключення малоінформативних змістовних частин і об'єднання ключових фрагментів, схожих за смисловою спрямованістю. Такий варіант реферату можна назвати індикативним (Abstract).

Look through the following examples of abstracts to the journal articles, translate them and fulfil some additional tasks.

Abstract 1. Define what field of investigation this abstract presents:

A brief discussion of first principles of extended tight binding (ETB) (also known as linear combination of atomic orbitals, LCAO) method for studying electronic structure of solids *is presented*. As the name suggests, the method is nonempirical and employs a linear combination of Bloch-adapted Gaussian orbitals as its basis set. Hamiltonian overlap matrix elements required for calculating electronic structure in solids *can be obtained* analytically using Gaussian functions. Various matrix elements are computed to convergence (which *may involve* interactions up to 10–20 neighbors), eigenvalues and eigenvectors are obtained by solving $\Pi H - ES \Pi = 0$. Since the tight binding wave functions are constructed from s.p.d, type of orbitals, the ETB method offers conceptual simplicity in understanding the nature of chemical bonds at a surface.

Furthermore the identification of surface states can be readily accomplished in terms of atomic localization, a quantity of which is straightforward to calculate within the framework of this method. The method *illustrated* by (i) adsorbate band formation in CO monolayers and (ii) chemisorption studies of CL on Si (111) surface. Future likely developments of the ETB method *are briefly commented upon*.

Abstract 2. Analyze all the underlined word-combinations from grammatical and terminological point of view:

Ageing kinetics of aluminium alloys containing 1.7–3.9 % Cu *were examined by means of* resistivity measurements *and interpreted in terms of* excess vacancies quenched-in from a solution treatment temperature or from a reversion temperature.

The resistivity of the alloy increases with ageing at around 0 °C after rapid quenching from a solution treatment temperature or from a reversion temperature. The same activation energy, 0.47 ± 0.05 eV, and the same time law *were found* for both kinds of ageing *namely* the direct ageing after quenching from the solid solution region and the reageing after quenching following reversion treatment. An apparent formation energy for a vacancy *was determined* to be 0.06 eV from the initial rate of the resistivity increase after quenching from temperatures between 170 °C and 530 °C, and the binding energy between a copper atom and a vacancy *was estimated to lie* between 0.15 and 0.25 eV. Life time of excess vacancies *is discussed in connection with* the direct observation of defects in quenched Al-Cu alloys by Thomas and others.

Abstract 3. Find Chain of Nouns and translate them:

The problem of free vibration of non-linear structures is considered initially. It is shown that this problem can be represented as a non-linear eigenvalue problem. Variational principles for non-linear eigenvalue problems are defined. These variational principles are implemented with finite element models to define numerical approximations for the free vibration problem. The solution of these approximate equations provides a set of non-linear modal vectors and natural frequencies which vary with the amplitude of the solution. The non-linear eigenvalue parameters can be used in model expansion approximations for the non-linear transient or steady state response of structural systems. To demonstrate the proposed techniques the free vibration and steady state vibration of a geometrically non-linear circular plate are determined.

Abstract 4. Find *ing*-forms and Participle II and translate them:

A physical model has been constructed to represent turbulent recirculating flows that occur in argon-stirred ladles. By using a mechanically driven circulating system including a moving tube it was possible to generate flow fields such that all the boundary conditions could be defined unambiguously. The velocity fields developed in the system and the spatial distribution of the turbulent kinetic energy were measured experimentally using a laser-doppler anemometer. The experimental measurements were found to be in good agreement with predictions based on the K-W model for turbulent recirculating flows, provided appropriate wall functions were used. A simplified model was also described in the

paper, for representing the transient decay of turbulence in teemed systems or in bubble stirred vessels after the agitation had been terminated. This model, which in essence involved the use of a simple algebraic relationship, gave semiquantitative agreement with measurements.

Abstract 5. Before translating the abstract determine the Tense and the Voice of the verb in each sentence:

Equations describing heat transfer in a coke-oven charge have been derived and solved by an efficient, implicit numerical method. The mechanisms of heat transfer described in the model are: conduction through the solid material; conduction through the gas in the interstices or pores; radiation along fissures; and generation, movement and condensation of steam. In particular, a correlation for the thermal conductivity of solid coal and coke in terms of temperature and true density is proposed. The correlation gives good agreement with published values for the thermal conductivity of amorphous carbon as a limiting case. The model of heat transfer in a coke-oven charge is one-dimensional and uses, as submodels, the descriptions of the physical properties and chemical changes in coal during its decomposition to coke as given previously. The model has been implemented in a computer program which requires only basic data on the charge properties and oven conditions as input and its predictions are in reasonable agreement with experimental results covering a range of coking practice. The model has been used to estimate the effects of the charge bulk density, oven width and carbonizing temperature on throughput and energy consumption.

Abstract 6. What does the abstract proposed concern?

A comparison of anthracene and phenanthrene as solvents was undertaken by liquefying either Wyodak or Kentucky 9/14 coal in the presence of hydrogen or nitrogen. Phenanthrene was found to be a better physical solvent than anthracene for liquefying both coals. Anthracene and its derivatives are better hydrogen-shuttling solvents than phenanthrene and its derivatives. Hydrogenation of anthracene to tetrahydro-anthracene was observed with both coals. Dihydroanthracene is a better hydrogen-shuttling solvent than dihydrophenanthrene in the liquefaction of Kentucky 9/14 coal. Anthracene is a better solvent than phenanthrene in the presence of 1-methylnaphthalene in liquefying both Wyodak coal under hydrogen and Kentucky 9/14 coal under nitrogen. The minerals in

Kentucky 9/14 coal appear to be better hydrogenation catalysts than those in Wyodak coal. Labile hydrogen from coal appears to escape readily before reacting with hydrogen-shuttling solvents under the atmospheric environment.

Abstract 7. Does the present abstract reflect the object of your investigation? What branch of industry does it deal with?

An investigation is carried out to establish a relationship between the characteristics of cutting force fluctuations that cause vibratory response of the machine-tool-workpiece system and the formation of surface texture along the lay in a turning operation. Such interrelationships are established from extensive experimental results obtained by measuring, recording and analyzing the cutting force fluctuations and the resulting surface roughness of the work piece. The cutting forces were measured using a specially built three-component dynamometer and the surface roughness were measured with a Taylor-Hobson Talysurf 4 and Talyrond, and were recorded for further analysis.

The spectral densities of these recorded signals were measured using an automatic shock-random equalizer analyzer. Results obtained were employed to establish relationship between the amplitude characteristics of the cutting force fluctuations and those of the surface, texture along the lay. Signals were then processed with an amplitude distribution analyzer to determine the nature of the probability distribution which showed that the cutting force fluctuations and surface roughness are essentially distorted Gaussian.

To establish relationships between the characteristics of the cutting forces and surface texture along the lay, signals were converted to a set of discrete data points by a sequence of computer programs. These data points were then processed by an analysis program to calculate various probabilistic characteristics such as average wavelength, mean crest excursion, root mean square of the crest excursion etc. about preselected levels from the CLA value.

Results indicate essentially nonlinear relationships between the probabilistic characteristics of the cutting forces and the resulting surface roughness. For the values of the probabilistic parameters of the forces and surfaces which are of significance in finish turning and for the cutting conditions used in the tests reported, it was found that the nonlinearity could be reasonably approximated to an equivalent linear relationship for the purposes of applications.

3. СТІЙКІ СЛОВОСПОЛУЧЕННЯ

*Стійкі словосполучення, які використовуються при переказі
та реферуванні тексту*

I

The present paper

The theme (subject matter)

The main problem

The purpose (aim)

The basic principle

Problems relating to (concerning..., dealing with), problems of...

In brief, in short

II

Зв'язуючи елементи тексту

besides

крім того

in addition

then

потім

furthermore

більш того

moreover

therefore

тому, отже

so

отже, тому

that is why

ось чому

however

проте

first(ly)

по-перше

second(ly)

по-друге

third(ly)

по-третє

on the one hand

з одного боку

on the other hand

з іншого боку

nevertheless

проте, не дивлячись на,

thereby

таким чином, у зв'язку з цим

III

Мета написання статті

1. The object (purpose, aim) of this paper is to present (to discuss, to describe, to show, to develop, to give)...

2. The paper (article) puts forward the idea (attempts to determine)...

Питання, що обговорюються в статті

The paper provides information on (reviews the basic principles of..., presents...)

Початок статті

1. The paper begins with a short discussion on (deals firstly with the problems of...)
2. The first paragraph deals with...
3. First (at first, at the beginning) the author presents (points out that, notes that, describes...)

Перехід до викладання матеріалу

1. Then follows a discussion on
2. Then the author goes on to the problem of...
3. The next (following) paragraph deals with...
4. After discussing... the author turns to...
5. Next (then) the author tries to (indicates that, explains that)
6. It must be emphasized that (it should be noted that, it is evident that, it is clear that, it is interesting to note that...)

Кінець викладу

1. The final (paragraphs) states (ends with)...
2. The conclusion is that the problem is ...
3. The author concludes that (summarizes the)...
4. To sum up (to conclude, to summarize) the author emphasizes (points out, admits) that...

Оцінка статті (дається тільки при обговоренні статті)

1. In my opinion (to my mind, I think)...
2. The paper is interesting (not interesting), of importance (little importance), valuable (invaluable), up-to-date (out-of-date), useful (useless).

4. КЛЮЧОВІ МОДЕЛІ АНОТУВАННЯ І РЕФЕРУВАННЯ

Key patterns

- | | |
|--|---|
| 1. The book reviews ... | У книзі розглядається. |
| 2. The author examine. | Автор розглядає |
| 3. This volume brings together (covers) | У даному томі підсумовується (освітлюється, дається підсумок). |
| 4. This work is an overview of. The work presents an overview (overviews) | У даній роботі дається (наводиться огляд). |
| 5. The author focuses on. | Автор робить акцент на (приділяє увагу). |
| 6. This chapter is particularly concerned with | У цій главі в основному розглядається. |
| 7. The work concludes with the discussion of | В кінці роботи обговорюється. |
| 8. The reason of...are explained | Причини...пояснюються |
| 9. Special attention is given to... | Спеціальна увага приділяється ... |
| 10. This book treats (features)... | У цій книзі розглядається... |
| 11. This text introduces and draws together... | У тексті наводиться та аналізується... |
| 12. This book also records early developments in the field of and gives an account (explains). | У цій книзі наводяться перші розробки в області і пояснюються |
| 13. ... is proposed... | Пропонується... |
| 14. The text conveys (reports on, relates) | У тексті повідомляється... |
| 15. This article focuses (concentrates on)... | У цій статті основна увага приділяється... |
| 16. This article establishes some key principals concerning... | У цій статті наводяться основні ключові принципи... |
| 17. The problems relating to.are highlighted | Освітлюються проблеми, що стосуються... |
| 18. This paper presents (gives, reports, describes, etc.)... | У даній статті наводиться повідомляється, описується і так далі |

19. Method(s) (...) such as (or namely)...for studying (analyzing) ...is (are) discussed (illustrated, presented, compared)	Обговорюються (наводяться, порівнюються) метод(и), такі, як (а саме)...для дослідження (аналізу) ...
20. Results obtained (using) are discussed (analyzed)	Обговорюються, (аналізуються) отримані результати (використовуючи ...)
21. ... is studied (investigated, examined, reported)	Досліджується (наводиться)...
22. The results of... were obtained	Отримані результати ...
23. Various values (parameters, elements, variable etc.) are computed (calculated, estimated, determined, defined)	Визначені (обчислені) різні значення (параметри, елементи, змінні величини і так далі)
24. A new technique (method, machine, device, apparatus, unit, etc.) has been developed (designed) for determining (for applying)...	Розроблений новий метод (механізм, пристрій, апаратура) для визначення (для вживання)...
25. Different methods (ways) are compared.	Порівнюються (наводиться порівняння різних методів, способів).
26. The reasons are explained (interpreted)... in terms of...	Пояснюються причини ...з точки зору (з обліком)...
27. ...is stated	Наводиться (визначається, затверджується)...
28. Characteristics are presented according to ...	Наводяться характеристики згідно з ...
29. ... have been shown to offer many advantages over...	Було показано, що...має ряд переваг у порівнянні з ...
30. The basic principles and characteristics of... were reviewed (observed) first	В першу чергу (вперше) розглянуті основні принципи і характеристики...
31. A method ... is proposed to detect...	Пропонується метод ... для виявлення...

32. ... is used (applied) for the purpose of comparison	Використовується ...для порівняння...
33. From this study, it can be concluded that... has the effect on ... (influences or affects...)	З даного дослідження можна укласти, що ... впливає на ...
34. ... may be used for predicting ... under certain conditions	Можна використовувати ...для передбачення (прогнозування, визначення)... за певних умов
35. Some conclusions are made of ... (or paper concludes that...)	Зроблені деякі висновки відносно ... (В кінці статті говориться про ...)
36. The paper proposes a new approach based on . to estimate...	У статті пропонується новий метод, заснований на ...для визначення ...
37. The new method involves...	Новий метод включає ...
38. The problem of... is considered initially	На початку розглянута проблема ...
39. The way of designating ... is also shown	Також показаний спосіб визначення (позначення) ...
40. Finally different problems are reported concerning ... (or primarily that of)...	В кінці (нарешті) розглядаються різні проблеми ... (що головним чином стосуються ...)
41. This conclusions is supported by new experimented data concerning	Даний висновок підтверджується новими даними щодо ...
42. The results are found to be in reasonable agreement with theoretical estimates	Встановлено, що отримані результати сповна відповідають (майже узгоджуються з теоретичними даними)
43. Experiments confirm most of the theoretical predictions	Експерименти підтверджують велику частину теоретичних даних
44. The present measurements agree satisfactorily with recent analyses	Одержані виміри сповна узгоджуються з проведеними аналізами (тобто розрахункові дані відповідають експериментальним)

5. ПОЯСНЕННЯ ТА ЗАВДАННЯ ДО НАПИСАННЯ АНОТАЦІЙ І РЕФЕРАТИВ

У науковій літературі часто використовується таке граматичне явище як ланцюжок іменників або розгорнуті означення. Його утворюють декілька іменників, що стоять між артиклем та останнім іменником, до якого відноситься артикль. Саме цей останній іменник є опорним, з нього слід починати переклад, а всі інші іменники виступають означенням і перекладаються таким чином:

Examples (E. g.):

a <i>steam</i> turbine	парова турбіна (означення)
the airplane wing	крило літака (родовий відмінок)
water treatment	обробка води (обробка водою) (іншими відмінками)
the car speed calculation problem	проблема обчислення швидкості автомобіля (групою іменників)
plant accident	нещасний випадок на заводі (з прийменниками та без них)

Бувають також еліптичні конструкції ланцюжків іменників, коли деякі іменники випускають, але фахівці добре розуміють, про що йде мова.

E. g.: liquid rocket = тобто liquid (fuel) rocket – ракета, яка працює на рідкому паливі.

У ролі означення можуть бути також прикметники та дієприкметники.

E. g.: improved metal treatment methods – удосконалені методи обробки металів

different protection measures – різні міри захисту

Task 1. *Translate the following examples of chain of nouns.
Consult the examples above.*

wear resistance	energy distribution function
vacuum distillation	graphical extrapolation method
matrix element computation	filled energy zone
fuel supply	work function value determination
thermoelectric generator	energy transformation
development	
tensile strength	gold medal
successfully observed azimuthal	photographical X-ray analysis
behavior explanation	method
radial distribution function	high density surface state band
the energy accumulation process	planet surface
the temperature limit determination	insulation capacity

Task 2. *Translate the sentences, paying attention to Chain of Nouns*

1. Argument force rather than force argument should dominate. 2. The class of regulators can be thought of as composed of three parts: a parameter estimator, a linear controller and a block which determines the controller parameters. 3. They have used the conventional crystal growth method. 4. Here frequency dependent rate equations are applicable. 5. The approach is used for time and money saving purposes. 6. A cell growth rate increase has been observed. 7. They have constructed a gas-filled high pressure cell. 8. Such integrity has been achieved by a combination of manual and computer based controls. 9. An integrated absorption area value of all methyl groups is reasonably good. 10. Straumanis has built an elaborate temperature-control system.

Task 3. *Look through the text, find Noun Chains in it and translate them.*

System identification has arisen in different areas of application where the system model is completely unspecified but one wants to predict the system response, to regulate the system, or to simulate the system. The only data available are a sequence of known input and a sequence of noise-corrupted output. The intermediate objective is to specify a model, which agrees with the statistical da-

ta. To perform system identification requires three steps: structure determination, parameter identification, and model verification. Before solving the parameter identification problem, one should address the problem of identifiability of parameters. With an assumed structure, is it ever possible to identify the unknown parameters by extracting information from deterministic input and stochastic output data? The capability of answering this question will facilitate the selection of an appropriate model structure. Clearly, one should not select a model structure whose parameters cannot be identified. Thus the question of parameters identifiability is central in the procedures for system identification.

При написанні реферату ви перш за все повідомляєте про тему роботи. Розглянемо, які мовні засоби типові для введення теми в англійській мові в порівнянні з російською та українською мовами.

Для російської та української мов найбільш характерні речення з присудком у **пасивному стані** теперішнього і минулого часу **із зворотним порядком слів**, а для англійської мови – пропозиції з присудком у **пасивному стані**, але з **прямим** порядком слів (тобто підмет стоїть перед присудком)

E. g.:

1. Вивчається ізотопічний ефект у кристалах. The isotopic effect in crystals is studied.
2. Досліджувалися (досліджені, були досліджені) властивості радіоактивних елементів. The radioactive *properties* of elements *were studied (have been studied)*.

Примітка. Зверніть увагу на те, що англійські речення активного стану при підметі, вираженому займенником **we**, нерідко рідною мовою передаються реченнями пасивного стану.

E.g.: We discuss the problem of ... – Обговорюється проблема

Якщо підмети виражені такими іменниками, як **paper, study, experiment, investigation** і тому подібне, то ми бачимо таку різницю між мовами,

тобто перекладаються реченнями, в яких англійський підмет передається іменником у непрямому відмінку, а присудок – дієслівною формою, що закінчується на -ся, -сь.

E.g.: The investigation deals with the nature of DNA. - У дослідженні розглядається природа ДНК.

The paper presents the analysis ... — У статті наводиться аналіз...

Task 4. *Change the sentences in active voice into the sentences in Passive (see the model). Use chain of nouns where it is possible.*

Pattern: We investigated the structure of the cell. – The structure of the cell (the cell structure) was investigated.

1. The authors developed some theoretical models. 2. We found an approach to the problem. 3. The author has analyzed the material obtained. 4. The paper considered a series of standard programs. 6. The author gives the diagnoses and data which are concerned with the life-cycle of the ciliates.

У першому ж реченні анотації або реферату (або в двох перших) ви можете сказати про тему дослідження і про результати виконаної роботи. Для повідомлення про результати вам знадобляться дієслова show – показувати, find – виявляти, conclude – робити висновок.

E. g.:

1. Були розглянуті пелікулярні мембрани і (було) показано, що вони товщі, ніж в інших клітинах. Pellicular membranes were examined and it was shown that they were thicker than those in other cells.

2. Робиться висновок (приходять до висновку), що модель повністю відповідає всім експериментальним даним. It is concluded that the model provides a very good fit to the experimental data.

Зміст речень, що вводяться реченнями типу it is found (that) , it is shown (that) , можна передати інфінітивними зворотами (Complex subject):

It is shown that spin-wave distance in crystals is nonadditive.

The spin-wave distance in crystals is shown to be nonadditive.

E. g.:

1. Показано, що радикали малі. The radicals are shown to be small.

2. Виявлено, що під дією світла змінюються умови порогової іонізації. The illumination is found to change the impact ionization threshold.

Task 5. *Change Complex Sentences into the simple ones using Complex Subject, i.e. Infinitive Construction. Make up the same sentences using the lexics of your speciality.*

Pattern:

It is found that the spectrum exists only for small energies. The spectrum is found to exist only for small energies.

Your variant:

The thermal factor is found to play an important part in ecological adaptations.

1. It has been shown that the phenomenon is due to aminoacids.
2. It is found that the corresponding transition in the normal crystal is of the second type.
3. It is postulated that a capacity requirement is about 9.5 metric tons.
4. It has been found that the result explain the proton superfine structure.

Task 6. *Find and put down from an English article on your speciality those propositions concerning the facts of 1) what was studied, investigated, discussed, measured, computed; 2) what was found, shown. Reduce these propositions leaving only the group of subject and predicate with the words relating to them. Make up an abstract with these words.*

Task 7. *Fill in the gaps with your special terms:*

Pattern: A study is made of ... and ... are also investigated. – A study is made of cytoplasmic RNA and its properties are also investigated.

1. ... was studied and measured.
2. ... was analyzed and ... was calculated.
3. A study is made of ... and ... properties are also investigated.
4. Measurements (calculations) are made of ... It is found that
5. ... has been studied and shown to be

Task 8. *Analyze Ukrainian and English variants of the abstracts given below paying attention to the order of words, tenses and voices. Find English equivalents to the following Ukrainian ones:*

формулювати
 враховувати
 не враховувати (не оцінювати)
 залежати від чого-небудь
 бути у згоді з чим-небудь

Make up the similar abstract on your speciality.

- | | |
|--|---|
| <p>1. Формулюється теорія основного магнітного стану деяких змішаних феритів. Отримані формули для залежності магнітного моменту і температури Кюрі від змісту немагнітних катіонів. Знайдено, що розрахунки магнітного моменту і температура Кюрі добре узгоджуються з експериментом.</p> | <p>A theory of ground magnetic state is formulated for some mixed ferrites. Equations are obtained for the dependences of the magnetic moment and Curie t° on the concentration of non-magnetic cations. The calculated values of the magnetic moment and Curie t° are found to be in good agreement with the experimental results.</p> |
| <p>2. Літом 1990 р. було проведено загальне екологічне вивчення ряду озер, розташованих на північний захід від Ейрікйокул. Дані за попередні роки не враховувалися. Були досліджені характерні риси планктону, але не оцінювалися шляхи його утворення.</p> | <p>A general study of the ecology of a number of lakes, lying north-west of Eirikjokull, was carried out during the summer of 1970. The data of previous years were not taken into account. The characteristics of the plancton were investigated, but the estimate of the order of production was left out of consideration.</p> |

Якщо вам треба вказати, за яких умов (температури, тиску, напруги і ін.) проводиться дослідження (дослід, вимір) або відбувається певне явище, ви можете використовувати поєднання відповідних іменників з прийменником *at*:

at the temperature (of)	при температурі
at the pressure (of)	при тиску
at the voltage (of)	при напрузі
at the energy (of)	при енергії
at the concentration (of)	при концентрації
at the frequency (of)	при (на) частоті
at the speed (of)	при швидкості (з швидкістю)
at the wavelength (of)	при довжині хвилі
at the angle (of)	під кутом
at the point (of)	у точці
at the altitude (of)	на висоті

Уточнюючи температуру, тиск і інші умови, за яких ви проводите дослідження, можна використати прикметники: *certain, definite* – визначений; *usual, ordinary* – звичайний; *given* – даний; *the same* – той же, однаковий; *different, various* – інший, відмінний, різний; *similar* – аналогічний, схожий; *variable* – змінний, мінливий; *stable* – стійкий; *high, higher* – великий, високий; *low, lower* – малий, низький; *increased, elevated* – підвищений; *moderate* – помірний; *primary* – первинний; *final* – кінцевий.

E. g.:

- | | |
|--|---|
| 1. Інфрачервоне поглинання досліджувалось при різних температурах. | Infrared absorption has been investigated at different temperatures. |
| 2. Виміри, що проводилися в точці солідусу, дали інші результати. | Measurements <i>at the point of solidus</i> have led to (have yielded) different results. |

Вказуючи величину тиску, напруги і ін., ви повинні поставити числові одиниці після відповідного іменника – pressure, voltage, temperature

etc.: at the temperature of about 90 °C – при температурі, приблизно рівною 90 °C; at the pressure of 170 atm – при тиску в 170 атм; at a voltage as high as 170 volts – при (високій) напрузі (якщо напруга висока) до 170 вольт; at a voltage as low as 10 volts – при (низькій) напрузі до 10 вольт.

Task 9. *Read the abstract. Name the object of investigation, experiment conditions and results.*

Infrared Absorption, Photoconductivity, and Impurity States in Germanium

Infrared absorption and photoconductivity in *p*-type Ge with Au and Cu impurities have been investigated at various temperatures. Photoconductivity in Au-doped Ge at liquid-nitrogen and liquid-helium temperatures shows a long-wavelength tail beyond the falls off sharply at about 6 For Cu-doped Ge at low photoconductivity show a maximum at about 22 microns corresponding to 0.055 eV.

При складанні анотацій і рефератів використовуються іменники, що позначають: 1) метод, спосіб проведення дослідження; 2) прилад, засоби.

1) Залежно від того, який сенс ви вкладаєте в поняття, використовується те або інше слово. При цьому треба враховувати, що слово *method* означає ‘метод, спосіб’; *technique* – ‘метод, спосіб, методика, техніка (проведення досліджу)’; *techniques* – ‘методика’; *procedure* – ‘метод, прийом, процедура, операція (не у медичному сенсі слова)’; *approach (to)* – ‘метод, підхід (до рішення), розгляд (з певної точки зору)’.

Примітка. Українською мовою ми можемо сказати підхід до питання (підхід до проблеми), англійською – рекомендується в цих випадках уникати слів **question, problem**.

E. g.:

Викладається новий підхід до проблеми фазового переходу.

A new approach to phase transition is discussed.

Слово **прилад** можна передати словами ***device, apparatus, instrument***. При цьому *device* зазвичай означає ‘невеликий прилад’. Іменникам **облад-**

нання, пристрій, устаткування зазвичай відповідають іменники *device*, *apparatus*, *equipment*, *construction*, *set*, *set up*; апарат, апаратура – *apparatus*, *instruments*, *equipment*; обладнання – *equipment*, *apparatus*; установка – *set*, *set up*, *apparatus*; інструмент – *instrument*; агрегат – *set*, *unit*; вузол (блок) пристрою – *unit*, споруда – *construction*, конструкція – *design*.

Крім того, в англійській мові є два іменника, які узагальнюють поняття «засоби»: *tool* – інструмент, знаряддя, засіб, пристосування і *facility* – обладнання, предмети обладнання, апаратура, пристрій (воно включає поняття всього того, що може полегшити (facilitate) роботу).

Task 10. *Explain how the words **design**, **device**, **instrument** are used in the following microtext:*

The Crayford Eyepiece Mount (установлення окуляра) is described. *The design* is suitable for amateurs. However *the device* lends itself to sophisticated development. With suitable modifications *the instrument* can become a really first-class *mount*.

При повідомленні про спосіб дослідження, коли ви називаєте дію, за допомогою якої проводилося це дослідження, ви можете використовувати наступні структури: *by + Gerund (+Noun)*, *by + Noun (+ of Noun)*. В українській мові це відповідає структурам з дієприслівником або віддієслівним іменником (іменником утвореним від дієслова).

E. g.:

Ми отримали нашу величину шляхом (за допомогою) порівняння (порівнянням) даних (порівнюючи дані).

We obtained the value *by comparing* the data (*by the comparison* of the data).

Якщо смисловим центром вислову є не метод (спосіб, прилад), а об'єкт дослідження, то останній ставиться в кінці речення. Порівняємо два речення:

1. Оптичні константи вивчаються методом багаторазового розсіювання.
2. Методом багаторазового розсіювання вивчаються оптичні константи.

Optical constants are studied *by (using) the multiple-scattering method*.
 The multiple-scattering method is used *to study (in the study of) optical constants*.
 Using the multiple-scattering method *optical constants are studied*.

У першому реченні сенс вислову зосереджений на тому, яким методом вивчені оптичні константи (вони вивчені методом багаторазового розсіювання, а не іншим методом). В другому реченні робиться акцент на тому, що вивчене методом багаторазового розсіювання (вивчені оптичні параметри, а не інші властивості).

Оскільки в рефератах увага зазвичай зосереджена на предметі дослідження, то подібні структури є дуже поширеними. Проте буває що в українському і англійських текстах акценти різні.

E. g.:

Методом месбауерівської спектроскопії вивчено стан домішкових атомів олова в окислі нікелю (акцент – на предметі дослідження).

The state of tin impurity in nickel oxides was studied by Mossbauer spectroscopy (акцент – на способі дослідження).

Task 11. *a) Define in the following sentences the structures, pointing the method of research b) give the possible variants of their translation c) give, if possible, your own way to convey the same information in English.*

1. The difficulty is removed by simplifying the equation.
2. The ultrastructure has been investigated using an electron microscope.
3. Temperature structure coefficients were measured with temperature sensors.
4. The width of the paramagnetic resonance line was measured by means of a standard microwave spectrometer.
5. The valence band method was used to calculate the free valence.

Task 12. Compare Ukrainian and English sentences. Pay attention to the fact that despite using different syntactical structures they convey the same meaning.

- | | |
|--|--|
| 1. Імпульсним методом були вивчені механізми релаксацій в монокристалі. | A pulse method was used in a study of the mechanism of relaxation in a single crystal. |
| 2. Кінетичним методом отримано (виведено) вираз для ... | A kinetic method is used to derive a general expression for ... |
| 3. Методом еталонного завдання побудовані в аналітичному вигляді хвильові функції кулонівської частки в однорідному електричному полі. | The standard-problem method is used to construct the wave function for Coulomb particles in a uniform electric field in analytical form. |

Для позначення мети, призначення дослідження можна використати наступні іменники: *the aim, the object, the purpose, the task* – мета, призначення, завдання.

Примітка. Іменники *aim, object, purpose, task* вживаються з певним артиклем, що має конкретизуюче значення, оскільки ми говоримо не про цілі взагалі, а про мету (призначення) даної роботи, досвіду і ін.

Прикметники *main, chief, primary, principal* – головний, основний можуть визначати іменники із значенням ‘Мета, призначення’ (*purpose, aim, etc.*).

Якщо вам треба повідомити про мету своєї роботи, ви можете використовувати конструкцію, що складається з іменників *purpose, aim, object, task* з подальшим дієсловом *be + to (Infinitive)*.

Приклад:

The aim (object, purpose, task) of the study is to determine ...

Мета (завдання, призначення) роботи полягає у визначенні ... (у тому, аби визначити...)

Мета (завдання ...) роботи – визначення (визначити) ...

Робота проведена для (з метою) визначення...

Task 13. *Complete the following sentences telling of your research object.*

1. The aim of the study (research) is to test ...
2. The chief purpose of the investigation was to establish...
3. The main task of the experiments has been to measure...
4. The primary aim of the paper (discussion) was to describe...
5. The object of the experiment (technique) was to explain...

Task 14. *Convey in Ukrainian the context of English propositions given below. Say what propositions inform of 1) object of research, 2) work procedure, 3) aim of the work, 4) test conditions conclusions. Make up your own propositions similar to these ones.*

1. A system to measure plasma electric fields is discussed.
2. An effective device is used to detect electric currents.
3. A technique is described for the measurements of atom-molecule rate constants over the temperature range 300–1000 °K.
4. Methods that have been used for evaluating the nongravitational effects on a comet are briefly discussed.
5. A process for separating fission products from uranium employing liquid metals and liquid salts as solvents is described.
6. The results indicate that additional work is needed to improve precision at low molybdenum levels.
7. In order to identify the traps the effects of different temperature cycles, dislocations and chemical impurities have been studied.

Якщо ви хочете розповісти про основні характеристики предмету, що вивчається, процесу, явища, речовини, способу, теорії, приладу і т. д., використовуйте наступні іменники і сполучення: *feature* – риса; *characteristics* – характерна риса; *peculiarity* – особливість; *be characterized by (some feature, property etc.)* – характеризуватися; *have (some feature, property)* – відрізнятися (володіти) властивостями; *be characteristic of* – бути характерним для ...; *be typical of* – бути типовим для...

E. g.:

- | | |
|--|--|
| 1. Особливістю цього методу є його висока чутливість. | <i>The peculiarity of the method is its high sensitivity.</i> |
| 2. Цей метод відрізняється (характеризується, володіє) високою чутливістю. | <i>The method is characterized by high sensitivity. The method has high sensitivity.</i> |
| 3. Висока чутливість характерна (типова) для даного методу. | <i>High sensitivity is characteristic (is typical) of the method.</i> |

Task 15. *a) Translate the following propositions; b) write in English similar propositions telling about the substance (device, process, method, etc) you study. The words in brackets will help you.*

1. Головною особливістю приладу є змінні електроди, положення яких можна регулювати (*adjustable, removable, electrodes*).
2. Основною рисою лампи є те, що вона може працювати (*can be operated*) з різними наповнюючими газами (*different filling gases*).
3. Характерною особливістю додаткового полімеру (*addition polymer*) є висока міра лінійності (*is high linearity*) структури ланцюга (*chain structure*).

Кажучи про властивості речовини (приладу і ін.), що вивчається, можна використовувати дієслова *show, reveal, exhibit* (показувати, виявляти, проявляти) + іменник, що позначає дію, характерну для даної речовини:

show absorption, absorb	поглинати
show (exhibit) deviation, deviate	відхилятися
show (exhibit) marked deviation	помітно відхилятися
show a sharp rise, rise sharply	різко зростати
exhibit a behavior, behave	поводитися
exhibit a slow decrease, slowly decrease	повільно зменшуватися
show a tendency to increase, increase	зростати, збільшуватися

Task 16. Compare the propositions given below, paying attention to the fact how matter properties are expressed.

- | | |
|--|--|
| 1. Конфігурація доменів носила менш регулярний характер. | The domain configuration revealed a less regular character. |
| 2. Крива поглинання в ультрафіолеті має максимум поглинання при 260 мкм. | Ultraviolet absorption curve shows the absorption maximum at 260 mcm. |
| 3. Підвищення абсорбції не мало відношення до доданих домішок. | The rise in absorption showed no relation to the number of foreign impurities. |

Описуючи, в чому полягає вживаний вами метод, теорія, завдання дослідження, використовуйте дієслова: *be + to Infinitive, consist in + Gerund/Noun, involve + Gerund/Noun* – *полягати в, включати*.

E. g.:

- | | |
|--|--|
| 1. Метод полягає у вимірі інтенсивності розсіювання (включає, вимагає виміру інтенсивності розсіювання). | The method is to measure scattering intensity (consists in measuring (in the measurement of, involves measuring/the measurement of) scattering intensity). |
| 2. При обчисленні напруги була використана система рівнянь. Метод обчислення цієї системи полягає в тому, що з неї виключається тензор напруги ϵ_{ik} . | In calculating the stress a system of equations was used. The method of solving this system is to eliminate the stress tensor ϵ_{ik} from it. |

Task 17. a) Translate the following propositions; b) Make up similar propositions (in English) to say what your method, process ect., consists in.

- Інший (an alternative) метод включає поглинання (absorption) енергії випромінювання (radiant energy).
- Інший підхід полягає у спостереженні (to observe) поверхні кристалів.

3. Реакція полягає в естерифікації (*esterification*) жирних (*fatty*) кислот гліцерином (*glycerol*).

4. Процес включав нагрівання (вимагав нагрівання) з подальшим (*followed by*) швидким охолодженням (*quenching*).

Якщо вам треба повідомити про те, що можна зробити (отримати і ін.) за допомогою методу (приладу, використовуючи речовину і т. д.), що може дати метод (прилад і т. д.), то вам треба використовувати дієслова, які передають поняття можливості, здібності, а саме: 1) *can*, 2) *be capable of*, 3) *allow*, *permit*, *enable*, 4) *make it possible*.

Task 18. *Make up short sentences using constructions with the modal verb **can**.*

Е. г.: *solve the equation. We can solve the equation* та *The equation can be solved.*

1. Obtain a pure substance, 2. measure the pressure, 3. decrease the temperature, 4. determine the pressure, 5. maintain the temperature, 6. demonstrate the phenomenon, 7. control the temperature.

Якщо ви хочете написати про те, що можна виконати за допомогою приладу чи що може дати такий метод, вам знадобиться сполучення **be capable of + Gerund** або **Noun**, що відповідає українському сполученню «бути здатним (спроможним), давати можливість + інфінітив».

Е. г.:

1. Ця помпа *може створити*
(*створює, дозволяє отримати*)
високий вакуум.

The pump is capable of producing
high vacuum (produces high va-
cuum).

Примітка. Ця ж думка може бути висловлена інакше:

За допомогою цієї помпи можна *отримати (отримують)* високий вакуум.

Task 19. a) Translate the following sentences, using *capable of, be capable of*; b) Write (in English) similar sentences connected with the field of your investigations.

1. Цей генератор може створювати (*produce*) світлові (*optical*) імпульси порядку 100 в секунду (*as narrow as 100 psec*).

2. У статті описується лазерна установка на CO₃ (*a CO₃ laser system*), яка дозволяє генерувати і підсилювати (*amplify*) імпульси випромінювання тривалістю 500 ps (*a 500 psec. pulse*).

3. Описані методи здобуття точних (*precise*) вимірів, які дають можливість визначити (*yield*) поверхневу напругу в межах від (*within*) ± 2 до 3 відсотків.

Поєднання слів **давати можливість (робити можливим)** і дієслова **дозволяти, допускати** можна виразити англійським сполученням слів ***make it possible + Infinitive* або *make possible + Noun***.

E. g.:

Наші результати дають можливість (дозволяють) застосувати спостереження Доплера.

Our results make it possible to apply Doppler observations.

Наші результати допускають вживання спостережень Доплера.

Our results *make possible* the application of Doppler observations (*make the application of Doppler observations possible*).

Task 20. Translate the following sentences using *capable (be capable) of, enable, allow, permit, make (it) possible*.

1. Лічильник (*the counter*) дозволяє реєструвати (*count*) частки.

2. Описаний прилад, який дозволяє отримати високотемпературну плазму.

3. Описаний прилад дозволяє зменшити (*reduce*) аберації до незначних величин (*negligible amounts*).

4. Описується прилад, який робить можливим досягнення стабільно-

го тиску (*pressure stability*).

5. Ці мембрани можуть (здатні) пропускати іони лише одного вигляду.
6. За допомогою цього методу можна досягти великої точності.
7. Пропонований метод дозволяє вивести (*derive*) рівняння руху.
8. Ці досліді дозволяють порівняти обоє явища.

При оцінці роботи, методу, матеріалу, приладу вам знадобляться іменники: *advantage, merit* – заслуга, перевага; *limitation, disadvantage, drawback* – недолік, обмеження.

З іменниками *advantage, merit* можна використовувати дієслова: *have, present, offer* – мати, давати; *combine* – поєднувати.

Загальновживане поєднання слів *have (offer) advantage over* – мати перевагу (перед).

E. g.:

- | | |
|--|---|
| 1. Цей метод має ряд переваг. | The approach has (present, offers) several advantages. |
| 2. У цьому приладі поєднуються деякі переваги раніше використаного приладдя. | The apparatus combines some advantages of the previous devices. |

Для того щоб показати (вказати), в чому полягають переваги або обмеження пропонованого способу (приладу, матеріалу і ін.), можна використовувати наступні структури: *the advantage (the limitation) of ... is + Noun, is in + Noun / Gerund, is that ..., is in that..., is due to Noun / Gerund, is due to the fact that* – перевага (недолік, обмеження) полягає (полягає в тому, що ..., обумовлюється тим, що ...)

E. g.:

- | | |
|---|---|
| 1. Перевагою нової конструкції є простота розрахунків. | <i>The advantage of the new design is the ease of calculation (is in the ease of calculation; is that it permits easy calculation).</i> |
| 2. Перевага нової конструкції полягає у простоті розрахунків. | The new design has (offers) the advantage of the ease of calculation. |

Task 21. a) *Compare the following sentences. Define their lexical-syntactical difference;* b) *make up similar sentences saying about advantages and disadvantages of the device, method, substance you work with.*

- | | |
|---|---|
| 1. Показано, що в обмежених, але важливих областях аналогові машини за вартісним параметром істотно перевершують цифрові. | It is shown that the analog computer offers a significant advantage in hardwire performance over the digital computer in certain limited but important areas. |
| 2. Однією з позитивних якостей полімерних волокон є простота поводження з ними, яка обумовлена великим діаметром і гнучкістю волокна. | One of the advantages of the plastic fibers is their facility for handling, owing to their relatively large diameter and their flexibility. |
| 3. Переваги особливо істотні при роботі апарата в інфрачервоному спектрі. | The advantages of the device are especially important for the infrared applications. |

Основними дієсловами для вираження зіставлення є: **compare with... make /give (a) comparison of with...** — порівнювати, зіставляти, проводити (робити) порівняння (зіставлення з); **make/give (a) comparison between ... and** — проводити (робити) порівняння між... і... .

Якщо порівняння проводиться між аналогічними предметами або явищами, то іменник, що позначає ці предмети або явища, в українській мові може бути повторений або опущений, в англійській мові він замінюється займенником-замінником **that (those)**.

E. g.:

- | | |
|--|---|
| Отримані дані порівнювалися з передбаченими теоретично даними, передбаченими на основі теорії. | The values obtained were compared with those predicted from the theory. |
|--|---|

Task 22. a) Translate the following sentences using *that (those)* instead of nouns b) write down sentences connected with the object of your investigation.

1. Ми порівняли наші дані з тими, які були отримані (з даними, отриманими) в попередніх роботах (study).
2. Надійність результатів, що отримуються на цьому приладі, перевірялася шляхом порівняння з результатами інших методів.
3. Величини, розраховані цим способом, порівнювалися з тими, які були отримані (estimate) іншими обчислювальними методами.
4. Дається зіставлення отриманих і очікуваних величин.

Для повідомлення про результати своєї роботи вам знадобляться такі іменники: result (on, of) – результат; findings (on) – дані (про, по, відносно); data (on, concerning, as to) — дані, відомості (про, відносно, які стосуються щодо); evidence (for, of, on, concerning, that) fact (of, concerning, that) – факт, дані по (про)...

E. g.:

Отримані нові дані про поведінку цієї речовини.	New data on (concerning) the behavior of the substance were obtained.
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Task 23. Translate the predicates in the following sentences and remember English order of words.

1. Обговорюються the results obtained.
2. Розглянуті the experimental data.
3. Спостерігалися the temperature effects.
4. Були розроблені new methods.

Task 24. Following the pattern in task 20 make up your own sentences using lexics on speciality.

Task 25. Compare Ukrainian and English texts of the abstracts given below. Use them as a pattern for writing abstracts on your speciality.

Новий механізм випромінювання електромагнітних хвиль з кристалів при проходженні струму	New Mechanism of Current Emission of Electromagnetic Waves from Crystals
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Вивчалось випромінювання хвиль з кристалів. Описується новий механізм збудження електромагнітних хвиль в кристалах при проходженні сильного струму у відсутності зовнішнього магнітного поля. Цей механізм дає пояснення явища випромінювання електромагнітних хвиль з кристалів теллура.

The emission of electromagnetic waves from crystals has been investigated. A new mechanism for the excitation of electromagnetic waves in crystals through which strong currents are passing in zero external magnetic field is described. This mechanism provides an explanation for the emission of electromagnetic waves from tellurium crystals.

Завершальні пропозиції анотацій і рефератів часто вводяться такими словами і поєднаннями слів: *conclude* – дійти висновку; *make, draw, reach a conclusion, come to a conclusion that* робити висновок відносно; *it is concluded that* – доходити висновку, що; *lead to a conclusion, make it possible to conclude that ...*, (*concerning as to*) – наводити до висновку, давати можливість зробити висновки; *from the results it is concluded that...* – на підставі отриманих результатів приходимо до висновку; *it may be noted that* – можна відзначити, що... – *thus, therefore, consequently, as a result* – таким чином, отже, в результаті.

E. g.:

Був зроблений висновок, що провідність р-типу спричиняє (призводить до) на зменшення концентрації.

It was concluded that the p-type conduction resulted in a decrease in concentration.

Task 26. *Look through the abstract given below and find the sentences where it is said about conclusions. Write down the Ukrainian – English equivalents that describe the conclusions. Use them for making up some final sentences of abstracts on your speciality.*

Дослідження поліморфної війчатої інфузорії за допомогою електронно-мікроскопічного сканування

Scanning Electron Microscope
Observations on the Polymorphic
Ciliate

Обговорення отриманих результатів підтвердило ті дані, які були накопичені в попередніх роботах. Затверджується, що не можна переоцінити значення електронного мікроскопа в роботі, яка була виконана в ході даного дослідження. Робиться висновок, що роздільна здатність і збільшення є проміжними між звичайним електронним та світловим мікроскопами.

Discussion of the present findings has confirmed the data accumulated in earlier studies. It may be stated that the value of the scanning electron microscope cannot be overestimated in a work such as that carried out in the present investigation. It is concluded that the advantages of resolving power and magnifications are intermediate between the transmission electron microscope and the light microscope.

Task 27. *Translate the following sentences. Instead of gaps put down words and terms on your speciality. See the pattern given below:*

Pattern: Можна стверджувати, що експериментальні дані підтверджують роль...у процесі... – It may be stated that the experimental data prove the role of **mitochondria** in the process of **regeneration**.

1. Таким чином, ефект...має (is of)...характер.
2. Такі міркування використовуються для того, щоб зробити висновок про умови виникнення...
3. З результатів робиться висновок, що...виникає унаслідок...
4. Робиться висновок, що...визначається підвищенням концентрації...

6. СТАТТІ ДЛЯ ІНДИВІДУАЛЬНОЇ РОБОТИ ТА ДЛЯ ПІДГОТОВКИ ТЕЗ

(Articles for Individual Work and for Making Abstracts)

Task 1. Choose the articles which deal with your speciality or the problems you are concerned with.

Task 2. Translate these papers.

Task 3. Make up an Abstract or Precis to them in English and in Ukrainian.

Task 4. Fulfil additional grammatical or lexical tasks.

Pretext task. Look through the text and find sentences with Modal verbs and Infinitives and translate them.

NEW FUNDING SPARKS BATTERY RESEARCH

If there is any correlation between the level of support for research and development and the emergence of a viable product, advanced storage batteries for utilities and electric vehicles may come into existence in the decade beginning about 5 years from now.

Two years ago, before the establishment of the Energy Research and Development Administration (ERDA) and when the Electric Power Research Institute (EPRI), Palo Alto, California, was newly born, estimates of funding for advanced batteries totaled something less than \$2 million. This year, ERDA has allotted \$8.4 million, and EPRI is spending \$3.3 million (of which about two-thirds is matched by cost-sharing by the contractors). Additional support comes from the National Science Foundation's RANN program and from independent industrial research.

In addition, a battery energy storage test (BEST) facility costing \$6.5 million will soon be under construction. Supported equally by ERDA and EPRI with an additional million contribution from the Public Service Electric and Gas Company of New Jersey, BEST will begin operation in 1979 as a part of the New Jersey electric power grid. The facility will have three bays, each servicing a 1-megawatt battery system with a storage capacity of 10 megawatt-hours. Advanced lead-acid batteries will be evaluated first, but the high-temperature batte-

ries that many see as the eventual solution to energy storage problems (see story) probably will not be tested before 1981, and will not appear in commercial quantities before 1985.

Testing and demonstration of new batteries to power electric vehicles face a less certain future. A year ago, Representative Mike McCormack (D-Wash.) introduced a bill designed to stimulate interest in electric vehicles. After substantial revisions in committee, the McCormack Bill (H.R. 8800) passed the House last September. Since then, however, it has languished in the Senate Commerce Committee, reputedly as a political hostage for a Senate bill that the House committee is sitting on. A source on the Commerce Committee says he expects action to perk up later this spring.

As passed in the House, H.R. 8800 provides for \$160 million to be spent on electric vehicle research, development, and demonstration over 5 years. Another \$60 million would go toward loan guarantees for manufacturers undertaking production of such vehicles. In the demonstration phase, the bill provides that within 12 months after enactment, a selection of currently available electric or hybrid vehicles of various types be procured; that within 15 months, procurement begin on 2500 vehicles designed with the best current technology; and that within 42 months, procurement begin on an additional 5000 or more vehicles designed with advanced technology. These vehicles are to be distributed throughout government agencies and perhaps to individuals as well for testing and evaluation.

Battery researchers predictably say that these large-scale purchases come too soon and that no advanced batteries could be ready in time to be tested under the provisions of H.R. 8800. Some worry that, if no vehicles with acceptable performance can be engineered in this short time, electric vehicles and batteries may get an undeservedly bad name.

Nonetheless, ERDA has already issued requests for proposals for several near-term batteries, including advanced lead-acid batteries and alkaline electrolyte batteries with nickel cathodes and either iron or nickel anodes. These are expected to be ready for demonstration in commercial quantities in from 2 to 5 years, and preparations for a national battery test facility at the Argonne National Laboratory near Chicago to evaluate them prior to large-scale production have begun. — A.L.R.

Pretext task. Read the text and make the plan to it.

IM MEANS BUSINESS

Picture this: a just-in-time delivery of sheet metal arrives at the assembly line, but it has blemishes. What to do? Shut down the line? See how quickly the supplier can replace it? Use the sheets despite the defects? The line manager, Bob, doesn't answer his office phone. Every hour spent tracking him, down wastes thousands of dollars.

Fortunately, the line supervisor, Alice, knows Bob's instant messaging screen name. If he is logged in on any device, be it desktop computer, cellphone, or PDA, her question will reach him wherever he is, in the office, at home, or in between.

That hasn't actually happened yet, but it's a favorite story for companies like Ikimbo Inc. (Herdon, Va.) and Jabber Inc. (Denver, Colo.). And they're just two of many software developers making instant messaging (IM) tools and programs for a field that has suddenly exploded, with applications ranging from stockbrokerage to customer service, from e-retailing to police, emergency communications, and the military.

Maybe it's even a compelling tale. Recently Ikimbo got another round of scarce investor capital, while Jabber signed up such customers as Hewlett-Packard, BellSouth, and Disney. Each is looking to tap into a market that spans over 100 million unique home users and another 18 million in offices.

A scenario that must have seemed unlikely a year ago was the U.S. Navy's Office of the Chief of Naval Operations (Washington, D.C.) turning to instant messaging when its workers were dispersed after the 11 September attacks. But it did, and now the service's top admirals are messaging their staff – and another. Nor does the Navy's embrace of the technology stop there. Over 300 ships at sea are connected by another IM system.



Fig. 4.1.

As it emerges from the world of teenage chat, IM – sending text messages and, ultimately, audio, video, indeed, files of any sort, interactively – is already being put to use at corporations like IBM Corp. and Accenture Ltd. (Hamilton, Bermuda). Workers in these companies are using it to share documents remotely, to ask a quick question of one another, or to exchange notes during a meeting, despite being hundreds of kilometers apart.

IM is also moving from computers and laptops to cellphones, PDAs, and other devices. Through its prosaic "buddy list," a continuously updated window that shows who among your family, friends, or colleagues are online and available, IM connects you to your inner circle in ways that phones and e-mail can't.

What will make IM more than just the next hot idea to come and go is a single key feature called presence. In essence, this is a protocol to tell the world that you're available on a particular device. Outside IM, presence is being built into collaboration tools, word processors, e-mail directories, and even online games.

Being always available has its drawbacks, of course. All too often, work and other obligations spill over into our private time. Many find the prospect of co-workers and even family always being able to contact us daunting. Concentration can be shattered; questions that seem important to the questioner may not be so to you. If usability researchers and application developers get it wrong, presence will be a burden, instead of a benefit.

If they get it right, though, if they can deliver the right amount of your availability to the right set of people, IM can become the main way we initiate

contact with the people we communicate with most often. Indeed, those now-primary forms of communication, the telephone and e-mail, will either have presence built into them, or take a back seat to IM.

Why not just call?

As a mode of interactively exchanging a great deal of information, the phone is still unparalleled. As a way to initiate communication, though, it's terrible. Until the 1970s, the phone was about as intrusive a technology as there could be. Like subjects in a Pavlovian experiment, when it rang, we responded.

Since then, we've erected walls of voicemail. By one estimate, only two in five office phone calls lead to an immediate conversation. Many of us find ourselves scheduling calls as formally as face-to-face meetings. Pagers attempt to pierce the wall of voicemail, but (except for two-way types) they're not interactive. Only unreliable caller-ID systems tell us who is calling.

The phone can also be an imposition. Erin Bradner, a postdoctoral researcher at the Institute for Software Research, at the University of California at Irvine, observes, "The recipient of a phone call is at a severe disadvantage – he or she doesn't know who is calling, or what it's about, or the urgency of the call. IM levels the playing field between sender and recipient."

Here's how: first you set up the buddy list, adding the IM system user (screen) name of those you want to be able to message. The other person need only have an account on the same system you're using, or one that can exchange messages with yours.

The buddy list tells you if someone is generally available. For example, in the AOL Instant Messenger (AIM) window, there are two tabs, one a list of everyone you've made a buddy and the other, those among them who are currently online. When your friend logs in to the system, the instant messaging server updates the application of all who have him or her on their buddy lists.

But knowing someone is logged in may not be enough – is the person really at his or her device right now? More detail can be provided through an "away" message, such as "at lunch" or "back at 3:00," which tells you the other person's status. Again, every change to their away message is pushed out to you and every other buddy list they're on.

When Alice sends Bob a message, he sees who is contacting him as well as the message itself (say, "Acme's sheet metal is defective, send it back?"), which tells him the topic of discussion. Unlike with the telephone, Bob need not respond instantly, but can shift his attention from his current task in an orderly way. If not at his desk, Bob can see the message on his return. If Alice is on Bob's buddy list as well (some experimental systems require that sort of mutuality), he'll see whether she's online to be answered.

By showing up in a little box on Bob's screen, Alice's message is as visible as the blinking light on a voicemail system, and infinitely more informative. (Having a bunch of windows popping up on your monitor raises the question of screen management; more on that later.)

Ready, AIM, fire

Corporate use of IM has soared of late, with most users simply downloading AIM or one of the other free commercial IM software packages, a practice many firms are uneasy about. One reason is security. There basically is none, and no company wants its sensitive conversations on AOL's servers. Another problem is the potential for viruses. There have been no major outbreaks yet, but IM is a perfect breeding ground for them, so one is bound to show up sooner or later.

Another knock against the commercial IM systems is that they don't work well with other desktop applications (though Microsoft Corp. has begun tackling that, at least for its own software, for example, showing presence in its Outlook e-mail directories). And some companies develop or customize software to meet a particular need. For example, the financial industry is required by law to archive all communications, even instant messages.

Hoping to exploit such opportunities, companies that provide IM applications and programming tools, including Ikimbo, Jabber, Scan Mobile Ltd. (London), and ActiveBuddy Inc. (New York City) have sprung up. They and other software manufacturers are equipping existing applications, such as the software used by customer support specialists, with IM and presence. Instant messaging is also being added to off-the-shelf applications. Groove Networks (Beverly, Mass.), for one, has added it to its collaborative work software, Workspace.

Not all applications are so serious. Disney has inserted real-time messaging in dozens of networked games, and Yahoo! has added chat functions to its Webcasts of live music performances so that "concertgoers" can interact as they do at a real concert. *ELLEgirl* magazine's ELLEgirlBuddy, an automated query agent, "talks" to teenagers, offering them fashion tips. IM is even being used at auto racetracks so that pit crew members can communicate with each other.

Some applications, though, are very serious. The U. S. Navy, for instance, has built presence into IM and chat functions using IBM's Lotus Sametime IM software (though with a custom Web-based interface). The software development was done by defense contractor X.Systems Inc. (Manassas, Va.).

In the aftermath of the 9/11 attacks, X.Systems built an IM application for the Navy in less than a month. Besides the larger issue of the loss of 184 lives at the Pentagon, the bombing destroyed many offices, including some used by top Navy brass. Many found themselves without access to the Navy's secure telecommunications network.

Existing plans for a general executive portal – a one-stop site for briefing documents and status reports on topics like readiness, logistics, and munitions – were tabled in favor of one particular component: an IM system that would allow the Navy's most senior officers, its three- and four-star admirals, to communicate with one another and their immediate staffs. By making the system Web-based and using secure sockets layer (SSL) encryption, it would have the needed security, even when used in temporary offices not hooked up to the military network.

IM has also been built into other Navy applications, notably the Collaboration at Sea system, a single network serving over 300 ships [see "In the Navy," below]. "There are only a couple of telephones on each ship and it's a party line, so anyone on any ship can pick up a phone and listen in," says X.Systems project manager Doug Garnett-Deakin. "With Collaboration at Sea, two supply officers, for example, can IM, privately and directly."

The Navy admirals are enthusiastic about IM, though their own use of it has been spotty, according to Mary Ann Rochey, the civilian Navy manager in charge of the portal's development. "We have some admirals who totally embrace it, not just for the fleet but for themselves, and then we have some who say 'That's something my teenager does, not me.' And then some say, 'I have the

phone, I have e-mail. E-mail is overwhelming me, I'm not sure I want these people IM-ing me."

Cutting the clutter

The admirals aren't the only ones feeling overwhelmed. Bonnie Nardi, principal research scientist at Agilent Laboratories (Palo Alto, Calif), says, "In our studies, people talked about

In the Navy

Instant messaging (IM) is one component of the U.S. Navy's Collaboration at Sea, a system of applications for communication and data transfer for over 300 ships in the Atlantic and Pacific fleets. Here's how it works: a dedicated IM server running Lotus's Sametime IM software constantly monitors presence, or who is logged in and available. An instant message goes from a user's client application—in this system, a Web browser—to an applications server that runs the Web-based IM applet.

Next it goes to the Sametime server, then back through one of the application servers to the recipient's browser. (In a commercial system like AOL Instant Messenger, the client software communicates directly with AOL Instant Messenger servers.)

When Hennessy started his research, the wider computer world had only limited interest in real-time systems. But just as he was finishing his Ph.D. in 1977, the technology suddenly began getting a lot of attention as its potential became apparent. "So this little field I was working in just exploded," he told *Spectrum*.

For someone about to enter the job market, this was not a bad position to be in. Hennessy's job search focused on academia. "I loved working on research and with students and never thought about doing anything else," he says.

He started as an assistant professor at Stanford, teaching a microprocessor laboratory course to graduate students and a systems programming course to undergraduates. His research focused on compiler optimization.

In 1980, the U.S. Defense Advanced Research Projects Agency (DARPA) began funding researchers as it developed what would become its very large-scale integration (VLSI) research program. Stanford's project for DARPA, led

by Forest Baskett and) Jim Clark, was to design an IC chip to do three-dimensional graphics transformations. This design evolved into the geometry engine, the chip that was to be the foundation for launching Silicon Graphics Inc. (Mountain View, Calif), one of the first successful manufacturers of high-performance graphics workstations.

To implement the complex 3-D transformations, which required using floating-point arithmetic, the design resorted to microcode, a series of stored instructions that are not program addressable. The microcode translated the high-level geometric operations into simple instructions that could be implemented with a small number of transistors. As part of the Stanford team, Hennessy developed the high-level programming language and the compiler used to generate that microcode.

Hennessy was perfectly happy in academia. "I never envisioned trying to take my ideas out to industry," he said. But in 1981, Carver Mead, a professor at the California Institute of Technology (Pasadena) known to Hennessy through Mead's landmark work on VLSI, started a company to commercialize some Caltech research that demonstrated how to design VLSI chips from high-level descriptions. The company was called Silicon Compilers Inc. (now part of Mentor Graphics Inc.). Aware of the work Hennessy had done on the microcode generation language for the geometry engine, the charismatic Mead easily convinced him to spend one day a week working for his nascent company.

Hennessy ended up helping to define the microarchitecture, which included a pipeline and the engine for implementing the instruction set, for what was to become the MicroVAX 1, a computer released by DEC in 1984. This was the first single-chip implementation of the VAX minicomputer architecture. It was also the first large-scale use of high-level synthesis tools, often called silicon compilers.

This stint at Silicon Compilers was the beginning of what was to become a parallel life for Hennessy in industry. When Silicon Graphics was formed, Hennessy left his day-a-week job at Silicon Compilers for a day-a-week job there, where he worked on the system architecture for what was to become the company's first workstation.

Back at The Farm

Meanwhile, back at Stanford, often called The Farm, Hennessy had begun looking for a new area of computing to explore. To generate ideas, he organized a series of brainstorming sessions as a graduate seminar, asking this question of the group: given that VLSI will soon become the technology of choice, how should we change the way we design computers?

The group read papers, brought in guest speakers, and candidly exchanged ideas. The concepts that came out of the seminar helped to form the basis of what came to be called RISC. At the core was the idea of eliminating microcode. Instead of needing microcode to translate the instruction set, the processor would encounter instructions so simple that it could execute them directly.

It was Hennessy's experience with microcode in the MicroVAX 1 project that helped him see that it could be eliminated.

Hennessy's group was not alone in coming to this conclusion. Researchers at IBM Corp. had for several years been working on the 801 project, an attempt to implement similar ideas. (The project was never brought to market, although the ideas influenced later IBM products, including the PowerPC architecture.)

Somebody else who also concluded that microcode was unnecessary was David Patterson, a professor of computer science at the University of California at Berkeley. Some six months earlier, he had discovered that computers could run more efficiently without it. Patterson's research team coined the acronym RISC.

But most of the rest of the computer world was skeptical that RISC would work. The fact that the original performance results were obtained from simulations only added to their doubts.

So Hennessy, with a handful of graduate students and the occasional collaboration of other professors, spent about 18 months designing, building, and testing a VLSI chip, along with compilers and a simple test computer, to prove the technology. Looking back, he admits they made a fair number of design errors and the chip wasn't as efficient as it could have been.

But, he said, "the opportunity for improvement was so big that the fact we made mistakes didn't matter. We built this little 25 000-transistor microprocessor, and it was twice as fast as a big minicomputer that cost US \$250 000."

Hennessy wrote papers and began giving talks about this new computer architecture, thinking that existing computer companies would be quick to embrace such an obvious technical improvement. "To say I was naive," Hennessy told *Spectrum*, "is an understatement. People just didn't believe it."

Patterson, who was also promoting the new concept, did not see Hennessy as a rival. "We were a persecuted minority," Patterson told *Spectrum*, "It was better for us to be on the same team."

There were two issues to deal with, Patterson recalls, a technical one and a business one. "Technically, what we were doing was designing computers based on careful measurements at a time when computer designs were being driven by aesthetics. Computer architectures were supposed to be beautiful, not driven by efficiency," he said.

On the business side, people questioned whether RISC made sense economically. Using the analogy of train tracks, Patterson added, "While perhaps changing the width of train tracks might make technical sense, given the investment of infrastructure, it will never happen." Software would have to be recompiled for these new machines.

To get around town, John Hennessy drives a GEM, an electric vehicle made by DaimlerChrysler.

C. Gordon Bell, DEC's former vice president of R&D, thought otherwise, even though DEC's own RISC project had never come to fruition. He had just started Encore Computer Corp. (now Encore Real Time Computing Inc., Fort Lauderdale, Fla.) to create massively scalable computer systems, and he was aware of Hennessy's work on RISC. He told Hennessy that to get RISC ideas out into the world, he would have to start his own company, and that, if he did, Encore Computer would be his first customer and an investor.

"It was clear to me that a chip with RISC architecture needed to be built," says Bell, currently a senior researcher at Microsoft Corp. "I thought it would give us at least a one-time performance gain of a factor of two or three."

So Hennessy, along with John Mous-souris, who had worked on the IBM RISC project, and Edward ("Skip") Stritter, who had worked on the Motorola 68000 microprocessor, decided that starting a company was just what they would do.

Backing into business

"We went to the venture capitalists with the most ridiculous business plan you'd ever want to see," Hennessy says. "We had a bunch of slides about why this was a great technology and a spreadsheet showing how we'd spend the money. We didn't have a realistic technical schedule; we didn't have any marketing plan."

But they got funded in the summer of 1984 for \$1 million from the Mayfield Fund, a venture capital company based in Menlo Park, Calif. That summer, MIPS Computer Systems Inc. set up its first office in subleased space in Mountain View.

Unwilling to completely give up his academic career, Hennessy took an 80 percent leave from Stanford, working there one day a week. He planned to return full-time once the company was solidly established. Since the initial technical research at MIPS was done, Hennessy, as co-founder and chief scientist, ended up becoming chief evangelist, doing cold calls on computer companies in an effort to convince potential customers that this first RISC microprocessor was going to change the world of computing.

About six months later, MIPS signed a letter of intent with its first customer, Prime Computer Ltd. (now defunct), committing to deliver chips by the end of 1985. In the final deadline crunch, Hennessy jumped in as needed, from working on the compiler team, to writing test code, to debugging the processor, and the MIPS R2000 came out on schedule. Then Hennessy turned his focus back to Stanford, though he still spends an occasional day at MIPS.

MIPS chips are now used primarily in embedded applications, including products such as the Sony PlayStation, Hewlett-Packard color laser writers, Cisco Systems network switches, and digital set-top boxes. The company had its initial public offering in 1989, was acquired by Silicon Graphics in 1992, and later spun out as MIPS Technologies. Countless other RISC chips have been designed since, and RISC is now the dominant architecture for embedded applications. Hennessy's time in the corporate world fed positively into his university career. "In academia," he says, "we have a tendency not to make decisions until we get all the data in, know every single fact, and it's crystal clear what the right decision is. In industry, it doesn't work that way; time is considered a valuable

commodity." Hennessy found that learning how to be decisive helped him in academia, particularly as he climbed up the administrative hierarchy.

With MIPS demonstrating that RISC was an important breakthrough in computer architecture, Hennessy decided to try to teach this new design method to students. Patterson, still at Berkeley, was doing the same thing. Of course, there were no textbooks. So the two decided to write one.

Taking sabbatical time, they moved into an office donated to them by DEC's Western Research Laboratory in Palo Alto. The fall of 1987 was spent figuring out the framework for the text: what it needed to teach and what its structure would be. They divided the chapters between them and edited each other's work. They then asked their colleagues in the industry to critique the book and, after reviewing suggestions, revised it. Finally, in the spring of 1990, *Computer Architecture: A Quantitative Approach* was published by Morgan Kaufmann (San Mateo, Calif). The publisher expected lifetime sales of the book lobe about 15 000; it hit that number the first year. Hennessy and Patterson's book is still being widely used and has sold over 100 000 copies.

Back at The Farm-again

In 1988 Hennessy was running the Computer Systems Laboratory at Stanford, teaching introductory computer architecture to graduate students, and putting together a group of researchers to explore how the RISC approach might be employed in parallel computing.

The key questions we asked," he says, 'were: what was the right balance of hardware and software mechanisms, and how should the mechanisms change with larger numbers of processors?"

In small-scale multiprocessors, a technique called a snooping cache is used to maintain consistency among the individual cache memories associated with each processor. A snooping cache requires that each processor send notifications to all the other processors when it changes any shared data. So, if more than 20 or 30 processors are used, they end up spending most of their time on notification.

One solution would be to use a single shared memory and not cache data that could be shared. But with large numbers of processors, that approach falls apart: the memory becomes a bottleneck and is much slower than the individual

caches. "The conventional wisdom," Hennessey says, "became that because of the cache coherency problem, you could not build a large-scale multiprocessor with a shared memory."

So in the 1980s, several groups around the country, including researchers at Cal-tech and Intel, were trying to optimize an approach called message passing, which avoids shared memory. Rather, it requires that data be explicitly communicated by messages between processors. Unfortunately, that setup uses a different programming model from that used for multiprocessors with a few tens of processors.

The first paper describing this directory concept was published by Hennessey and his colleagues in 1988; the group built a working design in 1992. The machine was called DASH, for Directory Architecture for SHared memory. Silicon Graphics used the directory approach embodied in DASH in 1996 in its Origin workstation, a scalable high-performance computer, and several other companies have employed the technology since.

Steps to the presidency

While Hennessey went on being involved in research for some years, his administrative functions at Stanford were increasing, as he stepped up to department chairman, then dean of engineering, then provost, and, now, president.

"John shot through the academic hierarchy faster than anyone I've seen," Patterson says.

Even as president, Hennessey does some work outside the university, although it now takes less than 10 percent of his time. This past year, much of that has been spent with Patterson preparing the third edition of their textbook. He also supervises one or two Ph.D. students and advises 15 undergraduates.

As president, Patterson observes, Hennessey runs the university with an engineering perspective, assuming he can analyze every problem and find the best solution. He has earned broad loyalty on campus because, Patterson believes, he is honest, doesn't play games, and speaks the truth, even if his positions aren't popular.

Hennessey sees a university presidency as being something one does for about a decade. These years will be busy ones, for Hennessey has made himself a

long to-do list [see "To-Do List," p. 35]. After his term is over, he says, he might take a real sabbatical, instead of starting a company or writing a book. Or not.

"The great thing about being a university president is you can keep that most wonderful of titles – professor. So you are able to go back to teaching and working with students," he says. And, undoubtedly, doing a little something on the side.

To do list

Themes of John Hennessy's ambitious agenda as president of Stanford University include:

- **MULTIDISCIPLINARY RESEARCH**, Hennessy believes researchers walled off into separate, individual worlds can't solve the problems of the future. "Look at the environment. If you want to attack environmental problems, the right way to do so is to bring together geoscientists, plant biologists, ecologists, engineers, and policy people," he says.

His first effort along those lines was helping create a new biomedical engineering and science program, bringing together within one building faculty from engineering, the medical school, and departments such as physics and biology. Hennessy secured US \$150 million from Jim Clark to fund this effort, the largest single donation Stanford has ever received from a nonalumnus.

- **UNDERGRADUATE EDUCATION**. At Hennessy's inauguration, he announced a billion-dollar funding campaign to strengthen Stanford's undergraduate programs by creating an endowment for innovations in that area. One of the most important innovations so far is a series of over 200 small seminars (with 16 students or less) offered to freshmen and sophomores. Undergrads also have more opportunities to engage in research worldwide.

- **RESEARCH**. As the major industrial laboratories shut their doors or re-direct their efforts away from basic research and toward development, Hennessy says it's time for basic research to play an even greater role in research universities, and that corporations need to commit to funding such research. As a first step in that effort, Hennessy helped establish the Stanford Networking Research Center, a collaboration of 3Com, Cisco, Sony, and other communications companies that make large initial grants and fund ongoing projects.

Pretext task.

Put the questions to each paragraph of the text so that to cover the gist of it.

MOBILE SYNDROME CAN A PHONE SOLVE THE PROBLEM OF LONELINESS IN THE BIG CITY?

Mobile phones first hit the market as luxury items, with only representatives of a very limited circle of affluent Ukrainians boasting them. With time, when the majority became aware of their pragmatic rather than social role, the ranks of phone owners expanded as did the number of mobile communications companies, the trailblazers of this now fashionable line of business in Ukraine. Store shelves are crammed not only with brand new and rather expensive mobile phones, but also with secondhand ones, and Ukrainian pickpockets have discovered a new and easy prey. It has become possible for crooks to make money by enabling phones blocked by seller companies and improving them by installing additional functions and games. In a short time, Ukrainians have found themselves hooked on the mobile phone frenzy.

Our compatriots were not the only exception. A study undertaken in Great Britain indicates that infatuation with mobile phones can be compared to a craving for tobacco or other hazardous habits. As confirmed by the latest research, with the young dependence on mobile phones tends to replace addiction to cigarettes, with advertising being the only seemingly logical reason in this case as it gives the young a feeling that the presence of a ringing phone in their pockets puts them one step above their age group. Manager of the Internet Expert ad agency Maksym Krainiev told *The Day* that many mobile communications companies have tailored their advertising campaigns to the needs of young clients by using the techniques most appropriate for teenagers. Placing ads on the Internet proved to be most effective, with the young extensively exposed to mobile communications when roaming the World Wide Web.

However, psychologists believe that the mobile phone frenzy is only a partial tribute to modern age, indicating rather the loneliness in a big city. In the opinion of candidate in psychology Iryna Holovniova, a mobile phone is an item which makes an individual feel one's significance, with a large number of calls

attesting one's wide circle of acquaintances and social importance. According to statistics, 32% of men coming to a public place put their mobile phones in some conspicuous place, trying to use them all the time. Interestingly, with women this syndrome is seen only half as much. Psychologists say that this pattern of male's behavior indicates their desire to attract attention and stress their masculinity. Iryna Holovniova also believes that mobile phones allow people to identify themselves with items of inorganic nature, that is, a telephone becomes a thing vital to one's existence because it can save a person from the feeling of isolation.

Now approximately every twentieth Ukrainian has one of the five essential symbols indicating a person's image. However, many foreign medical experts consider mobile phones a health hazard. As shown by a study in The Lancet medical journal, children using mobile phones risk developing amnesia, sleeping problems, and headaches. Physicist Gerald Highland warns against the risks of exposure to radiation coming from mobile phones, noting that children under eighteen, or a quarter of Great Britain's mobile phones users, have become more vulnerable because their immune systems are weaker than those in their age group who do not use mobile phones. The negative impact of low level radiation resembles radio interference, affecting body cells stability. Other researchers agree that the electromagnetic radiation of mobile phones affects brain tissue, although it has not been proven that it is detrimental to human health. Highland, however, still believes that the real threat comes from low level radiation commonly known as non-thermal.

Most Ukrainian medical experts disagree with such pessimistic assessments, arguing that any technology is hazardous to the organism. Despite the radiation emanating from televisions, computers, and microwave ovens, it would make no sense to stop using them. To date, mobile phones have become accessible to middle-income Ukrainians, as a ride in any commercial shuttle can easily show. If the beautiful gadgets can help combat juvenile smoking, their impact on health is more positive than negative.

Pretext task.

Look through the text and analyse all the Infinites in it.

THE POWER TO CHANGE

UNLIKE most other industrialised nations, Britain has long had the good fortune to be self-sufficient in energy.

Partly because of that it has, for the past decade, pursued an unusually free-market approach towards electricity generation. Over the next ten years, however, the government's commitment to that policy will be tested. Oil and gas production from the North Sea is running down, meaning that Britain will rely increasingly on imports. That will coincide with big changes in the electricity market, as many of Britain's coal and nuclear power plants (which between them produce just over half of the nation's electricity) begin to go off-line.

For nuclear power, the problem is age. Atom-splitting provides a fifth of Britain's electricity, but most of the reactors are decades old and near the end of their operational lives. Ten years from now, nuclear's share of generation is expected to fall to 11 %; by 2020 it will be just 7 %.

For coal, greenery is responsible. Tough new environmental rules, especially a European directive requiring coal stations to fit expensive chimney-scrubbing equipment, will make it harder for coal to pay its way. Plants that don't comply with the new rules will have to shut by 2012. Malcolm Grimston of the Royal Institute of International Affairs (RIIA) thinks that half Britain's coal capacity is threatened.

The government has not been entirely hands-off during these years of plenty. Its flagship policy has been subsidies for renewable energy-mostly wind power-justified on environmental grounds. Supporters point out that renewable can make a contribution to energy security as well as reducing carbon emissions. Ministers want renewables to generate a tenth of Britain's electricity requirements by 2010.

But, says Gareth Davies, a researcher at Oxera, a consultancy, that seems a vain hope. And although renewables don't require fuel and are, in that sense, the most secure of all energy supplies, they are intermittent-especially wind-mills, which are useless on a still day. This makes them unsuitable to replace the reliable "base-load" provided by coal and nuclear plants.

Complaints about the cost are growing, too. The National Audit Office, an independent watchdog, predicts that subsidies to renewables will cost £1 billion (\$1.8 billion) a year by 2010. A recent report from the Public Accounts Committee reckons that another £1.5 billion will be needed if the national grid is to reach out-of-the-way wind farms, and complains that none of the subsidies are scrutinised by Parliament. And while the public likes the idea of renewables, it is less keen on the reality, with fierce planning battles springing up over several proposed wind farms.

An alternative is to replace old nuclear plants with new ones. The nuclear lobby is busily pointing out that nuclear power is well-understood, carbon-free, and would contribute to security of supply (uranium can be bought from stable, friendly countries such as Australia and Canada). New reactor designs, says the industry, are cheaper, cleaner, and easier to build. The European Emissions Trading Scheme, which puts a price on carbon, is raising the cost of nuclear's fossil-based competitors.

But historically, atomic energy has had a vast appetite for public money, and its economics are still tricky. Although they are cheap to run, nuclear plants are expensive to build (see chart). Investors are wary of an industry with big, front-loaded capital costs that are repaid over several decades. In Finland, currently building one of the new generation reactors, long-term contracts between power users and suppliers help mitigate these problems.

Pretext task.

Comment all ed-forms and ing-forms from grammatical point of view.

ALL THE ILLS THAT FLESH IS HEIR TO

Bugbear, the newest Internet virus, was first spotted in Malaysia on 29 September. Within 24 hours, it was found in over 100 countries; in its first week, it infected over a million computers.

It's shaping up to be one of the worst viruses so far. Instead of trashing files, as Klez and Sircam did, or overloading networks and bringing them to their knees, as did the infamous Nimda and Melissa, Bug-bear can quietly log passwords and credit card numbers, and leave them exposed on the Internet.

What's more, it can leave the computers and networks it infects open and at the mercy of hackers and future viruses by deleting antivirus software and firewall protections.

Yet as bad as Bugbear is, viruses to come will be much worse, say many computer experts. They're reluctant to talk about the problem, in part because they fear giving virus writers helpful hints. Nor do they want to say anything that might be taken as a challenge. But the threat is great enough that this summer, Tim Mullen, chief information officer at AncliorIS.com (Charleston, S.C.), a firm specializing in security software for accounting, told a Las Vegas hackers' convention, "Arguably the biggest threat the Internet faces today is the propagation of a big worm."

Worms are particularly nasty computer viruses because they can exist independently of other files or programs. They can move from one user to another on their own, without the user having to open or download a thing, spreading to more computers than ever. In 1999, users might have seen one infected message in 1500, according to Message Labs Ltd. (Gloucester, UK). The company filters e-mail for organizations like the Bank of England and Fujitsu. "Today it's as much as one in 150," says chief technical officer Mark Sunner.

One problem is that old viruses don't die, and they can even take a very long time to fade away. "In the biological realm, you either develop immunity, or you die – in either case, you're no longer a carrier," notes Purdue University computer science professor Eugene Spafford. "In a network, the infected computer gets fixed and put back online without becoming immune to reinfection." Moreover, on the Internet, with its highly concentrated hubs, viruses spread much more efficiently than they do in a medical epidemic.

Experts also believe that the attacks will be ever more damaging. "If it is obvious the virus writers are holding back," Mullen told *IEEE Spectrum*. "When a virus gains root privilege on a Windows NT box, as did the Code Red bug, it could have done a lot worse damage than just flooding Web servers with traffic. It's like an intruder coming into your home and not taking the cash on the table."

Several experts warn of much more Machiavellian virus schemes. "Far more deadly," said one, "would be a worm that subtly changed data over time. On its first pass, it wouldn't show itself, but once it's living within your corpo-

rate environment – changing individual cells in spreadsheets, for example – there's no telling the damage it could do." Another pointed out that such a virus could actually be out there right now: "You could be running it for weeks, the bad data could work itself into backups, and sites wouldn't know."

And here's an even worse thought: worms could be designed to dynamically adapt themselves over time. That is, once a system is infected, the virus could get new deadly code across the Internet, in the way updates are soul how soil ware manufacturers.

What's to be done?

"We have to build resistant systems from the bottom up," says Purdue's Spafford. "Far too much money and attention has been paid to the equivalent of cough medicine and antibiotics – blocking and recovery. Programs should check themselves and alert us if a virus is trying to modify it. And we should be separating data and code. We've known this for decades."

If data and code (a computer's executable software, that is) are separated, then the code can be protected, greatly limiting the damage from code introduced by a virus. Security expert Peter G. Neumann, principal scientist at SRI International Computer Science Laboratory (Menlo Park, Calif.), told *Spectrum*, "We got this right even back in the days of Multics [an operating system that originated in the 1960s]. It's easy to do. Yet in the Microsoft environment, you can't protect the operating system from itself and from applications. Viruses shouldn't even exist on a well-designed system."

Pretext task.

Scan the text and find the Chain of Nouns. Translate them.

DUST COLLECTION COSTS REDUCTION

The high cost of dust collection and associated ducting can be avoided by the simple expedient of collecting the dust where it is generated and using a wall fan of modest horse power to make the necessary air movement – through any convenient wall.

By providing a box to collect the dust and a power filter cell to rest on the box, letting the air out (but retaining the dust), an efficient dust collector is provided at a fraction of the cost of a conventional unit. Running costs, too, are down, because 4 h.p. is enough to remove air at the rate of 10,000 cu. ft (283 cu. metres) per minute.

The system incorporates air operated jolting to clear the cell of accumulated dust particles automatically each time the fan is switched off.

The system works best when the density of the dust particles exceeds 1, which means everything that sinks in water.

A further bonus is available if the operator creating the dust is protected with an air-fed helmet. Provided no other operator not similarly protected is in the area, the air can be circulated by a system railed vent-cycle, thus preventing heat losses in winter.

The filter cell is built from a number of vooden frames covered on both sides with liter cloth, each, giving a cloth area of 3.3 square metres.,. There are four standard cell sizes, giving total cloth areas of 50, 66, 82 and 100 sq. metres of cloth. A flow rate of 2-metres per minute is recommended, depending on the amount of dust being generated, and therefore one cell can be used to cater for an air movement ranging from 100 to 300 cubic metres per minute. Multiple banks of cells will increase this range proportionally.

The cells may be used as a fixed installation. as described, or as freestanding items in a dust-laden area, where they will take in dusty air at the rates indicated, and discharge clean air, instantly improving vision and collecting e airborne dust. In fettling areas where small castings are being dealt with, bench work in the vicinity of the extractor fan is always possible, but for work on large stings in a relatively open space, the freestanding version is preferable because of its ability to improve vision over a wider area.

The cells have an efficiency rating in excess of 98% which ensures removal of dust particles larger than 5 microns. cause of the unavoidable presence of micro dust in the discharged air, face masks are an essential requirement for operators, but for fettling or other work in a dusty environment, they are in any case a legal obligation. The presence of such fine dust, however, in no way impairs vision, and ii the lighting is good, the operator is not in the least inconvenienced.

If one or more operators are working in an enclosed area, and are wearing air-fed helmets, it is then possible to circulate the ventilating air, and this provides two main benefits. Firstly, in cold weather, the air can be heated, to the considerable comfort of the operators, and the heat is retained in circuit with consequent power savings.

Secondly, the element of fine or micro-dust inevitably discharged on the clean side of any cloth filter, is retained in circuit and thus causes no discomfort to workers who are not protected, but operating in the vicinity of the dusty area. A further fringe benefit is that if no dust is being created and the ventilating air is allowed to circulate freely for three or four times, even the finest dust particles are retained on the filter cloth, a degree of air cleanness approaching 100% being achieved.

This system known as vent-cycle, is illustrated as used for shotblast room ventilation. For this extreme case of dust creation and subsequent suppression, the table shows the recommended flow rates and fan capacities for different size rooms, and an indication of the recommended filter cell number and sizes. For ordinary fettling operations these recommendations would be reduced to approximately one-third.

Pretext task.

Scan the text and define the tense of all the verbs.

TALK OR TYPE?

To speed up the calling process, the phone packs a few useful dialing features. One is dialing by voice, and when I did it, the phone was flawless in interpreting my commands. Unlike other devices, where I'd often have to repeat or reissue commands, the T 68i heard me the first time, every time. I easily dialed by voice command even in the noisy St. Louis airport.

The phone has speed dial, too, but programming that function wasn't as easy as it should have been. The manual only explains how to change the position of numbers in speed dial, not how to program them.

Tapping out messages on a cellphone is tedious at best, but the T68i incorporates short-message service messaging, or SMS (akin to what two-way

paggers use), a feature that nearly all phones made in the past couple of years have employed. The service is popular in Europe as a low-cost alternative to pricey voice calls and e-mail service. It has attracted less interest in the United States, where callers have buckets of calling minutes and unlimited Internet access, thanks to price wars among cellular service providers.

As for facilitating text input on the T68i, Sony Ericsson has done a decent job. The phone packs predictive logic algorithms to predict the word you're trying to spell based on letter combinations. I tapped out the message "Running late, see you soon," which is the kind of quick message SMS was designed for. It came out as "Running late, see you room" because the same phone keys are used to type the words "room" and "soon." I simply had to thumb down the joystick one space to get alternative words; "soon" was the first to come up.

I was able to exchange SMS messages with my own AT&T Wireless phone but not with a friend who's on the Sprint PCS network. All major carriers have promised to make SMS cross-carrier-compatible but have not done so yet – another reason it has been slow to take hold in the United States.

The phone also has its own chat function, which I used to engage in a chat session with my Nokia 8260 phone on the AT&T network. (AT&T Wireless is in the process of converting its network to GSM.) Again, tapping out text using the phone keypad was too laborious for my impatient fingers. And again, the feature didn't work with my friend on Sprint.

SMS is also the channel used for T-Mobile's Ping Pong service, which delivers alerts on demand for sports scores, stock quotes, horoscopes, and so on. Using the VoiceStream Web site, I set up my phone to receive the lottery numbers and my horoscope, both of which rang in daily. On the day my horoscope said, "This is your lucky day," my lottery numbers weren't in sync, but I couldn't blame that on T-Mobile, Sony, or Ericsson. The iStream packages start at \$2.99 per month for 500 Internet page views and 300 Ping Pong messages.

Pretext task.

Find and analyze all suffixes and prefixes. Say what part of speech they are.

PRACTICAL MATTERS

The phone comes with a 1MB dynamic memory, which can be allocated in various ways to store ring tones, images, and other content. Unfortunately, I wasn't able to determine how easy downloading a ring tone can be: that feature had not been activated for my phone when I tested it before the official launch this summer.

Other T68i pluses include good battery life of 3–12 hours (I used it frequently throughout a long weekend without losing power); a sliding switch on the side that allows users to dial by voice, change volume, and scroll through menus; Bluetooth compatibility; and infrared beaming capability for swapping contact information with a PDA. Also worth mentioning are the simple menu-based interface, two-line capability with distinctive rings, and a stopwatch.

Minuses include limited coverage of T-Mobile's GSM network in the United States, although the network is growing; too many page jumps in the T68i owner's manual; too much of an effort needed to back out of the phone's menus; and too much time needed to access information from sources such as the Zagat restaurant guide. Once the wow factor of having so much information at hand on a phone has worn off, it's frustrating to make multiple taps for information you're used to pulling up quickly on a PC.

Bottom line: the Sony Ericsson T68i is an impressive communicator combining smart phone features with fun multimedia functions. (At press time, published reports indicated Ericsson was weighing its future commitment to the joint venture. I do hope I can look forward to future products from the collaborative effort.)

Pretext tasks.

1. Look through the text and analyse the verbs should and would.
2. Find in the article sentences with Complex Object and Complex Subject. Translate them.

WORLDWIDE, US E&P SPENDING

Worldwide spending on exploration and production of oil and natural gas will likely increase more than the 20–30 % forecasted previously by many analysts. Similarly, increases in E&P spending in the US this year could conceivably surpass previous estimates.

According to reports from a selected group of US independents compiled by Oil & Gas Journal, worldwide E&P spending will undoubtedly eclipse companies outlays in 2000, barring a collapse in oil and gas prices. This sample group's worldwide E&P spending plans are expected to rise 46% above spending last year (see table).

In addition, Dain Rauscher Wessels Inc. (DRW), in a report released last month, revealed that actual E&P spending in the US this year will likely rise by close to 50 %. And recent indicators from many US-based independents would seem to track these predictions. These companies have reported increases in their originally proposed E&P budgets in the US and else where for 2001.

Price the catalyst

According to DRW's report, the year-over-year increase in E&P spending in the US will, in all probability, be linked to "pricing improvement" rather than to an upsurge in activity levels.

In its report, DRW said that - as was the case last year - there was an overall "under-expectation" that took place this year regarding companies spending plans. In 2000, many of industry's more widely trusted capital spending surveys had forecast a spending increase of 18–22 %, while actual spending made a 48 % jump.

"This same under-expectation is occurring again this year," DRW said. "In the popular surveys, oil companies based prospect economics and cash flow generation of natural gas and oil based on prices lower than are currently being realized.

"Since the focus is on production growth and the fact that [US] independents reinvest free cash flow, any higher cash flow generation vs. expectation is likely to be reinvested. Any expectation that much of the independents' cash flow would be dedicated to buying properties up for sale by the majors is being

dashed as well, with virtually no properties for sale and majors indicating the opposite, being better buyers."

In addition, DRW noted that, at a recent energy conference, a number of US independents spoke of intentions to boost their 2001 E&P budgets - some by as much as 40 %.

"A survey of 16 leading [US] independents shows an [average] increase closer to 35 %," DRW noted.

"The total number of rigs that can be put to work this year would increase the total by no more than 15 %. Against a 35 % spending increase, this implies that [service] pricing will move up by 20 %. This is probably close to correct and has a significant impact on [earnings per share] estimates and price targets of oil field service companies."

DRW concluded with the RMH expectation that company budgets should rise by about 35 %, "based on public statement."

"Commodity pricing is staying high enough that there is little current risk to these budget statements. The number of rig reactivations is based on public statements by companies and is supported by continual industry surveys and studies showing capacity, the number of rig yards, and other factual reviews. Pricing is already moving up. Pricing accelerates up through a cyclical industry's recovery," DRW said.

"So not only is spending by oil companies ... expected to increase, it is likely to increase at a faster rate, to a higher level, and significant data and a great deal of history exist to confirm this.

"This means that [service company] revenues and earnings in most models are too low and that earnings have much greater upside relative potential than the revenue increase due to margins expanded by price increases rather than just utilization-driven incremental gains."

Anadarko's budget revisions

Earlier this year, Anadarko unveiled a \$2.8 billion capital spending plan for 2001. This is a 65 % increase over 2000 spending.

Anadarko's plan will focus primarily on finding new natural gas reserves, along with increasing production from the Lower 48, the Gulf of Mexico, and Canada, said Robert J. Allison Jr., the company's chairman and CEO.

“Natural gas is and will continue to be in tremendous demand in North America,” he said. “Given our current outlook for commodity prices, we expect Anadarko’s cash flow to be significantly higher than this initial spending plan. The company is looking at potential uses for additional capital, including acquisitions of producing properties in core operating areas, improvements to company’s balance sheet, repurchase of stock and other strategies. We’d like to have that cash in hand before we commit to specific plan,” Allison said.

Anadarko has earmarked \$1.4 billion for development projects. Of this amount, the company plans to spend 79 % in North America, 12 % in Algeria, and the remaining 9 % on other international projects, mainly in Venezuela.

Anadarko has budgeted \$830 million for its exploration activities. The lion’s share of this amount, 90 %, will be spent in North America, the company said.

Anadarko in the Rockies

Anadarko said it would more than double spending to over \$131 million in the Rocky Mountains area this year.

Anadarko is looking for gas and coalbed methane. It plans to drill more than 20 exploration wells and 130 development wells in Wyoming, Colorado, and Utah and plans to participate in more than 275 wells operated by other companies. It will also acquire and interpret more than 500 sq miles of 3D seismic.

"Because of the large acreage position that we hold in the region, Anadarko has certain economic advantages that can't be matched by our competitors," said John N. Seitz, Anadarko president and chief operating officer. "Our strategy this year is to deploy more resources in the Rockies in an effort to unlock the full potential in this underexplored area. In fact, we view the Rocky Mountains as one of the richest areas capable of providing new natural gas supplies for the US."

In Utah, Anadarko intends to invest more than \$20 million in Helper and Drunkard's Wash coalbed methane fields.

In Wyoming, Anadarko has interests in seven coalbed methane plays. It plans to drill 35 wells in the Powder River basin in 2001.

Anadarko also plans to drill 60 wells this year in Greater Wamsutter gas field in Wyoming.

Anadarko's Canadian plans

Anadarko also increased capital spending plans for its Canadian operations by 49 % to \$3 86 million this year.

James Emme, Anadarko Canada Corp. president, said the acquisition of the Berkley Petroleum Corp. assets provides excellent opportunities in addition to existing prospects in British Columbia, Alberta, Saskatchewan, and the Northwest Territories.

Anadarko acquired Berkley Petroleum for \$11.40/share (Can.) in cash for an equity value of \$777 million and assumed an estimated \$250 million of Berkley debt.

Anadarko originally set a \$259 million budget for its Canadian operations this year. The acquisition will increase capital spending by \$127 million for the combined companies, which includes \$38 million of additional spending above Berkley's original 2001 plans.

Anadarko is the sixth most active driller in Canada and plans to increase its winter activity level from a peak rig count of 28 rigs working this year to as many as 35 rigs in winter 2002.

In addition, Anadarko Canada expects to run 15 rigs this summer in Alberta, British Columbia, and Saskatchewan. The Berkley acquisition increased Anadarko's Canadian reserves 42 % to 312 million boe, 65 % of which is gas. It also increased the company's holdings in Canada to 4.7 million acres from 3 million.

Vintage budget increase

Vintage Petroleum has recently hiked its spending plans for 2001. The company's original estimate, announced last year, was for a budget of \$225 million. Earlier this year, Vintage increased its expected E&P outlays to \$285 million – a 71 % increase from spending in 2000.

The company said it would focus a majority of its outlays on exploitation projects in the US and Argentina. Additional projects are slated for Ecuador and Bolivia.

Of the total budget, \$212 million has been earmarked for "lower-risk" exploitation projects; these will be split evenly between North America and outside North America.

The remainder of the budget will be used mainly for exploration projects in North America, the company said.

Other independents

Triton Energy Ltd., Dallas, has budgeted \$320 million for its 2001 capital expenditures. The spending plans are a 19 % increase over the company's 2000 spending.

The bulk of this total, \$211 million, will be spent for Triton's continued appraisal and development of La Ceiba field off Equatorial Guinea. About \$42 million will be allocated for the exploration of Blocks F and G in that area. Triton also plans to expand the topsides facilities of its floating production, storage, and off loading vessel in the Gulf of Guinea.

Also, the company plans to spend \$39 million to contribute to development of the Cusiana and Cupiagua oil fields in Colombia. This work is to include drilling on the adjacent Recetor license.

Louis Dreyfus Natural Gas Corp., Oklahoma City, has increased its outlays to \$290 million for 2001 vs. the \$220 million budgeted for 2000. Of this sum, Louis Dreyfus's exploration and development drilling plans break out as \$ 106 million on the Gulf Coast, \$ 119 million in the Permian basin, and \$65 million in the Midcontinent.

"We are completing another very active year with the drillbit and have aggressively increased our budget for 2001, said Louis Dreyfus CEO Mark Monroe. He said that the company hopes the increase in spending will lead to "double-digit production growth" this year.

Stone Energy Corp., Lafayette, La. – which has recently completed the acquisition of Basin Exploration Inc., Denver – expects to spend \$253 million in. The merger with Basin, Stone said, has increased the combined companies' daily production, reserves, and prospect inventory. Stone said that it expects to drill 77 gross wells this year.

Cabot Oil & Gas Corp., Houston, said it plans to spend \$167 million in 2001, a 36 % increase over spending in 2000. Cabot attributed the gain to "record high commodity prices." The total for 2001 includes \$ 112 million for drilling projects – respectively split 42:58 between exploration and development.

"As we have over the last several years, we intend to continue to build on our exploration activities in the Gulf Coast and Rocky Mountains," said Ray Seemiller, Cabot Oil & Gas chairman and CEO.

Pure Resources Inc., Midland, Tex., said that it will spend \$ 160 million in 2001. Of this total, \$60 million will be used for development projects, \$34 million for exploration programs, \$42 million for probable projects, \$22 million to acquire additional acreage and seismic, and 52 million for other corporate items.

The company's budget comprises 300 capital projects, Pure said. These are split among the Permian and San Juan basins and South Texas.

ATP Oil & Gas Corp., Houston, anticipates spending \$130 million in 2001. Of this sum, \$85 million will be used to start production from some of the company's proved undeveloped properties. The remaining \$45 million will be spent on acquisitions as well as the development of new properties with proved reserves.

ATP focuses primarily on the acquisition, development, and production of natural gas in the Gulf of Mexico and the southern gas basin of the UK North Sea.

Comstock Resources Inc., Frisco, Tex., plans to spend \$1 00 million for development and exploration projects in 2001. The company's spending plans are a 43% increase over the prior year.

Comstock said it intends to drill 7 6 wells this year. Of these, 50 will be development wells, and the remainder will be exploration wells. A substantial portion of Comstock's budget – \$46 million – will be spent on wells drilled in and around the Gulf of Mexico. Comstock plans to drill 21 wells in shallow waters in the gulf and another 8 wells onshore along the Gulf Coast.

The company expects to spend \$29 million in its East Texas-North Louisiana region to drill 30 infill wells, which will target the natural gas-productive Hosston, Travis Peak, and Cotton Valley sands at depths of 8,000-10,500 ft.

M. Jay Allison, Comstock president and CEO, said that the company was able to increase spending on drilling this year due to last year's "very successful drilling program."

This program, Allison said, would be funded "exclusively" through operating cash flow. Given current oil and natural gas prices, Allison added that the

company "should have additional cash flow available" that it will use to reduce its debt and otherwise improve its balance sheet.

Magnum Hunter Resources Inc., Irving, Tex., has budgeted \$85 million to participate in the drilling of 142 wells during 2001. This sum includes 17 wells to be drilled in the shallow waters of the Gulf of Mexico and 125 wells to be drilled onshore in Magnum's chief operating areas - West Texas and the Texas Panhandle, southeastern New Mexico, and western Oklahoma. Of the planned exploratory wells, 13 will be offshore and 14 onshore.

Ultra Petroleum Corp., Houston, said it plans to spend \$47 million in 2001, which is double the firm's 2000 spending plan. This year, Ultra plans to spend \$35 million to participate in 39 wells in Wyoming and \$ 12 million for 15 wells in China's Bohai Bay.

"I believe that Ultra is positioned for extraordinary growth over the next 5 years and is probably the premier small-cap E&P company in terms of growth potential," said Michael D. Watford, chairman, CEO, and president.

Abraxas Petroleum Corp., San Antonio, Tex., increased its capital spending budget for this year to \$41.7 million. This compares with its \$39 million budget established for 2000.

The 2001 budget breaks out as \$19.4 million for US projects, \$12.5 million for wholly owned subsidiary Canadian Abraxas' projects, and \$9.8 million for 49 % – owned Grey Wolf Exploration Inc. projects.

"This budget allows us to grow our current production while maintaining financial flexibility," said CEO Robert Watson. "Our improved cash flow and inventory of projects should allow us to grow the company for 2-3 years without going to the capital markets."

Dallas-based Wiser Oil Co. increased its 2001 capital and exploration budget to \$ 36 million from previously announced spending plans of \$20 million. Wiser said it would spend \$ 16 million on exploration activities and \$20 million on development projects. Of the total sum, \$22 million will be spent in the US and the remainder has been allocated for Canadian activities.

Post-text tasks.

1. Make up an abstract (precise) including 15-20 sentences.
2. Put 10-15 questions to cover the gist of the article.

Pretext tasks.

1. Scan the article and say what it deals with.
2. Choose 10 sentences and comment the tenses in them.

FROM ANWR TO BAGHDAD

With leasing prospects dimming for the Arctic National Wildlife Refuge coastal plain, most US companies are hoping White House energy policymakers turn their attention outside US borders. President George W Bush recently signaled he recognizes the country will have to continue to go outside the US to meet energy demand. But in a nod to national security concerns, he emphasized a "hemispheric" strategy focusing on neighboring Canada and Mexico. No mention was made of the Middle East, even though that is where the vast majority of oil reserves lie.

Go east

Yet many companies say it is impossible to talk about national energy policies without rethinking international restrictions against two key players in the region: Iraq and Iran.

Nevertheless, no Capitol Hill energy proposals address unilateral US embargoes against either country, even though sanctions proponents admit the current laws are not moving US interests forward. A Republican House energy bill may include sanctions reform later this month, but leaders say they don't expect consensus before summer

Summer showdown

The White House, meanwhile, professes to be on a faster timetable, despite President Bush's relative silence thus far on sanctions policy.

Encouraging remarks have come from Sec. of State Colin Powell. He has said he wants to see a new, "smart" sanctions consensus at the United Nations before the group reapproves the oil-for-food regime this June. Expanding the flow of oil in exchange for tighter weapons monitoring is one option on the table.

Oil analysts, however, predict a long, tough debate that could backfire on the administration, exacerbating tight oil supplies.

"If the Iraqi regime perceives proposed changes as an attempt to undermine its security, it will balk at participating in the program. Under these circumstances, a temporary suspension of Iraqi exports in June and July - and possibly even longer – would be inevitable," warned Raad Alkadiri of Washington, DC, consultants Petroleum Finance Co.

"The US is going to struggle to get its ideas through unamended. They have a very different aim than much of the rest of the international community. The latter sees smart sanctions as a means of engaging the Iraqi regime and addressing the problems associated with it. For the US, the aim is to isolate the Iraqi regime inside Iraq.

"Baghdad isn't going to willingly acquiesce to any plans that threaten the regime's security, no matter how much international support there is for it," said Alkadiri.

Yet it is dangerous to assume US allies will rush in to support a plan that could hurt their own economies.

Neighboring states such as Jordan or Syria know they are not going to receive cheap oil if they are forced to stop smuggling, US policymakers concede. That's because there is no incentive for Iraqis to sell at reduced prices if it is not going to contribute to circumventing sanctions.

In the end, the success or failure of the administration's Iraq policy will turn on how much the US is willing to compromise. And given that many of the same players who helped craft the original sanctions regime are back in power, there is a unique opportunity to set things right. The two biggest challenges to increasing North American natural gas production are access to prospective land and availability of adequate drilling services, according to a survey by Ziff Energy Group, Calgary.

Ziff released the survey at its North American Gas Strategies conference in Houston last week. Representatives from 97 North American companies participated in the survey, representing producers, end-users, marketers, pipelines, storage operators, and local distribution companies. The survey was conducted in February and March 2001.

Paul Ziff, Ziff Energy CEO, said, "Our, survey is designed to provide an integrated description of the outlook for the North American gas industry from wellhead to burner tip. Over the 3 year period [that] we have conducted this study, the change in expectations and issues is remarkable."

Challenges

Last year, low gas prices were listed as the biggest challenge. This year, 65% of the survey's respondents expect that the average 2001 New York Mercantile Exchange futures price will be \$4.50-6/MMbtu.

Meanwhile, 97 % said gas prices must exceed \$3/MMbtu to provide sufficient economic incentives to increase North American gas production.

Price volatility was listed as the third biggest challenge to increased gas supply during the next 5 years, the survey said. Other challenges were environmental regulations and availability of gas processing and transportation capacities. Concern about slowing growth in gas demand was listed as the sixth and lowest concern.

Panelists speaking at the conference said they also considered access to capital to be a major challenge to increased North American gas supply.

Post-text tasks.

1. Write down key-words to this article.
2. Make up an abstract (3–4 sentences)

Pretext tasks.

1. Read the article and allot its main idea.
2. Commenr on using ing-forms in it.

INDIGNATION OVER KYOTO

Global warming looks more and more like an excuse for the world's politicians, led by official Europe, to bellow self-righteously at American expense. US President George W Bush took a sensible half step on the issue late last month when he repudiated the Kyoto Protocol on climate change. European politicians exploded with indignation.

Here's an especially scathing sample from Malcolm Bruce, president of Scotland's Liberal Democrats: "George Bush prides himself on having authorized the execution of more people than many dictators, but he is now tearing up the Kyoto Treaty on behalf of the polluting oil, gas, and mining interests that back him and his family. Not content is he with killing Texan prisoners by lethal injection, he now wants to kill thousands or millions around the world by lethal pollution."

Take that, conservative president. Take that, big business. Take that, Texas. Take that, America.

Most European reaction to Bush's move showed more restraint. But little of it showed more scientific sophistication.

Religious intensity

In Europe, the quest for international hand-holding on climate change has attained religious intensity. Politics, therefore, has snuffed analysis. Official Europe wants the developed world to raise taxes on the consumption of fossil energy. Why ask why?

To official Europe, the beginning and end of scientific inquiry is the Intergovernmental Panel on Climate Change, a group of 2,000 scientists working under United Nations auspices. The IPCC issued its latest report in February along with an alarming summary for policymakers.

Citing that report, European Commission Environment Commissioner Margot Wallstrom responded to Bush's move by declaring, "There is no doubt that there is a broad consensus in the scientific community that climate change is happening faster and to a greater extent than previously expected." The report, she said, "sends a very clear message about how serious the situation is on climate change."

A very different view came earlier from one of the authors of the IPCC report at a meeting in Washington, DC.

"The whole notion of a scientific consensus has been contrived to disguise the genuine disagreement among scientists on a number of different issues," said Richard S. Lindzen, Alfred P. Sloan professor of meteorology at the Massachusetts Institute of Technology. "The aura of certainty with which the IPCC's conclusions are being reported is clearly more a matter of politics than science."

Participating scientists complain that the IPCC summary misrepresents underlying documents, especially in its claims of certainty about the warming threat. Yet official Europe apparently looks no further than the summaries. There and elsewhere, it ignores too much.

Scientists recently have voiced doubt that a buildup of carbon dioxide in the atmosphere represents that main cause of observed warming. Assurance also grows that climate feedback mechanisms – mishandled or overlooked by IPCC's computer models – can offset most if not all human influence. Among scientists who do think climate data reveal warming of human origin, many recommend adaptation rather than prevention likely to prove futile. And some scientists assert that greater warmth and more CO₂ would sustain life better than current conditions do.

Official Europe, in its zeal to raise taxes, will hear none of that. Its narrow approach to so complex a subject is appalling. And its moralizing against the US on behalf of governments that have not ratified the treaty is hypocritical.

Bush was right to scuttle Kyoto. Clear-minded Europeans know that he was. The treaty is unfair. It won't work.

But Bush's bold and proper move didn't address a larger problem. It responded to only one of Kyoto's many flaws: that the agreement exempted developing countries, which will account for most future growth in greenhouse-gas emissions. In fact, the Bush administration pledged to stay engaged in the issue and took pains not to raise questions about the need for or likely effectiveness of a human response to climate change.

US isolated?

European zeal notwithstanding, those questions need clear answers before anyone's taxes increase for reasons having to do with global warming.

Apparently, the US must stand alone against political single-mindedness on global warming. Apparently, only the US can defend the world against a costly mistake and preserve the scope essential to deliberations involving scientific complexity. In some quarters, they call that being isolated. In other quarters, they call it being right.

Pretext task. Using the title try to predict what the article is about.

THE APPLICATION OF CROSSFLOW FILTRATION TO THE TREATMENT OF LIQUID RADIOACTIVE WASTE

Introduction

Crossflow filtration is a highly flexible process which has a number of advantages over other conventional treatment methods. The waste can be processed at the optimum pH for radionuclide removal and a wide range of possible absorbers can be used including finely divided ion exchange material. The process can also be operated over a large range of solids content producing a concentrated slurry which can still be pumped. As only small amounts of absorber material are added to the waste in this process, these additional solids do not significantly increase the total arisings.

The technique of crossflow filtration also reduces the decline in flux caused by deposition of solids onto the membrane surface. The effect of shear at the membrane surface is to reduce the rate of decline of membrane flux even when the filtration circuit is operated at a high solids concentration. Despite this effect, there will still be a long term, steady decline in flux due to surface fouling of the membrane. This fouling layer can be routinely removed by chemical cleaning.

All the membranes tested at pilot plant scale were constructed from inorganic materials and had internal diameters of between 2.8 mm and 6 mm. These large bore tubes were chosen as they reduce the requirements for prefiltering the waste to avoid the risk of tube blockage. Inorganic membranes were also chosen as they generally have better chemical and radiation stability than organic membranes. This better chemical resistance means that more aggressive chemical cleaning conditions can be applied.

Pilot Plant Description

A pilot plant was built to test the process on real radioactive waste and also to assess the reliability of plant equipment. The liquid used as a feed to the plant was the low active waste which arises at a rate of about 150cu.m/day from various operations on the Harwell site. It is a chemically complex waste which is variable in composition and also contains 10 % of a laundry effluent. The alpha,

beta, and gamma activities in this waste are about 0.4 Bq/ml and the solids content is approximately 100mg/liter. At present, this stream is treated by a ferric floe precipitation process.

A schematic diagram, Figure 1, shows the main features of the crossflow filtration plant. The radioactive waste feed is passed through a coarse 0.5mm strainer to remove large lumps of solid material. This liquid is then fed to a stirred conditioning tank where the pH is monitored and then controlled by the addition of sodium hydroxide or nitric acid. This tank can also be dosed with finely divided ion exchange material to absorb soluble radionuclides.

The waste liquid is then pumped into the filtration loop at a pressure of between 2–5 bar(g). Initially a displacement pump was used for this operation but it was found that its performance declined because fine slivers of plastic adhered to the pump valves. This pump has been replaced by a centrifugal pump which has performed reliably.

The membrane tubes tested have been inorganic ultrafilters and microfilters with nominal cut-off pore sizes in the range 2 nm to 0.2 microns. The tubes were either carbon coated with a zirconia surface layer or alumina tubes.

Twenty-five percent of the power generated by the Armenian nuclear plant was transmitted to Georgia, which sold a portion of this to Turkey. Operation of the plant had caused growth of a working and residential community of approximately 10,000 people around the site.

Armenia Plant Site Geology. Based on the regional geologic map of Armenia, the plant site appears to be located on a large field of flat-lying Quaternary volcanic rocks.

The Unit 2 plant building itself is excavated into hard basalt. A sand or soil layer that is about 10 feet thick is sandwiched between two basalt layers in the foundation. Beneath the reactor shaft, this soil layer has been removed and replaced with concrete. This is common engineering procedure for construction of power plants of all kinds in volcanic terrain.

Armenia Plant Response to the Earthquake. The plant is equipped with three motion detectors – in the office building, chimney stack, and electric substation – that are designed to activate at a peak ground acceleration of 0.05 g, which plant engineers have correlated to shaking intensity MSK-64 VI. (MSK

intensities are similar to modified Mercalli intensities used in the United States.) The reactors are programmed to scram and shut down if two of the three detectors are triggered. Intensity at the site was estimated in the mid-V range and no triggering occurred. However, vibration-reduction dampers connected to equipment activated after 2.4 millimeters displacement caused by the earthquake. The horizontal peak ground acceleration (PGA) at the facility was reported at about 0.03 g with amplified building response at about 0.05 g. Following the earthquake, the plant was shut down for 48 hours for a safety inspection. No significant damage was found, and upon restart all systems functioned normally.

The original seismic design of the plant was based on MSK-64 intensity VII, which, during design was upgraded to VIII as required for important facilities in the former Soviet Union.

The criteria specify that equipment and structures be segregated into three categories: 1. for inventory essential to safe shutdown; 2. for inventory generating power not directly critical to the integrity of Category I equipment; and 3. for inventory comprising all equipment, not contained in the first two categories. A retrofitting program for critical equipment was implemented at the Armenian site shortly after imposition of the enhanced criteria, which specified that reactors, pumps, steam generators, and valves be designed to resist shaking intensity IX. Scientists believed that the plant was located in an area of expected maximum magnitude of about 7.0 Richters instead of the M6.5 Richters expected before.

The following additional seismic strengthening features were observed by the writer during a visit to the plant after the December 7, 1988 earthquake:

- All electrical cabinets were bolted down and extensively braced to each other in the control room Unit 2.
- The suspended ceiling of the Unit 2 control room was seismically braced.

The plant manager was planning to strengthen the steel-frame roof trusses of the turbine building of Units 1 and 2.

- The office building for the plant, which is outside the power plant, is a precast concrete-frame building of the type that performed poorly in the December 7 earthquake.

- The steel-frame turbine building is a massive, well designed building

that appears to have a large seismic capacity.

Despite the upgrading program the Armenian units still lack a complete emergency core cooling system and a containment, both of which are mandatory in the United States. U.S. investigators also noted that the control room for Unit 2 had windows, a feature that has been eliminated from critical structures at U.S. nuclear plants to reduce the risk from tornado and other potential missiles. Some officials acknowledge that to remain operationally safe the plant would have to be retrofitted to resist intensity X, a program they say would be prohibitively costly.

Because of the plant's proximity to the Araks valley, the major agricultural area in Armenia, and to quell the population's fears that a nuclear accident similar to the Chernobyl disaster may occur, the former Soviet Council of Ministers announced that Unit 1 would be shut down as early as February 25, 1989. Shutdown of Unit 2 would follow on March 18, 1989. In a related announcement made shortly after the Armenia earthquake, officials stated that construction at six nuclear plants, three of these in the Caucasus Mountains regions, would be halted or suspended for seismic and other safety-related reasons.

Post-text tasks.

1. Define if the title reveals the problem the article concerns.
2. Find the sentences with Passive Voice and translate them.

Pretext tasks.

1. Read the Abstract to the article and say what the article below deals with.
2. Copy out 10 term and word-combinations which can be key-words to this article.

A COMMUNICATION MODULE THAT CONNECTS APPLIANCES TO A HOME NETWORK

ABSTRACT

The subject of communicating appliances is becoming more important as initiatives such as the "Internet House" and the "Smart Home" gather momentum.

This raises the issue of how to make the appliances communicate and be accessible via the web in a cost-effective manner.

The Invensys Communications Module connects the appliance electronic control with a local area network in the home. This enables the appliance to communicate with other appliances in the home and, via the Invensys Home Manager™, to be given a virtual user interface for remote monitoring and control.

HOME NETWORK

A Home Network is defined as a number of devices and appliances connected to a local area network in a manner in which they can communicate with each other. This communication allows sharing of data and resources. As more devices become connected, the data and resources which can be shared rises and the value of the network rises exponentially. If the network is connected to the phone line then access to dial-up services, including the internet, is possible. Similarly, service operators can access the system to offer and deploy their services remotely. The availability of WAP internet access using mobile phones increases the scope still further.

PROTOCOLS AND MEDIA

Appliances do not generally require a large amount of data to be exchanged in order to benefit from a network. Alarms, diagnostic data and control or programming signals can be measured in bytes not the kilobytes or even megabytes required by data hungry applications such as audio or video. This means that appliances can use low data rate protocols which generally are less expensive to implement than the high data rate protocols.

There are a number of suitable protocols available ranging from Lon-Works and EIB already used in commercial buildings through to EHS developed as a low-cost plug and play protocol for home use.

With regard to the internet, it is theoretically possible to connect the appliance direct to the internet. This, however, requires protocol software that, due to its large size of probably several hundred kilobytes, would not be feasible or cost-effective to incorporate in the 8-bit micro-controllers typically used in appliance electronics. The costs can be held in check by using simple protocols for

the many appliances and devices home network and putting the protocol software into the gateway that connects the network to the internet.

The transmission medium for the home network is also important with the mantra "no new wires" continually being heard. Thus, use of existing wiring such as telephone, co-axial cable or the mains wiring or the use of RF techniques is desirable to avoid new wiring having to be installed in existing houses.

The numerous possible combinations of protocol and media which may be suited to particular applications or environments means that the decision for the OEM which combination to use is not an easy one.

There is no one standard which dominates in this market segment today although it cannot be excluded that, in the near future, a preferred choice will emerge.

NETWORK READY

This uncertainty means that it is unlikely that appliance manufacturers will build the networking capability into all their appliances. Adding the required communication electronics to the existing electronic control would unnecessarily load cost into appliances that would not be used in a network

It thus makes sense to add the communication electronics only to those appliances that will be networked. This can be achieved in a number of ways.

For the expense of a connector, housing and a few cables the appliance could be made "network ready" so that the electronics necessary to connect the appliance to the network could be added by the distributor at the time of purchase. If once installed in the home, the user would like to connect the appliance to the home network then the service department could perform the upgrade. This allows the protocol-media combination to be selected at the latest time necessary. A pre-requisite of this approach is that adding the communications module should be as simple as possible and should not involve disassembly of the appliance or re-configuration of the electronics.

Alternatively, the communication electronics as a bare PCB can be built into the appliance during assembly in the OEM's factory. This reduces cost but at the expense of a loss in flexibility. Once the appliance is built it is difficult to re-configure for another protocol-media combination.

COMMUNICATION MODULE

Such a communications module must fulfil several requirements. First it must be able to communicate with the appliance electronic control so that the required data can be exchanged in both directions. Secondly, it must be able to connect to the home network to communicate with other devices and the home gateway. Thirdly, the concept should enable simple assembly either as factory build or as a field retro-fit device.

To address the first requirement almost all electronic appliance controls today include a serial link to access control variables for test and service purposes. This link can be used by the communications module in most cases without changes. If changes are required, they are usually straightforward software changes that do not affect the control algorithm.

The actual protocol used for the serial data transfer is specific to each appliance manufacturer. This means that the communications module must be easily adaptable so that the changes required for different manufacturers protocols can be incorporated and tested with the minimum of effort. This is most easily achieved with a modular software architecture and the use of flash memory in the communications module. Flash memory allows the final software to be stored in the module at the time of manufacture. Waiting for a re-mask would take too long and the use of One Time Programmable devices (OTP's) would be too expensive. The Invensys SmartModule™ used in the Invensys Communications Module is based on flash technology and so meets this requirement.

As well as the protocol for the data transfer, there are a number of physical implementations such as RS232, I²C and SPI. A universally applicable communications module must be able to interface with all of these standards. These interfaces are part of the Invensys SmartModule™ and can be easily selected during manufacture with an appropriate jumper setting.

To meet the second requirement, a communications module must connect to either a power line network (PLC) or a radio network (RF). Figure 1 gives an example of a PLC module. The power for the module is taken from the live and neutral connection of the mains. A PLC transceiver chip is coupled via a transformer to the same mains connections enabling bi-directional communication over the mains wiring with other similarly equipped devices and appliances.

To enable the communication between the appliance electronic control

and the home network requires a protocol translator. This software function ensures that the data received from the appliance control in manufacturer-specific formal is converted into the protocol used on the home network and vice-versa.

If the chosen medium is RF, then the PLC transceiver will be replaced by an RF transceiver and the transformer by an antenna.

To meet the third requirement the module should be capable of plugging in to the appliance without the need to use any special tools or make any modifications.

This is possible if a receptacle of the type shown in Figure 1 is fitted to the appliance. This holds an electrical connector which is pre-wired to connect to the appliance control and the live and neutral of the mains. A snap-in cover provides electrical and environmental protection. When the time comes to connect the appliance to the network, the cover can be removed and the appropriate network module snapped into place without the need for any further wiring. The connector in the receptacle mates with the Communications Module connector and provides the connection to the serial connection of the appliance electronic control and, in the case of a PLC module, with the mains wires. No screws or additional wiring are required and the design ensures electrical and environmental protection.

The final confirmation that the appliance is now "network capable" is obtained by inserting the mains plug in the wall socket, switching the appliance on and carrying out a short test programme.

HOME MANAGER

Once the appliance is communicating via the home network it has access to the features provided by the home gateway. These features differ between the various types of gateways which are available but the Invensys HomeManager™ ControlServer™ provides a comprehensive set of features for managing the home network and providing access to various services, including the internet.

By incorporating the appropriate software such as the HTTP server and the TCP/IP protocol stack, the HomeManager™ ControlServer™ can connect any appliance on the home network to browser software such as Microsoft Internet Explorer or Netscape Navigator. Thus any PC connected to the ControlServer™ via its ethernet port can serve as a user interface to the appliance.

Similarly, with an appropriate modem, the ControlServer™ can be con-

nected to the internet so that, with appropriate security measures, access from any internet-connected browser is also possible.

Using large screen icons to represent each system or service available simply selecting the icon opens up a further screen which presents data relating to the device or service or allows interaction with the device or service. Examples would be internet access (browsing, e-mail, on-line shopping or banking); adjustment of the HVAC and lighting system: monitoring energy usage or interacting directly with appliances.

The lower page shows an example of a virtual interface to an oven control provided by HomeManager". The virtual control panel can be used exactly like the actual control panel by clicking on the buttons. Similarly, the displays on the virtual panel update in synchronization with the actual control. This is made possible by the Communications Module providing the interface to the oven control via a serial link and exchanging data with HomeManager" via the home network.

The system can be used to access web-sites which can give meal suggestions, preparation instructions and then finally offer to download a cooking profile directly into the oven control. This eliminates any programming activity on behalf of the user and ensures that the temperatures and times are correctly programmed for the particular recipe being prepared.

Similarly, any other appliance can be given a virtual control panels to allow interaction via such browser pages. The HomeManager™ links them together with other house systems such as lighting and security and provides one common interface to these and traditional internet functions.

The possible applications are not just web-based. More down to earth applications such as remote monitoring and fault diagnosis become possible once an appliance is connected to such a home network. Data can be sent via the telephone line on a regular basis to a call centre which can look for trends so that preventative maintenance can be carried out. If a breakdown does occur then an alarm signal can be sent immediately to the service centre. Knowing the type of machine sending the alarm, and having historic diagnostic data available means that repairs can be completed more quickly and effectively than before. Offering lower service premiums to the end-user would be a motivation to use such systems and could quickly offset the cost of the communications capability.

CONCLUSION

As the home becomes more "connected" there will be an increasing demand for communicating appliances. The Invensys Communications Module is a simple, powerful and flexible way to achieve this and to avoid the problems posed by the many possible protocol-media combinations.

Combined with the Invensys HomeManager™ system, appliances can be linked into the home network to increase their capabilities, simplify their use and lower the cost of ownership.

Biography

Graham Bailey is the European Engineering Manager for Invensys Network Systems based in Ludwigshafen, Germany. Prior to joining Network Systems in November 1999, Graham was Engineering Manager for the Invensys Appliance Division based in Speyer, Germany.

Post-text tasks.

1. Define the core sentences in each subsection of the article.
2. Find 10 examples of PI, PII and Gerund. Translate them.
3. Find sentences with Modal verbs. Translate them.

Pretext task.

Determine whether *some* significant points are not missed from a set of problems given by the headline.

THE EFFECT OF DIAMETER ON THE INCREASE IN PREFERRED ORIENTATION IN PITCH MESOPHASE FILAMENTS ON GRAPHITIZATION

John C. Jenkins and Gwyn M. Jenkins

University College Swansea, Swansea, UK

Pitch mesophase filament has been produced by extrusion and drawing above 400 C. The preferred orientation of component molecules was determined by X-ray diffraction. Changes in preferred orientation were monitored after oxidation and subsequent heat treatment up to graphitization temperatures. It is

demonstrated that the preferred orientation in such filaments does not change significantly on graphitization if the diameter is $>200\text{ }\mu\text{m}$. For thinner filaments, there is a marked increase in the degree of preferred orientation as the diameter is reduced. The relevant orientation profiles and defining parameters are presented and analysed.

(Keywords: pitch; mesophase; graphitization)

Graphite fibre is produced by heat treatment of spun pitch mesophase and the final axial stiffness is directly related to the degree of preferred orientation induced in the mesophase molecules by the spinning process. Mesomorphic pitch filament is extruded and drawn from a refined homogeneous pyrolysate. The flat aromatic molecules align easily along the fibre axis and follow a predictable affine tilting mechanism much more closely than long chain polymer systems'. Polyacrylonitrile (PAN) molecules, for instance, are not as well orientated during spinning, and require an additional stretching stage to form precursors for high modulus and high strength carbon fibre.

Both pitch mesophase and PAN fibres show further increases in preferred orientation on heat treatment above $1000\text{ }^{\circ}\text{C}$. Bright and Singer have shown that $10\mu\text{m}$ diameter mesophase filament increases in preferred orientation above $500\text{ }^{\circ}\text{C}$. A loss in preferred orientation was recorded only during heat treatment below $500\text{ }^{\circ}\text{C}$ – before extensive cross-linking between the molecules occurred. Increase in preferred orientation was observed in fibres with both radial and random microstructure in cross-section. However, in Swansea it was found that when much thicker filament was extruded and drawn, possessing similar degrees of preferred orientation, no equivalent increase in preferred orientation during graphitization was apparent. Indeed, a marked loss was observed. A measure of preferred orientation (the Bacon anisotropy factor) steadily decreased at all heat treatment temperatures between the as-drawn, oxidized, coked and the graphitized state for a 1.8 mm diameter mesophase rod. In other cases, the orientation profiles of mesophase filaments between 620 and $270\text{ }\mu\text{m}$ were characterized and showed a very slight loss in preferred orientation between the 'as extruded' and graphitized states, much less of a loss in comparison with the thicker specimens.

Clearly there is a discrepancy between our work on thick pitch mesophase filaments and the work by Union Carbide on thin filaments that show a marked increase in preferred orientation on graphitization. In this work, a range of filaments with different diameters and similar initial full width at half maximums (FWHM) of azimuthal flat plate X-ray intensity have been produced. The changes in preferred orientation after heat treatments up to 2600 °C are reported. By way of comparison and contrast PAN-based fibre was also heat treated in a similar manner, as an example of a nongraphitizing carbon fibre.

EXPERIMENTAL

A pitch mesophase was prepared by heating petroleum pitch at 10 °C h^{-1} under nitrogen through the mesophase transformation range to 462 °C. The pyrolysate was produced by techniques outlined elsewhere. After cooling and comminution, the mesophase powder was transferred to an electrically-heated stainless steel extruder and brought to 400°C. The molten mass was then expressed through a round orifice and stretched into round-sectioned filament. The diameter was regulated by varying the rate of pull-off. Cross-polarized light reflection microscopy of transverse sections showed that the material was fully transformed from pitch to mesomorphic material with small randomly orientated domains. No radial arrangement of the domains was observed to correspond with the textures obtained in some of the Union Carbide fibres.

Filaments with three initial diameters (270 μm , 170 μm and 50 μm) were chosen for this study. The 270 μm filament was produced by drawing rod at 400°C and the finer filaments by direct drawing from 450 °C pyrolysate. Each filament was oxidized to avoid softening immediately prior to coking by heating at 100 °C h^{-1} to 350 °C in air. They were then carbonized to between 700 and 1000 °C in nitrogen. They were subsequently heat treated at 2600 °C in helium.

After each stage of heat treatment, flat plate X-ray diffraction patterns were obtained for each filament. At 2600 °C, diffraction traces derived from the graphitic 002 spacings. At lower temperatures the more diffuse diffraction traces derived from imperfect protographitic spacings.

Figures 1(a)-(d) show the results of densitometry of the azimuthal scans of these diffractions, normalized in each case to show the same maximum intensity for all four filaments. Each figure includes the FWHM data at each heat treat-

ment. The FWHM for radial variation in intensity was also recorded. Both FWHM values are presented in *Table 1* for ‘as spun’ and graphitized pitch mesophase filaments.

DISCUSSION

Inspection of *Figures I(a)–(c)* shows that all three of the chosen pitch mesophase filaments had the same FWHM (31°) in the as-drawn state. In all cases, there is little change on carbonization to between 700°C and 1000°C . However, on graphitization to 2600°C the effect diameter is most marked. The $270\mu\text{m}$ fibre retained its original texture. The $170\mu\text{m}$ filament showed a marked decrease in FWHM to 10° , while $50\mu\text{m}$ filament showed an even larger decrease to 5° . The nongraphitizable PAN-based fibre with an identical thermal history also showed a decrease in FWHM (from 44° to 14°) in *Figure I(d)* – it was not possible to find carbonized PAN fibre with equivalent broadening to mesophase filament.

Care should be taken in the interpretation of these results in terms of preferred orientation. For very sharp azimuthal intensity profiles, corrections for instrumental and crystal-size or ‘crystallinity’ broadening should be made. The former is easily determined to be less than 1 while the latter would explain the discrepancy between araphitizable and nongraphitizable fibre. None of these corrections can however, detract from the conclusion that an increase in preferred orientation occurs during graphitization which depends critically on the filament diameter. The very low half-width recorded for $50\mu\text{m}$ graphitized pitch filament should be particularly noted. Its sharpness indicates both high crystal perfection and high preferred orientations parallel to the filament axis.

True orientation profiles can be drawn from these data by a method that was described in a previous paper. From these the Bacon anisotropy factors can be calculated. However, this does not add anything to the arguments offered here.

The radial broadenings listed in *Table 1* can be related to crystallite size (L_c) along the c-axis. Care should be taken in interpretation because radial broadening can be caused by other factors (e.g. strain). However, it can be inferred that L_c dimensions are slightly greater in the thinner fibre before and after graphitization, but the effect is not nearly as marked as the azimuthal broadening variation.

To understand the evident effect of the surface to volume ratio (SVR) on the augmentation of preferred orientation above 1000 °C, we need to examine the results of other investigations. Edie *et al* have produced noncircular sectioned 5 µm mesophase filament, and Measured axial stiffness after heat treatment to 2100 °C. Trilobal and octolobal fibres possessed higher SVRs than circular fibres with the same cross-sectional area. It was found that Young's modulus (which is directly related to the degree of preferred orientation) of high SVRs fibre showed greater increases on heat treatment between 1000 °C and 2100 °C than the low SVR circular sectioned fibre. This supports our findings with varying cross-sectional areas.

In carbon fibres derived from spun phenolic resins. Young's modulus increased with decreasing fibre diameter. This was attributed to the effect of a highly textured sheath of constant thickness surrounding an untextured core. The smaller the diameter of the fibre, the greater was the ratio of textured to untextured material. Polarized light microscopy on fibre cross-sections revealed the presence of such textured sheaths. The explanation for increased preferred orientation on heat treatment above 2500 °C was that the core contracted much less than the sheath at these temperatures. Thus the sheath experienced a strong tensile force at a temperature when vacancies were able to contribute to the climb of in-sheet dislocations and so promote enhanced texturing in the outer layers. The sheath thickness was observed to be constant, and so its effect on the overall preferred orientation would be most marked for very thin fibres.

In general, we may presume that the ordering of crystallites to lie parallel to the fibre axis leads to a lowering of internal energy. Such re-orientation may be easier near a free surface, where diffusionaided realignment occurs more easily. Such alignments would start at the surface and move progressively into the interior at higher heat treatment temperatures and longer times.

For the same heat treatment, the depth of the highly orientated layer would be constant for all diameters, and so the ratio of textured to less textured volume would increase with decreasing filament diameter as is observed. The slight decrease observed in FWHM of radial broadening with decreasing fibre diameter indicating greater crystallite dimensions (L_c) tends to support this proposed mechanism.

However, we have not observed such sheaths in polished sections of our pitch mesophase filaments and so cannot confirm that these mechanisms apply. It may be that the order: disorder transition region in pitch mesophase fibre is much less marked than in phenolic resin fibre, and so cannot be resolved optically. Future work will concentrate on electron diffraction of longitudinal sections of the graphitized filaments to try to resolve any gradient in preferred orientation.

Post-text tasks.

1. Make up a precis (15–17 sentences) to the article.
2. Find 20–30 examples of word-building, define their part of speech, translate them.
3. Find the sentences (not less than 10) with Passive Voice and translate them.

Pretext tasks.

1. Read the text and say if the abstract given fully covers the problems highlighted in the article.
2. Express in 3–4 sentences the gist of each part of the paper.

ON THE COMPOSITION OF PITCHES

Maximilian Zander

The composition of pitches is discussed in terms of defined chemical compounds and classes of compounds that have been identified in these materials. The main emphasis is placed on polycyclic aromatic hydrocarbons, systems containing the acenaphthylene moiety and sulphur heterocyclic systems.

GENERAL FEATURES OF PITCH COMPOSITION

Coal-tar pitches and petroleum-derived pitches are known to have a very complicated chemical composition. In Figure 1 the classes of compounds that have been detected in pitches are listed. In most types of pitches polycyclic aromatic hydrocarbons (PAH) comprise the dominant class of compounds. Alkylated PAH as well as PAH containing olefinic double bonds, i.e. benzologs of acenaphthylene are also present. Partially hydrogenated PAH occur in petroleum

pitches in larger amounts but in high-temperature coal-tar pitch the concentrations are low. Oligo-aryls, i.e. systems in which aromatic units are connected by C-C single bonds have been found in coal-tar pitches and indication has been obtained that oligo-aryl methanes are also present. Phenols and aromatic amines are constituents of pitches but concentrations are very low. A few carbonyl derivatives have so far been detected in coal-tar pitch, the compound shown in Figure being an example. Many polycyclic hetero-aromatic systems are present in pitches although most of them in very low concentrations. All currently known compounds of this type in coal-tar pitch are benzologues of pyrrole, furan, thiophene and pyridine. However, there is some indication that other types of heterocyclic systems may also occur.

The enormous compositional complexity of pitches can be demonstrated, for example by 2-dimensional chromatography. Thus, glass capillary gas chromatography/mass spectrometry allowed the detection of only 13 nitrogen compounds in the molecular mass range 200–260 of a high-temperature coal tar, i.e. in the low molecular mass range of pitch. The column length was 92 m and the stationary phase a polyphenyl sulphonyl ether Poly S 179. However, the tar was also separated by micropreparative gas chromatography and a narrow fraction with molecular mass (MM) 210–235 was isolated. The fraction was analysed by high-performance liquid chromatography using a column that group-specifically separates nitrogen compounds from polycyclic hydrocarbons; about 35 nitrogen-containing compounds were then detected.

POLYCYCLIC AROMATIC HYDROCARBONS

Among the classes of compounds occurring in pitches, the polycyclic aromatic hydrocarbons are of particular interest. In Figure the building principles of PAH are shown. We distinguish between two classes of PAH, the cata-condensed and the pen-condensed systems. By considering the so-called 'characteristic graphs' of PAH a straight-forward definition is obtained. In the characteristic graphs the points are the centres of hexagons and the lines connect the centres of hexagons whenever these are condensed. Pen-condensed systems have characteristic graphs which contain cycles, while cycles are not contained in the characteristic graphs of cata-condensed systems. Two examples are given in Figure, the characteristic graphs of anthracene and pyrene. The entire group

of cata-condensed PAH can be farther divided into non-branched and branched systems. In contrast to non-branched PAH there is at least one point in the characteristic graph of a branched PAH that is connected with three other points. Branched systems are thermodynamically more stable and chemically less reactive than non-branched systems of the same size. All cata-condensed PAH are alternant. The entire group of peri-condensed systems can be further divided into alternant and non-alternant systems. According to a very simple description, alternants contain only six-membered rings while non-alternants have at least one five-membered ring. For the pen-condensed PAH we can further distinguish between closed shell systems having all bonding orbitals occupied by two electrons, and neutral free radicals where at least one electron is in a non-bonding orbital. Free radicals of this type are stable only if the systems have an odd number of carbon atoms. Since all possible cata-condensed PAH have an even number of carbon atoms, neutral open-shell systems do not occur here.

For convenience we may define isomeric PAH as those having the same number of hexagons. In Table I the number of possible isomers of cata- and peri-condensed PAH with 2 to 8 rings are listed. The number of possible isomers increases very rapidly with the number of hexagons, i.e. size of the systems. For PAH containing 12 hexagons 683 101 isomers are possible. PAH with 12 hexagons are medium-molecular weight compounds, the molecular weight of the cata-condensed PAH being 628 and of highly fused pen-condensed PAH of the coronene type about 480. However, these large numbers of isomers also include all possible peri-condensed open-shell free radical systems, most of which are extremely unstable. Moreover, among the closed-shell systems also are many very unstable compounds. For example, linear cata-condensed PAH of the acene type with more than 7 rings cannot be obtained by synthesis because of their extreme instability. Accordingly, a large number of the formally possible compounds are not expected to occur in pitches because of their instability. Nevertheless, even assuming that only relatively stable systems can occur in pitches, their number will be still very large. It could be argued, however, that not only thermodynamic but also kinetic factors greatly reduce the number of PAH that can be formed during pyrolysis of coal- or petroleum-derived materials, but there is some evidence that this is not the case.

DISTINCTION BETWEEN ALTERNANT AND NON-ALTERNANT SYSTEMS

As was mentioned before the entire group of pen-condensed PAH can be divided into alternant and non-alternant systems. In describing pitches in terms of their chemical composition it would be of great interest to have available a method which allows the distinction between alternants and non-alternants without the compounds having to be identified. In some cases C n.m.r. allows a distinction between alternants and non-alternants but it does not provide a generally applicable criterion. However, a reliable method for the distinction of these two types of PAH is fluorescence spectroscopy.

Due to the different HOMO/LUMO situation in alternants and non-alternants, the fluorescence of alternants is quenched by suitable electron acceptors, e.g. nitromethane, while the fluorescence of non-alternants is not. Conversely, electron donors, e.g. trimethoxy-benzene, quench selectively the fluorescence of non-alternants while they do not quench the fluorescence of alternants. This behaviour is known to apply to all alternants and non-alternants, which have their fluorescence transition at wavelengths longer than approximately 400nm. Curve A is the fluorescence spectrum of a mixture of four alternant and one non-alternant PAH (Compound) in the absence of a quencher. The spectrum observed is the superposition of the spectra of the five compounds. Curve B is obtained after adding nitromethane as a selective fluorescence quencher to the solution. The spectrum observed is the unperturbed spectrum of the non-alternant hydrocarbon present in the mixture. Curve C is the fluorescence spectrum of a mixture consisting of four non-alternants and one alternant, compound 11. By addition of trimethoxybenzene as a quencher the fluorescence of all non-alternants is completely quenched and the spectrum that remains is that of the alternant PAH (curve D). This principle has been termed Complementary Quenchofluorimetry.

Quenchofluorimetry using electron acceptor compounds as quenchers is of particular interest because it can be used in h.p.l.c. systems. The curves are h.p.l.c. chromatograms, with fluorescence detection. The unmarked peaks correspond to alternants while the shaded peaks correspond to non-alternants. Curve A is the chromatogram of a synthetic mixture. After addition of a small amount of nitromethane to the solvent, curve B is obtained. Due to the selective fluorescence

quenching effect only the non-alternants give signals. Curve C is the chromatogram of a low molecular-weight pitch fraction. Chromatogram d was obtained after addition of nitromethane to the system. Comparison of chromatograms C and D rendered possible a straightforward distinction between alternants and non-alternants present in the sample as shown in chromatogram c. The important advantage of the method lies in the fact that reference substances are not needed for the assignment of peaks to alternants and non-alternants, respectively. Work is in progress to apply the method to high-molecular-weight pitch fractions

SYSTEMS CONTAINING THE ACENAPHTHYLENE MOIETY

The non-alternant hydrocarbon with the simplest structure present in coal-tar is acenaphthylene. It is one of the main constituents of tar with a concentration of approximately 2 %. The compound can be easily detected and estimated by gas chromatography. However, it is difficult to identify by C n.m.r. spectroscopy as the olefinic carbon resonances are buried in the aromatic absorption bands. However, on thermal treatment of coal-tar, e.g. during distillation, hydrogen transfer reactions take place and the acenaphthylene is hydrogenated to acenaphthene. Coal-tar was distilled in the laboratory scale and the pitch and the distillate remixed to produce refined tar; the weight loss was less than 0.5 %. In the C n.m.r. spectrum of the refined tar a broad band at 29.5 ppm was observed, which is not present in the spectrum of crude coal-tar. Since the chemical shift values of the ethano-bridge of compounds containing the acenaphthene moiety are rather insensitive to a structural change in the aromatic part and are, therefore, limited to a very narrow range of approximately 2 ppm the broad band at 29.5 ppm can only be assigned to highly fused compounds containing the acenaphthene system. This, though, leads to a conclusion that highly fused compounds containing the acenaphthylene moiety are present in coal-tar before distillation, particularly in the high molecular mass range.

SULPHUR HETEROCYCLIC SYSTEMS

It is now becoming increasingly clear that many benzologues of thiophene are present in pitches and other coal or petroleum-derived materials. However, the concentrations of the individual compounds diminish markedly with increasing size as the number of isomers increases. For a given number of rings the

number of possible isomers is much larger in the thiophene than in the hydrocarbon series. A few examples of thiophene benzologues detected in pitches are shown in Figure. While thiophene analogs of cata-condensed hydrocarbons, e.g. compound 1, were identified in pitches more than 40 years ago, the first examples of thiophene analogs of pen-condensed hydrocarbons, viz. compounds 4 and 8 were not detected in coal-tar pitch until 1977. Since then, however, many other pen-condensed high molecular weight thiophenes have been found in various types of pitches and related materials.

The occurrence of peri-condensed thiophene systems in pitches is by no means surprising. It is well known that polycyclic aromatic hydrocarbons at the high temperatures typical of coking and pyrolysis processes react with hydrogen sulphide to give thiophenes. Conversion rates are normally low but increase in the presence of catalysts. Since the reaction with hydrogen, sulphide of PAH with a bay-region to give peri-condensed thiophenes is a very general phenomenon one may speculate that almost all possible thiophene analogs of pen-condensed hydrocarbons occur in pitches, although in much lower concentrations than the corresponding hydrocarbons.

Some evidence has been obtained that a noticeable proportion of the pitch sulphur content is contained in systems structurally unrelated to dibenzothiophene. The results of experiments leading to this conclusion are shown in Table. The thermal stability of a number of sulphur-containing heterocyclic compounds was studied. The individual compounds were thermally treated in the containing compounds, which are not structurally related to dibenzothiophene, are also present in pitches.

Liquid phase at 410°C for 12 h in the absence of oxygen and the loss of sulphur was determined by elemental analysis. Under these conditions sulphur extrusion was negligible for the thiophene benzologues studied. As can be seen from the figures given in Table this applies for both cata-condensed and peri-condensed systems. However, other types of sulphur-containing heterocyclic systems such as phenothiazines and the thianthrenes proved rather unstable under the experimental conditions used. Coal-tar pitch was also subjected to the same thermal treatment and a loss of sulphur of 30%, relative to the sulphur content of the original pitch, was observed.

Post-text tasks.

1. Find and analyse Chain of Nouns, translate them.
2. Choose the sentences with Passive Voice and translate them.

Pretext task.

Determine the core sentences of each paragraph.

AIR CLEANING EQUIPMENT

Clean air is an essential requirement for today's manufacturing industries: Not only do the factory staff demand a clean healthy working environment, but the law in the form of COSHH regulations enforces it.

Horizon International is a Bristol based manufacturer of the 'Smog-Eater' range of air cleaning equipment. The equipment is designed for applications in virtually all forms of industry e.g. mechanical engineering, electrical engineering, electronics, foundries, rubber, plastics and textile. Most industries create some form of air-pollution which has to be removed and collected.

The 'Smog-Eater' range includes mobile units which can be easily wheeled to the source of air pollution, units for free hanging to provide a general clean up of a workshop atmosphere, wall mounted units and units for inserting into ductwork systems. All units can be provided with automatic cleaning where necessary.

The 'Smog-Eater' range can filter down to particles as small as 0.01 microns in particle size with efficiencies as high as 99%. The 'Smog-Eater' is provided with an electrostatic two stage precipitator filter and requires periodic cleaning, not replacement. Power consumption is extremely low and units are available for all voltages.

The model SE.44 'Smog-Eater' unit can be connected to ductwork terminating with hoods, canopies, fume extraction arms etc. Alternatively it can be suspended from roof steelwork to provide a general clean up of the workshop atmosphere.

The Horizon 'Filt-0-Bench' can be manufactured either mobile or static and is a combined work bench with inbuilt fume and dust extraction. Standard sizes are available and purpose built units to any size can be provided. The 'Filt-

0-Bench' incorporates a work light and a heavy duty bench top through which dust and fumes are extracted down into the extraction/filtration unit. Handing of access doors, etc can be built in order to suit any site condition.

Pretext task.

Read the article and say if the headline reveals the problem of the article.

SEEING THE LIGHT

I work in Palo Alto, Calif., and commute five days a week over 30 km of narrow, winding back roads in the Santa Cruz mountains. There are 220 discernible turns between my home and my place of work. In many places, these roads are in deep shadow with camouflage-like patterns caused by vegetation. At times, I commute at sunup or sundown.

Does this relate to IEEE Spectrum and its readers? It does because I share the roads with numerous bicyclists, and one of the biggest revolutions in LED lighting is not mentioned in "Let There Be Light". There are already two generations of bicycle LED taillights on the market, and they have made a major difference in my ability to see cyclists under difficult lighting conditions.

The first generation is typified by a product such as Cat Eye. These taillights are extremely effective at night, but they are difficult to see off axis or during the day.

More serious cyclists are already replacing these devices with LED taillight arrays from NiteRider. They run from a separate battery pack and are bright enough to be seen during the day and well off axis.

These products only scratch the surface. Brightness, off-axis visibility, and efficiencies will continue to improve. Battery life will lengthen and costs will drop low enough so that all bicycles will come with a taillight that makes them visible under worst-case lighting.

Robert G. Huenemann La Honda, Calif.

Glenn Zorpette's article "Let There Be Light" never mentioned compact fluorescent lamps (CFLs) when comparing efficiency. Today's CFL is four times as efficient as an incandescent lamp and costs as little as US \$4 retail. While slightly bigger and heavier than incandescent lamps they replace, they last 10

times as long. Their lifecycle operating costs are far below those for incandescent lamps.

Pretext task.

Give in short the main idea of the paper.

BRAIN QUALITY

In "Robots Stand on Own Two Feet", Glenn Zorpette refers to the HOAP-1 robot as "beetle-brained." Not really.

Though beetles can't play "Sweet Adeline," engineers are far from emulating their capable brains. With very few neurons, they are able to walk, fly, feed, breed, and flee predators. Another good example is moths. Such a tiny brain and still they can deftly evade bats -by detecting their sonar. They can even produce fake echoes to confound them. When the bats change the sound, so do the moths.

Can we build a device to do all of that with so little to work with and with the same power efficiency? I wonder what humans could do if their huge brains were used the same way.

Leo F. Fernandes Rio de Janeiro, Brazil

Glenn Zorpette responds: The small size and efficiency of an insect brain is truly marvelous, and was not questioned by the article. Size and power constraints aside, insects' highly instinctual behaviors – including locomotion, feeding (re-charging), navigation based on auditory or visual cues, and fleeing – are well within the capabilities of advanced microprocessors. Experiments by Rodney Brooks at MIT, Hans Moravec at Carnegie Mellon University, Barbara Webb at the University of Nottingham, England, and others have left little doubt about that. Regarding moths and other winged insects: the average bug-eating bat consumes roughly 1000 of them each night. So perhaps "deftly" is not the best way to describe a moth's ability to evade a bat.

Pretext tasks.

1. Read the article and express the main idea of it.
2. Analyze the use of tenses in it and say which tense is used more often.

WILL IM AID THE ENTERPRISE?

Although Alexander Graham Bell managed to invent the telephone without a pocket calculator, a laptop, or an instant-messaging PDA, one can certainly imagine that wireless transmission of text bytes would have impressed the clever Scotsman. What great devices IM-transmitting PDAs would have been for the hearing-impaired in the middle of the 19th century!

The inventor of the world's first ubiquitous home invasion device would also have marveled at the extent to which it is now possible to find anyone anywhere and demand their immediate attention and reaction.

As IM makes its way out of teen land and into the corporate environment (much to the delight and relief of Internet executives everywhere, who've had nothing to buzz about lately), it will be interesting to see the extent to which it ends up being deployed in business settings once interoperability and security issues have been cleared away.

Is IM a short-lived fad or a technology with staying power? Its evangelists – like AOL, Yahoo, Microsoft, Lotus, Trillian, Jabber, and IBM – claim it is the first wave of pervasive computing, yet another beautiful link in what will eventually be a seamless chain of universal communication that will bring new efficiencies and productivity to our work and play. Ad hoc IM meetings will replace the hard-to-schedule teleconference, and e-mail servers everywhere will be liberated from the storage-zapping glut of messages sent to make a lunch date, answer a brief question, or pass on a joke. Impromptu white boarding and real-time collaborative work, emergency networking, and customer service will all become easier and faster, faster, faster. But murmurs of dissent about the value of IM lie beneath the buzz. Could it prove to be another, bigger, worse distraction than the telephone or e-mail, leading to less work and productivity, not more?

People who wear hearing aids often turn them off when they've had enough "information" for the day, a wonderfully defiant affirmation of the importance of being able to select what you pay attention to and when you pay attention to it. Perhaps the next big post-IM "killer apps" will be lots of ingenious devices to create downtime – including software to camouflage your on-line

presence or perhaps the IM equivalent of voice mail. The biggest barrier to ubiquitous computing could turn out to be human rather than technical in nature.

Pretext task.

Reading the article concentrate your attention on the main idea of it.

VISITING WHAT WAS, TO UNDERSTAND WHAT IS

To get a visceral sense of the warp speed at which technology has moved from the simple telephone to, for example, the instant-messaging-enabled Internet-browsing cellphone, make a pilgrimage to the Computer History Museum. This museum is home to a nomadic and extraordinary collection of landmark hardware and software that for the moment resides in warehouses next to the huge landmark hangar at NASA's Moffett Federal Airfield in Mountain View, Calif. Feeling a little less ambitious? Open your Internet browser and stop by the IEEE Virtual Museum. Since it opened last February, the museum has had thousands of on-line visitors every month, a phenomenon that another Bell, IEEE Fellow C. Gordon Bell, hope lies in the Computer History Museum's future as well, once its enormous machine collection is "cyberized" and launched into virtual space.

Of particular value to pre-college students and educators, the IEEE Virtual Museum uses interactive on-line exhibits based on unique artifacts from museums around the world to make learning about technology an adventure. New exhibits include "Women and Their Role in Technology" and "The Beat Goes On: How Sounds are Recorded and Played." Next up is an exhibit about microwaves, curated in conjunction with the IEEE Microwave Theory and Techniques Society. Try it some rainy Sunday afternoon. It's free, it's fun, and it's a breeze to set to.

Pretext tasks.

1. While reading the article choose and analyse all Modal Verbs.
2. Find in first two paragraphs sentences containing the verb *to do*, analyse different functions of it, translate these sentences.

NASA'S MASTER PLAN

NASA's mission is threefold: to understand and protect the home planet; to explore the universe and search for life; and to inspire the next generation of explorers. Soon after President George W. Bush appointed me administrator of NASA late last year, I asked my leadership team to help identify NASA's core strengths and activities and think hard about how each of them supports our mission. The purpose of the exercise is focus – and also direction. If a program or activity doesn't support one of these three objectives, we've got to ask why we're doing it, even if we may be doing it rather well. Once we have focused on the activities that do fit into NASA's mission, we must make sure we are managing them in the best way possible. For example, are there alternatives in universities or in the private sector? If there are, we ought to concentrate on supporting them rather than duplicating those efforts.

Concentrating on those things that advance our mission and that we alone can do will tell us what our direction should be and what specific programs truly need our support. That, in turn, will allow us to make solid decisions about what NASA's organizational structure and size should be.

I've also begun scrutinizing NASA's scientific priorities. Right now, our purview includes monitoring Earth's climate, studying distant galaxies, and searching for evidence of Life, past or present, in our solar system and beyond. The inauguration of the International Space Station (ISS), around 2006, will certainly expand our scientific reach. For example, the U.S. National Academy of Sciences has in recent years produced an impressive array of ideas for experiments it favors for the unique environment of the ISS or the Space Shuttle.

The problem is that all those ideas and disciplines are ranked as top imperatives. What we must do is assign priorities as a first step toward drafting a master plan that lays out what we're going to do and the sequence in which we're going to do it. Along the way, we need to identify the critical challenges in these various disciplines that could open up entirely new ways of looking at problems.

This task has fallen to a panel assembled by Rae Silver, a professor of natural and physical sciences at Columbia University (New York City), and David Shirley, director emeritus of the Lawrence Berkeley National Laboratory in California. The panel, which includes a few Nobel laureates, has met several

times since its formation. In the near future I expect to implement one of their first recommendations – the establishment of a chief science officer as a part of every ISS crew.

Developing ambitious but realistic scientific priorities will also help us decide what the configuration and crew size of the ISS should be. If we're going to ask astronauts and cosmonauts to spend weeks or months in a difficult and potentially dangerous environment, it should be for work that is intrinsically significant, not for chores concocted to justify the station's existence.

Until our panelists and others help us determine the best uses of the ISS, it doesn't make sense to continue developing projects such as the single-purpose X-38 emergency crew-return vehicle. After all, how can we design an escape vehicle if we don't know how many people it will have to accommodate? We nonetheless have an obligation as human beings to ensure that everyone we ask to fly on board the ISS has an opportunity to evacuate under extreme circumstances, however unlikely. As a result, NASA is considering a set of alternatives, including designing a multipurpose logistics or transfer craft that could also serve as an emergency crew-return vehicle, capitalizing on the remarkable technology developed under the X-38 project.

Another technological challenge I am eager to see NASA tackle is that of overcoming current limitations on how quickly we can get around the solar system and the amount of work we can do once we get somewhere. Once they pass low Earth orbit, our spacecraft today, piloted vehicles and probes alike, fly no faster than did their earliest predecessors, which took off for the planets 40 years ago.

Solar power, for example, frequently causes engineering headaches and in any case is inadequate much beyond the orbit of Mars. The most mature technology for overcoming the combined problems of power generation and propulsion is nuclear energy. This technology can be used safely: for 45 years, the U.S. Navy has operated over half of its fleet with nuclear power without significant incident.

At President Bush's direction, NASA has revived its nuclear power and propulsion research, which had been all but dormant for some time. We will actively engage the public, as well as environmental and other interest groups, by

telling them what we have in mind and soliciting their views on reaching our objectives in an environmentally safe manner.

Finally, I've been struck by the incredible energy and enthusiasm that permeates the entire NASA organization. As we pursue our ambitious aeronautics and space research and exploration agenda, NASA will continue, I trust, to engage the public in an adventure without end.

Pretext task.

Determine the core sentences in each part of the article.

POWER AND PURPOSE IN SPACE WITHOUT NUCLEAR-POWERED SPACECRAFT, WE'LL NEVER GET ANYWHERE

Wood, wind, water, coal, oil, gas, and nuclear energy: of those major power sources, only one – nuclear – can work in space. Like it or not, humanity is going nowhere, astronautically speaking, without the power of the atom.

Because of technical and political factors, nuclear technology has been confined to applications that produce rather little power, mostly in deep-space probes. Lacking nuclear energy as a robust and diverse option, for both propelling spacecraft and powering their on-board systems and instruments, we have been forced to make extensive use of solar power to systems and instruments and to rely exclusively on chemical rockets for propulsion.

Neither one is adequate. To power spacecraft instruments, the sun's thin rain of energy is of little use much beyond Mars's orbit. For propulsion, chemical rockets run up against the basic burden of space travel: weight. The cost of a space mission scales more or less proportionally to the mass of the spacecraft involved. Up to 90 percent of the weight of a typical chemical rocket at launch is propellant. So to keep this load to a minimum, propulsion experts choose chemical propellants whose reactions are very energetic. The more energy per unit mass of propellant, the less propellant needs to be carried, and the cheaper the mission will be.

Rocket engines fueled with hydrogen and oxygen have already come quite close to the practical performance limit of chemical propulsion. Spend all the money you want; you won't do much better. Nuclear reactors, on the other hand,

pack a million times as much energy per unit mass as the best chemical fuels. The challenge, of course, is getting the power out usefully and safely.

Kettles In the sky

The simplest way, which was demonstrated extensively in ground tests in the United States in the 1960s, is to use the reactor to heat a fluid and then eject that fluid out a rocket nozzle. This "flying steam kettle" technique, with hydrogen as the working fluid, yields about four times as much energy per unit mass as a chemical rocket based on hydrogen and oxygen fuel. Much higher energies are possible in theory, but in practice, the exhaust gas would become too hot to handle with any known materials.

To compare the propulsive efficiency of different rocket technologies, engineers use a characteristic called specific impulse. It indicates the amount of time, in seconds, that the technology can put out a pound (4.45 newtons) of thrust while expending a pound (0.454 kg) of propellant. According to the laws of physics, if you quadruple the energy density of a rocket's propellant by, for example, using the nuclear steam kettle rather than a chemical engine, you get a doubling of the rocket's specific impulse.

The actual figures are 450 seconds for the chemical engine and 900 seconds for the steam kettle (more formally known as a nuclear thermal rocket). If you run the numbers, you find you need half as much propellant, at most, with the nuclear rocket. (You'd probably get away with less than half because the rocket pushes not only the payload but also the propellant – and the nuclear rocket has much less propellant.)

Doubling specific impulse is not bad, but it's just the beginning. If we convert the nuclear power into electricity and then use it to accelerate an ionized propellant through an electrostatic grid, we can boost specific impulse by a factor of 10, to around 5000 seconds. Such a nuclear-electric propulsion system would be perfect for some applications, such as propelling uninhabited probes to the outer planets.

Power is money

Alas, it would be tricky to apply this kind of scheme to a large spacecraft, for example, one with a number of human occupants. For a nuclear-electric

rocket with a specific impulse of 5000 seconds to eject mass (propellant) at a rate that is high enough to push such a big ship, you'd need a huge nuclear reactor capable of generating thousands of megawatts. It might be possible to use a smaller reactor of about 100 kW, but the power would have to be dribbled out, resulting in electric propulsion burntimes lasting years. That kind of duration would probably be unacceptable for human missions.

One way around this difficulty would be to ship the reactor to a place like the moon or Mars; use the reactor's energy to convert local materials into chemical propellants; and then use those propellants in ordinary chemical engines, with their high thrust-to-weight ratios, to return to Earth. While the specific impulse of these engines would be no higher than for any other chemical rockets, the effective specific impulse of such a system, from the point of view of the overall mission, is multiplied many times. That's because only a small fraction of the propellants used would need to be launched from Earth.

To understand the economics of this concept, start with the conclusion of a decade-old report on the subject by the U.S. Department of Energy. The department estimated that it would cost about US \$500 million to produce a working first-generation space nuclear power reactor, with each additional reactor of the same design costing about \$100 million.

That's not cheap, but consider the possibilities and alternatives. On Mars, such a reactor could power an unattended chemical plant that would combine atmospheric carbon dioxide with water to produce the rocket propellants methane and oxygen. And with abundant propellants available on the Martian surface, a mission to Mars becomes much simpler to envision.

Moreover, the mission could be accomplished with today's technology. It would begin with two direct trips from Earth to Mars, each lofted by a heavy-lift vehicle in the Saturn-V class. The first would deliver an empty return spacecraft, a reactor, and the automated chemical unit that would make the propellant for the return trip. The second would deliver a habitation module containing the crew.

Cost analyses at NASA's Johnson Space Center have shown that such a live-off-the-land approach to human Mars exploration should reduce program costs nearly tenfold compared to traditional Battlestar Galactica plans based on transporting all mission consumables, including the vast load of propellant needed for a roundtrip.

Bottom line: the ability to manufacture propellants in space would pay enormous dividends. But you would have to have the power to do it.

Power is knowledge

Nuclear power is also necessary for the robotic exploration of the outer solar system. Solar energy diminishes proportionally to the square of the distance from the sun. So at Jupiter it is only 3.7 percent as strong as it is on Earth. And out there, unfortunately, is precisely where you need power the most, both to heat the spacecraft in the frigid void and to transmit data over the longer distances back to Earth.

We have long used nuclear generators on our outer-solar-system probes, including Pioneer, Voyager, Galileo, and Cassini. But these units are puny: NASA's standard radioisotope thermoelectric generator (RTG) module puts out a mere 300 W. NASA also makes extensive use on its probes of 1-W radioisotope heating units, which keep spacecraft instruments warm enough to operate.

We are going to need a lot more power – tens or hundreds of kilowatts – if we are to explore our outer solar system in an efficient and systematic way. Why? While on Earth, it has been said, knowledge is power, in the outer solar system, power is knowledge.

Data transmission rates are proportional to transmitter power, all other things being equal. A probe equipped with a 30-kW nuclear reactor would return 100 times as much data from the outer solar system as a conventional mission equipped with a standard 300-W RTG. And returning data is what a science mission is all about. Equipped with such a power supply, an outer solar system probe could use multi-kilowatt transmitters, akin to those now employed by the U.S.

Post-text tasks.

1. Find the sentences with the Infinitives and translate them.
2. Write out of the article 20 examples of word-building, translate them.

Pretext task.

Make lexical and grammatical analysis of the article below.

TRIPLE GATE DOUBLE PLAY

By the end of the decade, you may be talking to your computer, which will understand you and obey. But such features will require much more capable ICs. To this end, most of the semiconductor industry is turning toward three-dimensional, multi-gate transistor structures that can be smaller, more tightly packed on ICs, and probably faster, too, than the planar, single-gate structures of the last 25 years.

Intel Corp. is forging ahead. Robert Chau, its director of transistor research, described a transistor with three gates at the International Conference on Solid State Devices and Materials held 17–20 September in Nagoya, Japan. Intel claims that it is the first such triple-gate device and that, when fully on, its drive current is the highest reported for any nonplanar CMOS device.

The tri-gate device is a bit like the FinFET transistor, a 3-D, double-gate device. Both transistors are made by etching the top silicon layer of a silicon-on-insulator wafer to form a narrow vertical silicon fin that sticks up from the wafer surface. This fin becomes the transistor's silicon body: it is the channel through which charge carriers flow between source and drain when the device is on.

The gate is formed by depositing and patterning a polysilicon layer so that it covers the oxide-coated silicon body on top and both sides, giving it, in effect, three gates for the price of one. The FinFET, in contrast, has a gate on each side of the fin but none on top.

A key feature of the tri-gate device is that it can be fully depleted – a low voltage applied to the gate can force all majority charge carriers out of the silicon body. Full depletion significantly reduces the conduction between the source and the drain when the device is off, slashing off-state leakage current and reducing overall power consumption.

Gerald Marcyk, Intel's director of components research, told Spectrum that Intel may use the tri-gate devices in products by the end of the decade – just in time for you to talk to your computer and have it answer you back.

Pretext task.

Match the title and the content of the article.

A SECOND WIND FOR RED-LASER DVD TECHNOLOGY?

Din-ping Tsai, a physicist at the National Taiwan University (NTU) in Taipei, claims to have proved in principle that his novel adaptation of red-laser technology will make possible superdense DVDs with 100 GB of information – more than 20 times the density of the 4.7-GB red-laser disks currently on the market and four times the density of the first-generation blue-laser disks generally expected to supplant red-laser technology in a few years.

Tsai says the concept depends on exploiting near-field optical effects occurring at distances shorter than a wavelength. Near-field effects allow light to behave as if it had a much shorter wavelength, but they are extremely sensitive to minute changes in distance from the light source. Previously, attempts to use the effect focused on ways to keep the disk drive's laser very close to the disk with very high precision.

Tsai's team coats a regular DVD or CD with two extra layers: a transparent spacing medium above the recording layer and, on top of that, a "near-field active" layer in which near-field effects come into play when reading from or writing to the disk. The spacing layer finesses the problem of how to keep the light source in constant relation to the targets. The upshot is that pits as small as 100 nm in diameter can be written and read, as compared to 400 nm on today's DVDs and 900 nm on CDs.

Members of Tsai's team delivered academic papers describing the system at conferences last summer, and at the beginning of August NTU received a five-year NT \$166 million grant from Taiwan's Ministry of Economic Affairs and NT \$22.5 million from the National Science Council – US \$5.5 million in all – to pursue work on recording technologies using nano-optics and nanomagnetism. Taiwan's Ritek Corp., the world's largest maker of optical disks, has supported the team's work and currently is moving it from laboratory to factory to evaluate its potential for mass production.

Pretext tasks.

1. Find in the articles sentences with a) Infinitives and b) Complex sentences without Conjunctions. Translate them.
2. Write out adverbs and translate them.

SMILE FOR THE CELLPHONE

If you're looking for a basic cellphone, you probably won't be interested in many of the models that throw in cameras, PDAs, games – nearly everything but the kitchen sink. But if you're an early adopter or gadget lover, read on.

The T68i, from Sony Ericsson (Research Triangle Park, N.C.), one of the first offspring of the joint venture of the two consumer electronics giants, is also one of the first camera-cellphones available. It often takes better images than it can display on the phone's LCD screen, although it can instantly send those better images over the phone's e-mail service to any e-mail account that accepts attachments.

I used a T68i for several weeks last summer and was generally impressed with its colorful palette of cutting-edge features that draw on both Sony's multimedia muscle and Ericsson's GSM (global system for mobile communications) phone prowess. A wireless access protocol (WAP) Internet browser, plus multimedia messaging service (MMS) capability, as well as features associated with the optional snap-on digital camera, expand the phone's abilities beyond the routine task of simple voice calling.

Early adopters will need patience, though. Technology at the cutting edge does not always work as it should, and spotty cellphone networks outside major metropolitan areas limit, and even preclude, some services.

In my trials of the T68i, for example, I could never get AOL Instant Messenger up and running. And the tiny buttons on the phone's keypad will prove difficult for some users. On the other hand, the speech recognition abilities for voice dialing and composing short messages are impressive, and that is a help.

It's a phone...

In the United States, the hardware for GSM cellphones is here, but the networks are not yet fully ready to support it. The phone I tried out was set up for iStream, the always-on GPRS (general packet radio service) feature from T-Mobile (formerly Voice Stream, a U.S. service provider). Users of the iStream service receive news, flight schedules, stock quotes, AOL Instant Messenger, and restaurant reviews on their cellphones.

For me, connecting to the wireless service depended largely on where I happened to be. I connected nearly every time from my home about 50 km from New York City, but on a trip to St. Louis, Mo., only about two-thirds of the calls I placed there connected.

Still, the T68i is first and foremost a cellphone, and as a voice communicator it is quite admirable. For the most part, voice calls were clear and suffered from none of the echo-like effects inflicted by some cellular phones and networks.

At a svelte 100 by 46 by 20 mm and 84 grams, the phone is small and light enough to fit easily into a shirt pocket, and it also tucks comfortably in the hand. Some users, though, may find entering text and numbers difficult. It was a bit challenging for me to punch keys, despite my smallish hands (I wear a ladies medium golf glove). Tricky maneuvers requiring simultaneous presses – for entering punctuation keys for e-mail addresses, for instance – weren't easy. It would no doubt be vexing for someone with larger hands to navigate all the features.

The display of the Sony Ericsson 763 cellphone doubles as the viewfinder for the optional digital camera that snaps onto the bottom of the phone. Its shutter button is visible on the right, while its lens is hidden on the far side.

...and a camera

The optional CommuniCam digital camera snaps on to the bottom of the phone and you'll definitely want to pay US \$150 for it (the phone itself is expected to sell for about \$199 with activation). Roughly the size of a matchbox, the minicam has a single button that shoots pictures in various resolutions from 80 by 60 to 640 by 480. By design, the former yields small files for multimedia messaging. To succeed in sending an MMS, though, the recipient needs to have a phone with multimedia messaging, too. Not many people do so, instead, Sony Ericsson recommends sending pics to an e-mail account.

Pretext tasks.

1. Determine if there are some other problems in the article that are not revealed by the headline.
2. Make a list of key-words.

MICROARRAYS REVEAL GENE ACTIVITY

Decoding the human genome is just the beginning. "Next we must learn how genes are switched on and off and how they work and interact," said Claus Bertram, director of the Institute for Human Genetics, University of Heidelberg, Germany. The idea is to study the activity of genes before and after something has been done to their cells – say, a drug has been added or the cells irradiated.

The development of machines smaller and cheaper than the ones used currently in big and well-funded laboratories plays a role here. For example, at around US \$53 000, the GMS 417 arrayer from Genetic Microsystems Inc., Woburn, Mass., is within the afford-ability range of relatively small research facilities, which can devote the smaller machines to individual projects.

The arrayer relies on a DNA chip, or array, basically a glass microscope slide roughly 25 by 75 mm in area. On this slide thousands of droplets of DNA fragments can be placed. Fabricated chemically, these are short pieces of single-stranded DNA containing parts of the genes under study, – they are not in the typical double-stranded form where every base in a sequence has an opposing partner.

Extracts then made from the original "untainted" cells also contain single-stranded copies of the DNA. Rather as in sequence analysis, researchers couple fluorescent dyes to these DNA copies.

The next step is to lay the dye-marked cell extract on top of the chip. When the bases on the DNA chip and their matching bases in the cell extract make contact, they form double strands of DNA. After a rinsing process, only these double strands of fluorescent-marked DNA copies remain on the slide.

A view through a microscope reveals a fluorescent mosaic of spots, each representing a matched pair of genetic strands. Their colors indicate what bases have joined. Today no one need stare through a microscope counting spots and noting their color. Instead, a laser scanner reads the mosaic and passes the data on to a computer, whose algorithms may eventually answer a question such as which genes have been switched to a new state by a certain added drug.

Progress has been made in miniaturizing the underlying chemistry – the spots on a DNA chip and the spaces in between are 50-300 urn across. But the cost of the laser scanning equipment is steep. Hoping to both reduce costs and

improve performance, Genetic MicroSystems last year introduced a new laser-based GMS 418 Array Scanner to work with its GMS 417 Arrayer. The \$60 000 system's focused laser beam is scanned by means of an oscillating lens weighing a fraction of a gram, while a motor moves the stage holding the slide. The "flying objective" microscope can scan a 22-by-75-mm slide in about four minutes with 10-um resolution.

"This concept is extremely attractive for capturing a high-resolution image of a large field of view such as a DNA array," explained Jean Montagu, the company's chairman and president.

A more elegant way to detect the double-stranded DNA on the chip relies on direct electronic detection, under study by Rainer Hintsche at the Fraunhofer Institute for Silicon Technology, Itzehoe, Germany. Since the DNA bases are charged molecules, the electric field surrounding them changes as the cellular extract is added to the chip and as some bases move from single- to double-stranded DNA. This change can be detected by microcapacitors attached to the chip, with the magnitude of the effect depending on the base pair. The use of a laser scanner would be unnecessary.

"This procedure would really merge DNA chip technology with electronics and make a pocket-sized machine possible," noted Jorg Hoheisel, a researcher at the German Cancer Research Center, Heidelberg.

Others are also developing better and cheaper ways to prepare the single-strand DNA chips. The market leader in such chips – that is, the glass slides to which DNA is already attached – is the GeneChip from Affymetrix Inc., a Santa Clara, Calif., equipment maker that recently acquired Genetic MicroSystems. Affymetrix relies on photolithography techniques borrowed from semiconductor fabrication. Instead of putting down circuit patterns, the photosensitive technology deposits DNA strands and then defines them in tiny spots of material.

The arrayer from Genetic MicroSystems lays even smaller amounts on a DNA chip. It passes a pin down through a film of liquid that contains the fragments and is held by surface tension in an open ring. Packard Instrument Co., Meriden, Conn., has developed an ink-jet-like machine for depositing the droplets of DNA fragments. Glass capillary tubes spit out submicroliter volumes under piezoelectric control.

Post-text tasks.

1. Find the sentences containing the word “one”, determine its functions.
2. Find the sentences with Participle and Participial Constructions and translate them.

Pretext tasks.

1. Put 2 questions to each part of the article.
2. Find sentences with Passive Voice and define their tense.

THE ENVIRONMENTAL PROTECTION MANAGEMENT AND POLICIES OF SHANGHAI

a. Enforce the Establishment of Environmental Protection Institutes and Strengthen Environment Monitoring System

In 1979 the Shanghai Municipal Bureau of Environmental Protection was set up to take the responsibility of environmental protection affairs. Later on, specified environmental organizations and divisions have been established in some districts, counties, industrial bureau and plants which are responsible for heavy pollution. In this way, a three – level network of environment management was formed in which specialists from various disciplines work together to practice administration, scientific research and public education. At the same time based on the 'Environmental Protection Law of the People' s Republic of China', Shanghai has also issued the ' Temporary Measures for Preventing Environmental Pollution in Shanghai', the 'Regulations of Charges and Penalty for Discharging wastes in Shanghai' and some other regional legislations and audition actions. In the recent years, further efforts have been made to enforce environmental protection law. Nowadays, for any new construction projects, it is stipulated that environmental protection facilities be designed, constructed and put into use 'synchronously'. Otherwise the projects would not be ratified. Besides, heavy penalty charges have been legislated towards the factories which discharge industrial refuse or waste water. Actions, the sense of environmental protection could be established among the public.

b. Attract More Investment on Processing Waste Water

Industries like dying, leather processing, paper, food and chemistry, all produce huge amount of waste water. Local regulations require that these industry sectors increase their investment on waste water treatment, with an emphasis on the recovery of useful components and the recycling of water. Under supervision, 218 factories have now got the permission to discharge wastes in an acceptable way. A programme entitled "Comprehensive Studies on the Schemes Concerning the Recovery of Huang Pu River" was listed as one of the key research projects for the 1981 – 1985 development plan. Headed by the Municipal Bureau of Environmental Protection, more than one thousand of specialists from hundreds of different units joined the programme which lasted for about 4 years and cost 5 million yuan. A lot of firsthand data have been accumulated and a set of proposals been put forward. This surely has laid a found basis for the recovery of the river. In the past several years, the central government and Shanghai Municipal Government have invested several billion yuan to improve water quality, and some progresses have already been made.

c. Improve the Energy Consumption Efficiency and Introduce Central Heat Supply System in Some Areas to Ameliorate Air Quality

Shanghai is an advanced industrial city in China. In 1985 its energy consumption efficiency was 34 %, yet far behind that of western industrialized countries. To improve the energy consumption efficiency, the most important task is to innovate the large number of industrial boilers and furnaces which are widely spread. The Municipal Government require that in some factory – intensified areas, central heat supply system be introduced before the end of 1995. Now in districts like Yang Pu and Nan Shi, central heat supply is practically in use, and similar systems are under planning in other districts. In Pu Dong new area, special emphasis have been put to build central heat supply system or thermoelectrical system right at its first developing phase. It's expected that air quality in the new areas would prove to be essentially satisfactory. At the same time, factories are urged to invest more money on the innovation of their boilers and furnaces, to facilitate desulfurizing and smoke removal equipment, and to increase energy consumption efficiency. It is also under consideration that before the end of 1995, the 0.9 million family – used furnaces would be replaced, and gas supply rate be increased from the present 60 % to 80 %, and to 100 % by the end of last century.

d. Build More 'Quiet Areas' and Reduce Noise in the City

Under persistent efforts in the recent years, a number of 'quiet areas' have been built. At the same time, international cooperations on noise control are promoted to make this city a better residential one.

With the development of economic reform, especially the opening of Pu Dong new area, the Municipal Government of Shanghai now pays a lot of attention to the environmental protection issues. It is desired that a favorable condition could be achieved to attract more foreign investment.

Post-text tasks.

1. Write out of the article 20 words with suffixes and define what part of speech they are.
2. What are the four main problems Shanghai management face with.

Pretext task.

Determine core sentence of each paragraph.

AIR CLEANING EQUIPMENT

Clean air is an essential requirement for today's manufacturing industries: Not only do the factory staff demand a clean healthy working environment, but the law in the form of COSHH regulations enforces it.

Horizon International is a Bristol based manufacturer of the 'Smog-Eater' range of air cleaning equipment. The equipment is designed for applications in virtually all forms of industry e.g. mechanical engineering, electrical engineering, electronics, foundries, rubber, plastics and textile. Most industries create some form of air-pollution which has to be removed and collected.

The 'Smog-Eater' range includes mobile units which can be easily wheeled to the source of air pollution, units for free hanging to provide a general clean up of a workshop atmosphere, wall mounted units and units for inserting into ductwork systems. All units can be provided with automatic cleaning where necessary.

The 'Smog-Eater' range can filter down to particles as small as 0.01 microns in particle size with efficiencies as high as 99 %. The 'Smog-Eater' is provided with an electrostatic two stage precipitator fiber and requires periodic

cleaning, not replacement. Power consumption is extremely low and units are available for all voltages.

The model SE.44 'Smog-Eater' unit can be connected to ductwork terminating with hoods, canopies, fume extraction arms etc. Alternatively it can be suspended from roof steelwork to provide a general clean up of the workshop atmosphere.

The Horizon Filt-0-Bench can be manufactured either mobile or static and is a combined work bench with inbuilt fume and dust extraction. Standard sizes are available and purpose built units to any size can be provided. The Filt-0-Bench' incorporates a work light and a heavy duty bench top through which dust and fumes are extracted down into the extraction/filtration unit. Handling of access doors etc can be built in order to suit any site condition.

Pretext tasks.

1. Choose 5-6 sentences from each of the subsections of the following article to cover the content of them.
2. Write out of the article key-words.

MICROPROCESSOR APPLICATION: A LESS SOPHISTICATED APPROACH

There is a widespread appreciation for the impact of data processing by digital computers, which profoundly touches so many aspects of life today. The rapid development and application of the digital computer has indeed been one of the most dramatic achievements of technology. Digital methods of management and manipulation of information at very high speed with digital computer operating systems give access to solutions of problems so vast and so intricate as to have been simply inconceivable before their advent.

The unique capability of the digital computer operating system to solve complex problems in a timely way justifies the necessarily enormous expenditures for its development and its services. These high costs have largely restricted the application of computer methods to tasks which could justify the fees by efficient use of the full capability of the computer operating system.

The microprocessor offers the means to relieve this cost constraint in the use of digital methods for problems of smaller scope. It is a revolutionary tool by virtue of the fact that it incorporates the potential performance of at least the lower end of the minicomputer line and yet, as a component, it has a cost so low that its use can be justified in applications requiring only a small fraction of its capability. Moreover, while the application of complete computer systems, not to mention their design and construction, has been largely and properly left in the hands of a professional cadre of specialists, the microprocessor, intelligently used, can be an effective tool in the hands of the reasonably talented amateur.

This suggestion is not to denigrate the need for professional attentions in major computer problems. (The microprocessor has grown out of computer technology, and it reflects the complexity and sophistication of that field.) It is rather to state that the microprocessor offers, incrementally and at low cost, digital management and manipulative capability which can be understood and implemented, for simple problems, by nonspecialists. Applications in which use of the full range of even the minicomputer is contemplated are probably still served best by the engagement of professional technologists. The rare amateur who succeeds in such an application will, himself, have become an expert, at the expense of a considerable effort.

In this article I view uses of microprocessors as elements of instrument systems or to facilitate individual experiments. Of course, the instrument or experiment contemplated must succeed on its own merits; designs including microprocessors do not automatically guarantee superior performance. Indeed, because of the programmed nature of microprocessor operation, the experiment or instrument designer must exercise considerable care in planning and specification to avoid constraints that would be inconvenient in later operation.

Another Description of the Microprocessor and Its Operation

All descriptions of the microprocessor inevitably tend to illuminate its role as a potential element of a computer system. The computer role is deliberately de-emphasized here in favor of such descriptors as controller and data manager.

The microprocessor is a digital electronic device of considerable complexity in which electrical current pathways are susceptible to controlled switching. It

is designed to operate cyclically in such a way that during a cycle, data are (electrically) abstracted from one or more sources, manipulated by an arithmetic logic unit, and then distributed to one or more destinations, these steps of the cycle being under control of a prescribed control regimen called an instruction. The data are represented in this process as ordered sequences of binary statements. The binary nature of each statement, commonly called a bit, is conventionally conceptualized by word pairs such as false, true; off, on; or zero, one; and the ordered sequences are connoted as words or as (binary) numbers. The data themselves can be as diverse as definition allows.

Implicit in the utility of the data is some means for their temporary or permanent storage. Storage can be accommodated in registers, either external or internal to the microprocessor. A single register is a component possessing an ordered number of cells, each of which is capable of reflecting a binary statement in such a way that the statement can be entered or abstracted at will. The order of the cells in the register and the identity, or address, of the register itself preserve the identity of the data.

The microprocessor system, either internally or externally, is provided with several special purpose registers in addition to general purpose registers for data storage. The control regimen or instruction for each cycle of operation is impressed on a first special register, called the instruction register, in the form of an ordered sequence of binary statements — that is, an instruction word. A second special register is called the program register. This register contains a binary number which identifies the location from which an instruction, or occasionally other information, is to be drawn.

In addition to executing a cycle prescribed by the instruction word, the microprocessor system facilitates the execution of a sequence of instructions by adjusting the content of its program register, thereby calling for another instruction. Figure illustrates this operation, showing three successive cycles. The set of instructions, called the program, shown in the left-hand column of Fig. actually governs the events taking place in the microprocessor. These events, shown in the center column, include the step of adjusting the program register which points to the address of the next instruction. The complete collection of instructions for operating the microprocessor is called the program. The microprocessor cycles shown are numbered in the sequence P , $P + 1$, $P + 2$. It is quite natu-

ral to assign addresses in the program as sequential numbers as well, and to interpret the content of the program register as a multiple-digit binary number. The most usual adjustment of the program register then, is to increment this number by one. (It should be noted that an instruction may direct the microprocessor to treat the next program address as the location of a data source rather than an instruction, and another may direct the entry of a non-serial address pointer in the program register.)

In summary, the microprocessor is an example of a stored-program device; it can proceed autonomously through a sequence of operations, selecting, manipulating, and distributing data in accordance with a previously stored plan or program. It can perform its function rapidly; cycle times are typically from 1 to 20 μ sec.

Evolution of a Simple System Using a Microprocessor Well Below Its Capacity

The following paragraphs describe the incorporation of a variety of functions into an imaginary instrument by the use of a microprocessor. Actual development of a system provided with such a set of functions should be undertaken as a whole rather than by the steps that are serialized here for illustrative purposes.

Keyboard and display. The imaginary instrument will involve interaction with an operator; it will require inputs from the operator, and it will display certain responses to these inputs and its own operation. The growing popularity of keyboard entry and alphanumeric display suggests selection of this method to interface the instrument to the operator. The first function of the microprocessor, under control of a stored program, is to accept keyboard entries and to output these, and possibly other information, to a display.

The operation of a microprocessor lends itself naturally to this function. The operator's keyboard can be treated as a data source and the display as a destination. Successive access to source and destination requires control by a repeated sequence of program instruction steps. Particular requirements of the display device may necessitate the use of manipulative as well as distributive instructions.

Implementation of the keyboard-to-display function is shown diagrammatically in Fig. A word of explanation is required for the blocks in Fig. marked "memory." Memories are generally external to the microprocessors and consist of large numbers of registers or other word storage devices, each having a unique address susceptible to call from the microprocessor's program register output. The read only memory, ROM, acts exclusively as a source of instructions and data, being loaded with the proper sequence of words. The random access memory, RAM, can act both as a data destination and as a source to recall data previously deposited.

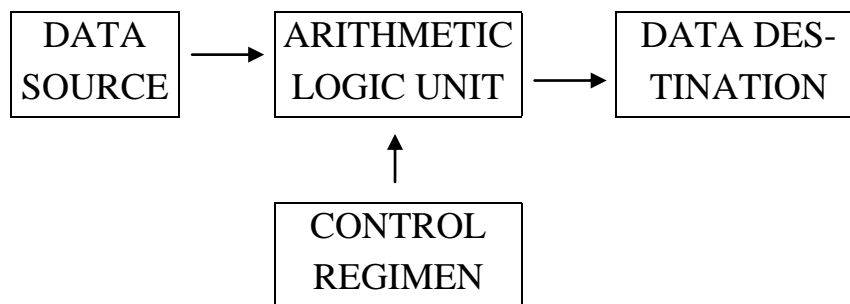


Fig. 4.1. Schematic representation of a data flow cycle in a microprocessor

Operation begins with an instruction in the ROM which directs the processor to "read" the first entry from the keyboard. When the entry is received the microprocessor must perform the equivalent of the following steps:

- 1) Retain the entry in temporary storage, for example, the RAM.
- 2) Assign a location for the entry on the display.
- 3) Retain this assignment paired with the entry itself in temporary storage.
- 4) Manipulate the entry to conform with a code appropriate to the display.
- 5) Deposit the coded entry in the assigned display location.

Many displays are volatile, and in this case the last operation must be repeated at a rate compatible with visual persistence (about 30 sec^{-1}). As the successive keyboard entries are directed to the display, each must be updated in its turn at this rate, and to accommodate this requirement the microprocessor must rapidly generate an elaborate sequence of data to deliver to the display.

Fortunately the system can be organized to do just this. One simple method is to have the microprocessor arrange data matrix in a block of the RAM

such that its addresses are in a one-to-one correspondence with locations on the display. This display "mirror" is built relatively slowly by entries from the operator's keyboard, as required, and rapidly scanned serially by the microprocessor to provide the continuous complex (but almost mindlessly repetitive) data stream required by the display.

A cathode-ray tube with a conventional television raster is a popular display device. The data stream, encoded by the microprocessor according to a stored program in the ROM, can be made to accommodate the image dissection of timing requirements of the raster. Factory encoded character generating ROMs are even available, at low cost, for this purpose, relieving the instrument designer of the chore of generating the codes.

While the function described above does not significantly tax the operating sophistication of the microprocessor and the rate of data entry from keyboard is extremely slow by microprocessor standards, the continuous update of the display screen will burden microprocessor to the point that no other functions can be accommodated. The difficulty can be relieved by augmenting the system with special purpose hardware which, standing alone, can convert the contents of the RAM display data matrix block into the data stream required by the display. This augmentation is shown schematically in Fig. 1. Access to the shared display RAM is invoked occasionally for data entry by the microprocessor and continuously by the dissected image generator for display updating. To prevent ambiguity, access to the shared RAM address is normally continuous from the dissected image generator, but is preempted by the microprocessor whenever the latter is required to enter data. This arrangement for priority of access permits completely asynchronous operation of microprocessor and display. With the hardware augmentation in the system of Fig. 2, the microprocessor is grossly underemployed, and other functions can be accommodated.

Instrument control and data acquisition. Since the function of writing to a display, by itself, is not an adequate operator-instrument interface, "the excess capacity of the microprocessor can be turned to good use in performing the additional tasks of instrument control and data acquisition. Instrument operating programs and operating parameters can be stored in the ROM, and instrument output, converted to digital words, can be read and stored in an orderly way in the RAM. The use of the keyboard and display can be merged with these tasks.

With the keyboard, the operator can access the microprocessor to select operating programs and parameters for a desired instrument cycle. Under control of the selected operating program, the microprocessor can also be directed to accept progressive and final results from the instrument, to format these results, and to enter selected results on the display.

An implementation of this more complicated operation is shown schematically in Fig. Data paths to and from the instrument and an additional RAM have been added, and the ROM must be considerably expanded to accommodate the new tasks required of the system. The utility of the system is dependent on the care and imagination exercised in the hardware and operating program design, and the burdens and benefits of microprocessor use are most sharply focused in the design process.

In terms of their hardware needs, instruments require input intermittently or continuously, and they generate outputs which must be accepted to formulate results. The inputs and outputs may cover a variety of physical quantities, not necessarily electrical in expression, and generally analog in nature. Since the microprocessor is digital and electrical, transducers are generally required to convert data to appropriate form in either direction. The transducers adjacent to the instrument are likely to be analog in character and may relate electrical levels to other physical quantities. The ones adjacent to the microprocessor accommodate analog-to-digital and digital-to-analog conversion (ADC and DAC).

Devices to accomplish a wide variety of conversions are readily available on the commercial market, specified with reasonable intelligibility. In digital parlance, the precision of a device is usually specified in bits, each bit representing a power of 2. Thus 8-bit precision represents a resolution of 1 in 2^8 or 1 in 256. Other specifications include speed of conversion, absolute accuracy, range, and so forth.

Data transfers are negotiated one word at a time. The width of the word (in bits) is determined by the data paths; the data paths into and out of most microprocessors are 8-bits wide; although other widths may exist in other parts of the system. (This constraint does not limit the precision of the data, since more than one word may be used to transfer a particular element of information if greater precision is required.)

Each of the functions to be controlled and each of the quantities to be monitored by the microprocessor must be assigned an individual address. Most microprocessors boast a number of input and output "ports" which represent the means to communicate with external devices. In addition, the addressing structure, usually designated for memory exchanges, can also be used to access a number of external registers for data communication to and from an instrument.

Equal in importance to the hardware in the use of a microprocessor in an instrument system is the organization of the operating programs. The designer must devise through these programs the means to utilize as much of the capability of the instrument as possible, to improve the efficiency of its use, and to reduce the errors and ambiguity of its results. To do this he must have a thorough understanding of the operating characteristics of the instrument and the methodology of the measurements made. Once a set of operating procedures has been established for a desired operating program, the procedures can be reduced to a chain of operating steps, each of which can be negotiated by the microprocessor under control of one or more instruction words.

The chain of operating steps can be as elaborate as the instrument requirements dictate. It can branch to alternative lines on the basis of incremental results. It can be keyed to external parameters such as real time. It can be interrupted temporarily, on demand, for the service of off-line requirements. It can sense anomalous events and return control to the operator, signaling a diagnosis of the anomaly it has acquired. The orchestration of this operation is by means of the flow of instruction words called from the stored operating program by the microprocessor. Although the reduction of the operating procedures to a set of instructions is necessarily complicated, it is negotiable, by hand, for simple problems, and writing the program can be facilitated by design and organizational aids such as flow diagrams which map the sequence of program steps.

The designer may choose in simple cases, to construct the program in the instruction code directly understood by the microprocessor. In routines of greater extent, coding aids are available which can be accessed by an accumulation of program statements in a simple formalism called assembly language. The reduction of these program statements to microprocessor code requires the use of a program assembler routine residing in a modest computer operating system.

Programming aids of even greater abstraction are available; however, their use entails access to specialists and large computer operating systems.

Most instrument operating routines are relatively simple and can be approached even at the level of microprocessor instruction codes. An example may be found in the frequently encountered case of observing a dependent variable quantity as a function of the sweep of a predetermined small interval of an independent variable, making observations at uniformly incrementing values of the independent variable. The procedure is as follows.

- 1) Begin, set initial and terminal values for independent variable in temporary registers.
- 2) Set memory (storage) pointer to the head of a one-column data matrix in the RAM.
- 3) Acquire the value for the dependent variable.
- 4) Deposit the value in the data matrix (RAM) address.
- 5) Increment data matrix address.
- 6) Increment independent variable.
- 7) Compare independent variable with its terminal value.
- 8) Exit if done; else
- 9) Loop back to step 3.

This small procedure is generally embedded in a larger routine which addresses, for example, the same measurement for a different interval of the independent variable. The larger routine itself may be embedded in a still larger program which (by keyboard selection) can access this or other routines. As long as the routines are simple, they may be individually coded with relative ease, and the collection of routines can be made accessible on selection by a supervisory portion of the program.

There is no rule other than good sense to proscribe hand coding as the problems grow larger. At some point — sometimes identified, in the end, by sheer frustration — the designer will discover that hand coding is too costly in time and effort. At that point a more formal approach, involving abstract methods of assembling microprocessor instructions with a computer operating system, will be clearly indicated.

Specialized instrument controllers. The simple instrument operating routine whose nine steps were sketched above can be viewed as an advantageous

use of a microprocessor in many cases. However, where the routine must be continuously exercised to operate the instrument, it may begin to strain the throughput capability of the microprocessor. In the interest of under-utilization, this difficulty can be relieved by the interposition of an instrument controller, which accepts broader and less frequent control commands from the microprocessor and which accumulates results in such a fashion as to allow delivery to the microprocessor with integrity of the data.

In accordance with the example mentioned the iterative part of the (independent variable) control routine can be managed by the controller with the resultant (independent variable) data being accumulated temporarily within the controller itself. Transmission of the essentials of these data can then be called for by the microprocessor after each complete cycle of the routine. With such a controller, the microprocessor is relieved with the continuous operation of the instrument and is required only to set the parameters defining the fiducial parts of the routine and to collect the relevant results.

The controller can frequently be simple as to be amenable to design with hardwired digital logic, or even with analog circuits and switches. However, the reader will recognize that the controller, with no other obligations than to carry out a repetitive cycle of operation, must itself qualify for implementation with underutilized microprocessor having own ROM and RAM. This subsidiary microprocessor can then be operated as instrument controller under the supervision of the primary microprocessor. Interconnection of the two through standard input/output data paths need not pose a difficult problem beyond the avoidance of possible timing conflicts which might lead to garbled results.

Data management and processing. With the system configured according to Fig. 3, where the primary microprocessor is underutilized in its function to respond to keyboard commands, operate the instrument, to accept instrumental results, and to load the display, there will be capacity remaining to perform the function of more elaborate management and manipulation of data. The first task for the microprocessor in this area is perhaps simply one of arranging the data in a convenient format. Other tasks depend, of course, on the requirements of the instrument, and the operations described below are mentioned only by way of example.

The microprocessor can easily be programmed to sort data by a prescribed rule; for example, to segregate maximum and minimum values. It can also generate difference tables and locate turn points. The latter operations are arithmetic and invoke the computational capability of the microprocessor. Other simple arithmetic operations might elude generation of moving averages by simple digital filtering of data.

Even more complex data processing is, of course, possible. However, elaborate data processing is difficult to program without the help of programming aids, and it is advisable to enlist the help of specialists and to review the suitability of the microprocessor (compared to a minicomputer operating system) where the application involves elaborate computations. The use of a microprocessor in complete imitation of a minicomputer operating system with major data handling peripherals is likely to be more costly and will certainly involve more labor than the use of its model. Notwithstanding this precaution, the microprocessor can be employed to remarkable advantage in systems which, superficially, appear to be very complex.

Judicious distribution of hardware assistance to the microprocessor can reduce its load, as has been shown by the examples above. In the computational area, two commonly required functions which, if relegated entirely to the microprocessor, can burden it excessively and consume inordinate amounts of time are multiplication and division. A hardware auxiliary for fast multiplication and division can be devised, either along classical calculator lines or with special purpose large-scale integration digital components. To use this auxiliary, the microprocessor simply distributes the multiplier (divisor) and multiplicand (dividend) to the auxiliary device, and then reads the product (quotient) resulting. The device can be made to operate at such a speed that there need be no hesitation in the entire process.

In the programming area, algorithms have been developed in the technology of computer application which can be borrowed for microprocessor use to speed up and simplify other operations. These are too numerous to permit a comprehensive list here; however they include such functions as extracting roots, double precision operations, floating decimal point management, arithmetic, trigonometric conversions, and exponentiation. In addition, where special functions or calibration corrections are required, they may be accessed by

simple interpolation of tabular entries introduced in blocks of the ROM or RAM.

Concluding Remarks

Since the microprocessor has been designed, by and large, to provide the principal part of the central processing unit of a computer, there has been a tendency on the part of vendors and many users to view it exclusively in that function. Good computers have been and will be constructed with microprocessors. In the paragraphs above I have tried to convey an alternative view, which perceives the microprocessor as a component having many features that can be used individually, and to a considerably lower level than its capacity would allow, without requiring the expertise of the computer architect. The very low cost of today's microprocessors and their ability to perform a variety of operations on digital data in accordance with a preconceived program can justify underutilization of their fullest capability.

No specific mention has been made of circuit details or of detailed instruction formats or algorithms in programming. Detailed data sheets are available for most of the processors offered. These give sufficient descriptions of microprocessor operating cycles, instruction sets, and other features to allow the enterprising amateur to develop useful simple systems. Successful use of the devices will often involve their augmentation in the systems with specialized hardware auxiliaries. These auxiliaries serve to reduce the complexity of the tasks required of the microprocessor itself.

A final illustration, Fig. 4, shows the advantageous application of a microprocessor to a portable mass spectrometer which was designed and constructed by an amateur oriented to the approach suggested in this article. The microprocessor used was a first-generation device with a relatively slow duty cycle, and the system could not have been operated without the several auxiliaries shown. The system accommodated several modes of operation based principally on the monitoring of a number of selected mass peaks and displaying a processed evolution of their amplitudes in the form of moving average values. Included in the program were an automatic self-calibration routine and one to allow sequential scans of the entire mass range of the instrument. The stored program occupied 1792 words of ROM, and 1024 words of RAM were pro-

vided, primarily to accommodate variable program and a data matrix for raw and processed data.

Most of the reference material for microprocessors as devices is in the form of product release descriptions and manufacturers' data sheets. A useful summary list of current offerings of manufacturers may be found in one of the electronic trade journals.

The decision to undertake the design and construction of a nontrivial system using a microprocessor is a commitment to a major effort and should be contemplated with a good deal of circumspection. However, if the system is reasonably confined in scope, the essay can be rewarding and fun.

Post-text tasks.

1. Find in the article Infinitive and translate them.
2. Find 15–20 chain of Nouns and translate them.

Pretext tasks.

1. Find the sentences containing non-finite forms of the verb. Translate them.
2. Find 10 examples of Passive and 10 examples of chain of Nouns and translate them.

NEW TECHNOLOGY IMPROVES NITROGEN-REMOVAL ECONOMICS

A new method of removing nitrogen from natural gas makes production of limited gas accumulations more economical.

Developed by Engelhard Corp., the process can reduce nitrogen levels to the 4% typically required by pipelines, while keeping methane at high pressure. It is economical at 2-50 MMscfd flow rates. A demonstration unit began operating in Colorado last year.

The Gas Technology Institute estimates that nitrogen contaminates 1–6 % of US natural gas reserves, and its removal substantially raises natural gas processing costs. Nitrogen levels greater than 4 % generally must be removed before gas may enter a pipeline system; therefore, costs and operating require-

ments can be prohibitive for small-to-mid-size production facilities that use traditional removal methods.

Nitrogen-removal processes using liquid solvents, adsorption, and cryogenic processing are currently available, but all of these methods require recompression of the methane product, which penalizes their economics. Many wells are shut in rather than brought into production because the cost of removing nitrogen for smaller facilities cannot be justified.

A new nitrogen-separation system from Engelhard Corp. overcomes this problem largely because it removes the contaminant at feed pressures. The new technology, called "Molecular Gate," can reduce nitrogen levels from about 30 % to the 4 % typically required by pipelines.

Unique adsorbent

The Molecular Gate technology traps nitrogen in a unique adsorbent material while letting methane flow through at high pressure.

Unlike traditional adsorbents, the material can be custom-designed to produce a pore size targeted at size-selective separations.

This is not possible with traditional molecular sieves whose crystal structures have nonadjustable fixed pore openings. These openings permit the adsorption of molecules through surface attraction. The sieves are used commonly in gas processing for gas dehydration and include pore sizes of 3 Å, 4 Å, 5 Å, and 10 Å, among others.

In some separations, molecular sieves take advantage of their fixed pore openings to exclude large molecules from the crystalline structure while permitting the entrance and adsorption of smaller molecules (e.g., dehydration of natural gas).

Traditional sieves will not separate methane from nitrogen, however, the sizes of these two molecules do fall on either side of the available pore sizes.

The Molecular Gate adsorbent for nitrogen separation of natural gas is a titanium silicate designed with a 3.7-Å size. Because nitrogen has a smaller molecular diameter (3.6 Å) than methane (3.8 Å), nitrogen can enter the pore and remove while methane passes through the fixed bed of adsorbent at essentially the same pressure as the feed.

Pressure swing adsorption

The new technology is based on the ability of the adsorbent to load a higher amount of a target molecule at high pressures and release that material at low pressures. This process, known as pressure swing adsorption, is used widely in f gas separation in the oil refining, petrochemical, and air separation industries purifying hydrogen, recovering reactant from vent streams, and producing enriched oxygen or nitrogen.

Molecular Gate Technology

This principle is applied in a cyclic pressure, during which nitrogen is removed and pipeline-quality product produced. Afterwards, stepwise depressurization and purging removes the adsorbed nitrogen.

In other words, when the adsorbent is saturated, the system depressurizes, and an enriched nitrogen off-gas stream is removed from the steam.

The swing between the high adsorption pressure, regeneration at low pressure, and repressurization is completed in rapid cycles that last only a few minutes, minimizing the adsorbent needed.

Maximizing recovery

Effective upgrading of natural gas requires a high recovery of methane and other hydrocarbons. Some methane losses with the rejected nitrogen are unavoidable in the PSA process, although the cycle design and recycle to the feed of a methane-rich stream minimize losses from the system.

Molecular Gate technology maximizes methane recovery at lower feed temperatures – typically 80–100° F. This is because nitrogen is weakly adsorbed. Lower temperatures tend to increase its loading, reducing the adsorbent required.

The lower temperature does not reduce nitrogen-methane selectivity because methane does not enter the adsorbent's pores.

The typical pressure range for the system is 100–800 psia, with an optimum 250–600 psia operating pressure. Operations at pressures greater than 300 psia with a feed of 10 % nitrogen and a 4 % pipeline specification result in a 95 % recovery rate.

Because the Molecular Gate system adsorbs the nitrogen, it works most economically at lower nitrogen concentrations. Typical nitrogen concentrations

for the system are less than 20%, although higher levels also can be treated. In general, the level of nitrogen in the feed and the pipeline specification for allowable inerts are the most important criteria impacting the methane-recovery rate.

The process incorporates a unique thermal stripping step into the PSA cycle, wherein each adsorber vessel undergoes a thermal regeneration step once each day. This effectively increases the workable capacity of the adsorbent and also allows removal of heavy components that could block pores and decrease capacity.

In the thermal stripping step, a gas-fired heater heats a portion of the product methane to about 300° F. This gas passes through an off-line adsorber vessel and heats and purges the adsorber bed. The heater is relatively small (about 150,000 btu/MMscfd of feed gas). After the bed is heated, recycling a portion of the nitrogen-rich tail gas at low pressure cools it.

Feed impurities

Carbon dioxide (CO₂) is a small molecule, about 3.3 Å in size, that can fit within the pore structure of the Molecular Gate adsorbent. Because it is adsorbed more strongly than nitrogen, CO₂ is removed by a system designed for nitrogen removal. Several percent of CO₂ in the gas can be treated and removed.

In traditional nitrogen rejection units (NRU), an amine solvent removes CO₂ to very low levels. Amine systems, widely used in industry for acid gas removal, require significant operator attention and represent added capital costs for the system as well as operating cost for solvent make-up, power, and heating and cooling requirements. The overall process is simplified by eliminating the amine system.

But an amine system would be placed in front of the Molecular Gate system to remove hydrogen sulfide (H₂S) from gas streams containing that impurity. This placement removes the H₂S at its highest partial pressure.

In feeds with both H₂S and CO₂, an amine solvent selective to H₂S should be used. This approach allows most CO₂ (about two thirds) to pass through the amine solvent system and into the Molecular Gate unit where it is removed by the adsorbent. In this approach, the amine system produces a rich H₂S stream with minimal CO₂ dilution.

The system can also remove oxygen at the same removal rate as nitrogen. Oxygen removal reduces safety or corrosion concerns for the downstream systems.

Pilot tests

The Molecular Gate system for nitrogen-methane separation has been optimized in several pilot plants using simulated feed compositions. Pilot-plant performance parameters were mapped and the process cycles refined.

Adsorbent life studies, starting in 1998, have used a small-scale, cyclic life-test unit. This unit has two independent adsorbent beds, one of 1-in. diameter and the second of 3-in. diameter. The unit processes glycol-dehydrated well-head gas with 45 % nitrogen from the Petrolia field in Texas.

The data from the unit have been consistent. Regularly conducted performance tests and offline evaluation of the adsorbent's crystal structure indicate no change.

In other services, PSA systems commonly operate for many years, indeed sometimes decades, without adsorbent deactivation. There is no reason, therefore, to believe this adsorbent will behave any differently.

In the field

Since August 2000, a Molecular Gate demonstration system has been upgrading natural gas at Tom Brown Inc.'s Hamilton Creek natural gas production facility in Colorado.

The gas, which contains 15–18 % nitrogen at the wellhead, is reduced to 3–5 % nitrogen in order to meet local pipeline specifications.

The product purity can be set by the operator. After upgrading, the gas enters a local pipeline.

The feed source is from several wells and varies with the wells in operation. To handle these variations, the unit cycle time or feed rate is slightly adjusted.

The flow rate and feed-product purities can be used to adjust operating parameters to maintain product inert specifications while maximizing production rates.

The unit at Hamilton Creek includes an up-front, three-bed, heavy hydrocarbon-recovery system that adsorbs the small quantity of C₄+ in the feed.

The operator purges the unit with product methane from the nitrogen-rejection section that reintroduces the C_4+ back into the methane product, recovering the heating value of the heavy components. In most lean feeds, such a heavy hydrocarbon recovery system is not required or is not economical.

The main Molecular Gate system is a nine-bed cycle. Peripheral equipment includes a vacuum blower, recycle compressor to maximize recovery rate, electric heater, and nitrogen cooling recirculation equipment. All the equipment for this system is mounted on a single skid measuring 8 by 25 ft. An adjacent trailer houses the control system for the operation.

The pumper responsible for overseeing the wells at Hamilton Creek also is responsible for the operation and of the Molecular Gate system. During normal daily visit to the wells, he reviews a checklist on the operation of the system, which generally takes less than 1 hr. This daily visit is all that is needed for normal operation.

The Hamilton Creek unit also has equipment for remote monitoring and operation of the Molecular Gate system. A remote CRT can be linked via modem to the control system and transmit the same information to the operator's office available at the site.

Design, operation

All Molecular Gate systems are of complex design and are shop fabricated. Appropriate feed sources for nitrogen-rejection applications include well-head gas, nature after NGL recovery, associated gas, down gas from expired oil wells, coal-seam gas.

Skid-mounting reduces installation costs; it typically results in installation costs being less than 10 % of the equipment costs.

Operating costs are low because system can run unattended, a major advantage over traditional methods of nitrogen removal that require a 1 degree of operator attention. The system can be automatically adjusted to the changes of feed rate highly.

Although the separation of nitrogen and methane for natural gas is the advanced application of Molecular technology, the range of possible separations is substantial.

Other potential applications include H_2S enrichment (CO_2 at 3.4 Å fro at 3.6 Å) and air separation.

Post-text task. Put 20 questions to cover the content of the article.

Pretext tasks.

1. Find in the article key-words and phases that are symantically connected to each other.
2. Analyse Modal verbs and “should” “would”

DIABETIC RETINOPATHY: NEW WAYS TO PREVENT BLINDNESS

One of the more severe problems encountered by individuals who have had diabetes for a long time is degradation of vision resulting from diabetic retinopathy. This problem, which was rare 30 years ago, is becoming progressively more common as improved therapies for diabetes prolong the lives of diabetics. New results from several studies, however, suggest not only that it may be possible to retard the progression of visual impairment with currently available therapies, but also that it might be possible to prevent – or at least delay the onset of – the condition through rigorous control of diabetes.

Retinopathy is a widespread problem. It is observed in about half of those individuals who have had diabetes for 10 years, three-fourths of those who have had it for 15 years, and more than 95 percent of those who have had it for 25 years. Although not all those who have diabetic retinopathy suffer visual impairment, the disease is the leading cause of new cases of blindness in the United States among persons between the ages of 20 and 65. Some 48,000 individuals in this country are legally blind as the result of it.

Retinopathy results from the diabetes-induced deterioration of tiny blood vessels in the eye. Similar deterioration of blood vessels occurs throughout the body and causes disorders of the kidney and other organs. The cause of this deterioration is unknown. In the eye, small vessels become leaky and occluded and, occasionally, new vessels form on the retina. In the more severe form of the disease, known as proliferative retinopathy, new blood vessels grow on the surface of the retina and protrude into the vitreous, the normally clear, jellylike fluid in the center of the eye. Eventually, these vessels rupture and hemorrhage into

the vitreous. And finally, fibrous scar tissue forms in association with the new vessels. This tissue may pull on the retina and detach it from the back of the eye. Proliferative retinopathy occurs in only about 3 to 4 percent of diabetics, but even so this comes to about 300,000 people in the United States who are susceptible to blindness from it.

Diabetic retinopathy is difficult to study in the laboratory because there are very few animal models for it, and these are not entirely satisfactory. One model of proliferative retinopathy similar to that caused by diabetes has been developed by Arnall Patz and Chung-Ho Chen of the Johns Hopkins School of Medicine. They observed that growth of blood vessels (vascularization) in the retina occurs naturally in puppies during their first 4 weeks after birth. If the puppies are exposed to an atmosphere of 85 percent oxygen for a 4-day period during this time, the peripheral vessels in the eye are destroyed, and new vessel formation begins at the border of the obliterated vessels after the dogs are removed to air.

Chen has found that the total amount of protein dissolved in the vitreous is closely related to the rate of vascularization in normal development, with the protein concentration declining to barely detectable amounts as vascularization nears completion. The new vascularization after exposure to oxygen is preceded by a sharp increase in the concentration of protein in the vitreous. Patz and Chen thus speculate that one or more of these proteins may be responsible for the new growth.

This speculation is supported by other experiments in which Patz, and his colleagues at Johns Hopkins, Daniel Fin-klestein and Steven Brem, implanted small malignant tumors in the vitreous. Such tumors have been shown by F. Judah Folkman and his associates at the Harvard Medical School to release a protein, named tumor angiogenesis factor or TAF, that stimulates the growth of new blood vessels toward the tumor. TAF may be similar to the protein observed in the vitreous of newborn and oxygen-treated puppies. When introduced into the eye, TAF produces retinal vessel proliferation.

The tumors thus provide another model for proliferative retinopathy. They also make it possible to study agents that may inhibit the process. Folkman has found, for example, that a substance extracted from cartilage inhibits TAF. Patz and his associates speculate that this or a similar inhibitor might block retinal

vascularization. It might thus be possible, sometime in the future, to find ways to stimulate the activity of such a natural inhibitor or to develop synthetic agents that could block the growth of new vessels in the eye.

Another animal model has been developed by Albert E. Renold and his associates at the Institute of Clinical Biochemistry of the University of Geneva. They render a special strain of rats diabetic with streptozotocin, an antibiotic that destroys insulin-secreting cells in the pancreas. They then observe that most of the rats that survive for as long as 9 months without insulin therapy exhibit many characteristics of retinopathy. They further find that they can isolate the retina and, by studying it under a microscope, quantitate many of the physical changes and correlate them with biochemical changes.

One of their major findings is a marked decrease in the number of mural cells that line the exterior of blood vessels. They observe a strong correlation between the extent of loss of mural cells and the concentrations of insulin and glucose in the blood and the volume of urine. This loss of mural cells could produce structural weakening of small blood vessels and lead to their rupture. Such a loss of cells was observed in only about half of a group of rats that were diabetic only 5 months, indicating that the loss is time-related.

Renold has also conducted nutrition studies in which he observed that the loss of mural cells and of endothelial cells (which form the interior of the vessels) was the greatest in diabetic rats fed diets high in either proteins or carbohydrates, but substantially lower in rats fed diets high in fats. Further studies of these effects are in progress.

The importance of diet and the control of metabolic symptoms in the development of diabetic retinopathy is particularly apparent in studies conducted by Ronald L. Engerman and James Blood-worth of the University of Wisconsin Medical School. They studied dogs made diabetic with another chemical, alloxan, and found that the dogs consistently developed, within 5 years, retinal lesions similar to those in humans. They then studied two groups of diabetic dogs. One group was given insulin in a conventional manner; nearly all of them died. The second group was meticulously treated with insulin and a restricted diet to control their symptoms. The urines of these animals were sugar-free from 25 to 50 percent of the time, whereas those of the first group were never sugar-free.

After 5 years, Engerman and Blood-worth found, the dogs on the controlled diet had a sharply reduced number of lesions of the eye, indicating that control of diabetes could retard the onset of retinopathy. The number of dogs involved in the study was rather small, though, and the effect needs to be studied in larger groups of animals and in humans. If the results are confirmed, Engerman says, it will then be necessary to find better ways to control the concentration of sugar in the blood. One approach might be the use of artificial pancreases or transplantation of either pancreases or islets.

There were no therapies available for proliferative diabetic retinopathy until about 1960. Around that time, Gerd Meyer-Schwickerath of the University of Essen in West Germany developed the concept of using intense light generated by a xenon arc lamp to fuse and destroy new capillaries in or on the retina, thereby preventing them from hemorrhaging. A few years later, Francis L'Esterance, Jr., of Columbia University, Christian Zweng and Hunter Little of the Retinal Group Eye Clinic in Palo Alto, and Patz began using an argon laser for the same purpose. By 1970, many individual scientists believed that photocoagulation was an effective therapy, but there was no conclusive evidence to prove it.

When the National Eye Institute was formed in 1970, one of its first goals was to determine the effectiveness of photocoagulation. A large scale clinical trial was planned and, under the leadership of Matthew D. Davis of the University of Wisconsin Medical School and Genell Knatterud of the University of Maryland at Baltimore, 1727 patients with diabetic retinopathy were enrolled in the study at 16 medical centers. To be eligible for the study, a patient had to have either proliferative retinopathy in one eye or severe nonproliferative retinopathy in both eyes, but still have retained a visual acuity of at least 20/100 in both eyes.

One eye from each patient was randomly chosen for treatment. This allowed each patient to serve as his own control and maximized the probability that useful vision would be retained in one eye. The patients were treated randomly with either the xenon arc or the argon laser. All new blood vessels that were not on the optic disk (the surface of the optic nerve) were destroyed; furthermore, areas of the eye away from the optic disk were treated in a checkerboard pattern on the theory that destruction of partially dead tissues might impede the release of substances that promote growth of new vessels.

The study is not scheduled to be completed until 1979, but the preliminary results have been so promising that they were released in April. Among some 470 patients who were studied for at least 2 years after photocoagulation, only 6.4 percent of the treated eyes were found to go blind, whereas 16.3 percent of the untreated eyes did. The therapy was most effective in patients with any two of the following three conditions: new vessels on the optic disk, hemorrhaging into the vitreous, and substantial growth of new vessels. Photocoagulation produced little improvement in patients who did not have at least two of these symptoms. Arc and laser treatments were equally effective in preventing blindness, but therapy with the xenon arc produced a somewhat greater loss of peripheral vision.

The initial results from the study have already been distributed to all ophthalmologists in the country. The second eyes of patients in the study are also now being considered for treatment in those cases where they meet the criteria suggesting therapy will be effective. Davis warns, however, that photocoagulation is not a panacea for diabetic retinopathy. It treats only the symptoms of the disease and not the disease itself. New vessels can thus grow in the eye after the therapy, although many of these can be destroyed by further treatments. It thus appears that photocoagulation is primarily a stopgap treatment that may only retard the onset of blindness, providing the diabetic with a few more years of useful vision.

Photocoagulation is of little value when vision is already severely impaired, and is not possible when the vitreous is severely clouded by hemorrhaging because light cannot pass through it. In some cases, it may be possible to restore vision by removing the opaque fluid – an operation known as vitrectomy. Robert Machemer of the University of Miami has developed a small instrument (Fig. 1) that cuts away blood vessels in the vitreous, removes the clouded fluid, and replaces it with a clear saline solution. This technique has shown great promise, and the National Eye Institute is now enrolling patients in a trial that will test vitrectomy in much the same fashion that photocoagulation was tested.

The optimum time for performing a vitrectomy has not yet been determined. It is possible, for example, that allowing a hemorrhage to persist for a long time might accelerate the growth of fibrous tissues on the retina and thus irreversibly damage the eye. It is equally possible, however, that the disease

process in the eye might run its course within a year or so after the onset of severe visual impairment, so that the vessels and hemorrhage could be removed without fear of their return. Because it is not known which hypothesis is correct, patients in the study will be divided into two groups. One group will be treated as soon as possible after the development of severe visual impairment; treatment of the second group will be delayed for 12 months. Results from this study will probably not be available for at least 2 years.

Vitrectomy may also be a stopgap solution, since it also treats only symptoms. It is thus becoming increasingly clear that more work must be done to provide a better understanding of the mechanism by which diabetes impairs microvascular circulation throughout the body and of the basic cause of diabetes.

Post-text task. Put a question to each paragraph of the article.

Pretext tasks.

1. Find chain of Nouns and translate them.
2. Find sentences with “that” and pay attention to their different functions.

ADVANCED STORAGE BATTERIES: PROGRESS, BUT NOT ELECTRIFYING

Advanced secondary or storage batteries have the potential, as one jokester put it, to meet demands for electricity that fluctuate hourly and seasonally. Such batteries are also needed to power electric vehicles having a range and acceleration acceptable to the public. At present, advanced batteries that perform adequately and are cost-effective do not exist for these tasks. A symposium on advanced battery research held at the Argonne National Laboratory (ANL) near Chicago in March provided an opportunity to assess the effect of the recent infusion of R & D dollars (see box) as substantial, but widespread availability of such batteries is still many years away. And, while batteries that operate at high temperatures continue to receive the most attention, researchers are increasingly turning to less exotic solutions for near-term batteries.

Instead of relying on older, inefficient steam turbines for load leveling during daylight hours and on gas turbines that require a high-grade petroleum fuel for

peak shaving at times of very high demand, utilities would like to make up the deficit between the power generated by base load plants that operate continuously and the instantaneous demand for power by storing electricity generated when not needed for later use. Load leveling usually refers to providing power ten or more hours a day, whereas peak shaving refers to satisfying short-term demands, such as those arising from the use of air conditioners on a summer day.

If the use of electric vehicles became widespread in the United States by the end of the century, estimated Albert Landgrebe of the Energy Research and Development Administration, a savings of up to 25 percent of imported oil could be effected. Electric vehicles would also play a load leveling role for utilities insofar as electricity for their use was generated at night. Acceptance of electric vehicles, however, requires the advent of energy storage devices that can propel a car at a cost and with a performance approximating that of the internal combustion engine.

Storage batteries, as an old and proved technology, have been the dominant avenue of investigation for energy storage for both utilities and vehicles. But the traditional lead-acid battery used for starting, lighting, and ignition of automobiles, trucks, and buses has not been up to the task of utility load leveling because it cannot sustain the deep discharge-charge cycles required, and heavy duty batteries that could function in this way have been too expensive. In vehicles, the large weight of lead-acid batteries prevents enough batteries being carried to provide a range greater than about 50 miles.

In recent years, researchers have looked to electrochemical cells that operate at temperatures well above ambient (principally lithium-sulfur and sodium-sulfur couples) to meet both cost and performance goals for utility load leveling (and more recently peak shaving) and electric vehicle propulsion. Although there were efforts in the United Kingdom and in the former Soviet Union, research on lithium-sulfur cells were centered in the United States. But major sodium-sulfur cell programs are under way in the United Kingdom, France, Germany, and Japan, as well as here in the United States. Moreover, there is relatively little interest anywhere in Europe in batteries for utility load leveling, apparently because there is an abundance of sites for pumped hydroelectric storage and the Europeans feel that cost goals would be hard to meet.

Pretext tasks.

1. Determine if the headline of the article discloses its problem.
2. Write out of the article key-words (terms) and translate them.

A GOAL OF \$20 PER KILOWATT-HOUR

Researchers in the United States believe that storage batteries with a specific energy of 220 watt-hours per kilogram (1 watt-hour is equal to 3600 joules), a lifetime of 5 years (one charge-discharge cycle per day), and a cost of \$20 per kilowatt-hour could compete economically with gas turbines at recent oil prices or with pumped hydroelectric storage for load leveling and peak shaving.

In automobiles, achieving this goal for specific energy would enable a driving range comparable to that of gasoline-powered cars, and a specific power of 220 watts per kilogram would allow a comparable acceleration. To compete with internal combustion engines, batteries for vehicle propulsion could cost somewhat more than \$20 per kilowatt-hour and must have a lifetime of 3 years, according to Elton Cairns of the General Motors Research Laboratories.

The initial enthusiasm for the high-temperature batteries was based in part on a quantity called the theoretical specific energy, which is calculated from the free energy of the reaction between anode and cathode materials and the weight of the reactants. In practice, battery designers feel that, if the battery achieves 20 to 30 percent of the theoretical specific energy, they have done about as well as they can because all of the components of a battery other than the reactants in the electrodes add weight without contributing any energy.

For example, the electrodes are composite entities consisting of a reactant and a current collector. A metal or carbon current collector is needed to support the reactants which are often in the form of a liquid or other nonrigid body. The current collector also connects the electrodes to the terminals of the battery. In order to make the cell as compact as possible, the electrodes are placed quite close together, so that a separator material that allows ions in the electrolyte to pass through but prevents the electrodes from short circuiting is needed. If the cell is hermetically sealed, feedthroughs and seals are required, and if it operates at a high temperature, insulation is needed.

For electrochemical cells with a lithium anode and a sulfur cathode, the theoretical specific energy is 2600 watt-hours per kilogram. Even 10 percent of this would exceed the required performance, whereas the entire 200 watt-hours per kilogram theoretically extractable from lead-acid cells would still fall short.

Lithium-sulfur cells operate at temperatures between 400° and 450°C so that the electrolyte, a eutectic mixture of lithium chloride and potassium chloride, is molten and hence has a high ionic conductivity. Researchers soon discovered that the liquid sulfur from the cathode was dissolving in the electrolyte, but it was some time before they overcame this instability by using a solid iron sulfide compound (either FeS_2 or FeS) as the cathode. Now generally known as a lithium-metal sulfide cell, these cells suffer from theoretical specific energies reduced by factors of 2 and 3, respectively.

Liquid lithium anodes have likewise been subject to degradation due to loss of lithium, a problem which scientists solved by using solid lithium-aluminum alloys for the negative electrode, but at the cost of another factor of 2 in the specific energy.

William Walsh of ANL, which has the largest lithium-metal sulfide program in the United States, summarized the current status of these cells as produced in that laboratory. Up from about 30 watt-hours per kilogram 3 years ago, engineering scale cells with a capacity of 130 ampere-hours and 200 watt-hours which have specific energies up to 155 watt-hours per kilogram are now being tested by ANL scientists. Similarly, researchers there have achieved an enhancement of a factor of 10 over the 1974 lifetime in cells with lower specific energies that have run for 5000 hours and are still going. Unfortunately, specific energy and lifetime tend to be inversely related.

According to Paul Nelson and Richard Ivins of ANL, much of the present effort there is in cooperating with commercial battery manufacturers to develop engineering prototype cells, which researchers hope will be ready to test on vehicles in about 2 years.

A number of substantial problems remain to be solved, however, which involve finding inexpensive, readily available materials that can function in the highly corrosive environment found in high-temperature lithium-metal sulfide cells. For example, the favored separator material is boron nitride in the form of a thin cloth that costs in the neighborhood of \$500 per kilogram to make.

As a result, it now costs about \$2000 per kilowatt-hour to make experimental lithium-metal sulfide cells of the new design. High-volume production could drop the cost to \$30 per kilowatt-hour, according to Walsh.

While large-scale production will have the largest effect on the final cost, technical innovations could also be important. Researchers at Atomics International division of Rockwell International, Canoga Park, California, are enthusiastic about the use of lithium-silicon (Li_4Si) anodes, which could raise the specific energy by 50 percent.

Research in the United States on sodium-sulfur cells is at a slightly lower funding level than that on lithium-metal sulfide. But, internationally, research on the sodium-sulfur system receives about twice as much financial support as research on lithium-metal sulfide.

At 750 watt-hours per kilogram, the theoretical specific energy for sodium-sulfur is comparable to that of lithium-metal sulfide. In most sodium-sulfur cells, a solid electrolyte made from a ceramic called beta-alumina ($\text{Na}_2\text{O} \cdot 11\text{Al}_2\text{O}_3$) is used. The ceramic requires an operating temperature between 300° and 400°C in order to increase the sodium ion conductivity of the electrolyte to a useful level.

Sodium-sulfur systems have at least two advantages over lithium-metal sulfide. First, there is no question as to the availability of materials, whereas the availability of lithium has recently been questioned. Second, the solid electrolyte permits a simpler cell design because it also serves as a separator and as a container for one of the liquid electrodes (usually the sodium) and because it prevents self-discharge of the cell.

Post-text tasks

1. Find sentences with “that”, translate them paying attention to its different function.
2. Find 10 examples of: a) Passive Voice; b) Chain of Nouns. Translate them.

LOOK THROUGH RUSSIAN AND UKRAINIAN ARTICLES. MAKE UP ABSTRACTS TO THEM IN ENGLISH

«ПРИШЕЛЬЦЫ» ИЗ ГАЛАКТИКИ

Астрономам нашего коллектива удалось прийти к научно обоснованному заключению, что кометы, астероиды и метеоры – «малые тела», движущиеся в космическом пространстве с необычно высокими скоростями, – являются результатом так называемой эруптивной, то есть взрывной, активности многочисленных планет и их спутников, обращающихся вокруг Солнца. Удалось даже подсчитать общее количество вещества, выброшенного с поверхности планет и их спутников, – в граммах оно выражается цифрой десять с 29 нулями. Был определен сложный механизм этих выбросов, зависящих от особенностей движения спутников вокруг планет и от периодов их активности. Выяснилось также, что в процессе распада комет из Солнечной системы должны обязательно уходить газы, метеорные частицы, а также другие продукты извержений с поверхности так называемых протопланет – первичных сгустков материи. При этом полезно вспомнить, что в Солнечной системе этот процесс продолжался не менее четырех миллиардов лет.

Подсчеты показали, что *масса* планет, то есть количество их вещества, значительно превышала существующую сейчас. Это навело на следующую мысль: Солнечная система за миллиарды лет своего существования уже выбросила в межзвездное пространство огромное количество вещества. Значит, и многие звезды нашей Галактики могли, «поставлять» свое вещество в космос. Их «пыль» могла пересекать границы сферы воздействия Солнца и, постепенно приобретая всё большую скорость под влиянием его притяжения, мчаться дальше.

Киевские астрономы обнаружили в документах, где описывались траектории метеоров, неожиданные сведения. Оказывается, скорость движения «межзвездных» частиц вдвое-втрое выше, чем обычных, находящихся в пределах нашей Солнечной системы.

Примечательна судьба этих «пылинок»: войдя в границы «сферы влияния» Солнца, они ускоряют свое движение – вступает в действие при-

тяжение нашего светила, и тогда на Земле фиксируются эти огромные скорости межзвездных частиц.

В киевском каталоге «гиперболических» метеоров (многие из них пришли из области созвездия Орион) отражаются и давние наблюдения астрономов, и данные последних лет. Так была подтверждена прямая материальная связь между Солнечной системой и далекими звездными мирами.

Этот результат заинтересовал также харьковских астрономов, возглавляемых профессором Б. Кашеевым. Проведенные здесь наблюдения принесли любопытную информацию. Из 80 тысяч зарегистрированных учеными метеоров около 800 оказались «сверхбыстрыми» межзвездными частицами. «Гиперболические» метеоры – замечательное открытие советских астрономов. Оно не только продолжает дальнейшее изучение эволюции планетных тел, но и является очередным, весьма своеобразным «окном» в мир звезд и их невидимых планет. Через это «окно» мы и получаем сведения о развитии важнейших процессов в межзвездной среде.

Каталог межзвездных «пришельцев» подсказывает насущную необходимость более тщательной и систематизированной организации радиолокационных и фотографических наблюдений как редких, спорадических метеоров, так и их потоков. Ведь не исключена возможность, что некоторая доля «гиперболических» метеоров имеет прямое отношение к межзвездным источникам.

Каждая поступающая из просторов Галактики информация не только способствует расширению наших знаний о Вселенной вообще. Она также раскрывает подробности жизни систем звезд и их планет, находящихся в состоянии взрывной активности. Несомненно, что эти сведения могут оказаться полезными при изучении особенностей образования планет Солнечной системы.

К ОБЩЕСТВУ БЕЗ ОТХОДОВ

Огромная гора из ПЭТФ-бутылок. Откуда взялись все эти бутылки? Захваченные круговоротом крупномасштабного производства, потребления и выбрасывания мусора, мы однажды очнулись и обнаружили, что по-

следние мусорные свалки будут заполнены уже через 10 лет. Скоро Япония окажется покрытой слоем мусора, который некуда будет девать.

Японцы только начинают понимать, что необходимо предпринять какие-то меры для того, чтобы приостановить увеличение объемов отходов и установить контроль за стихийным ростом мусора.

Гора пластиковых бутылок была собрана на заводе по утилизации ПЭТФ-бутылок в префектуре Тотиги. Промышленные потребители пластиковых бутылок заключили с организациями договоры на утилизацию более пяти тонн таких бутылок ежедневно. Согласно Закону о стимулировании сортированного сбора мусора и утилизации тары и упаковочных материалов, в Японии в ближайшее время будут введены в строй ещё три завода.

Вопросы, которые ещё предстоит разрешить.

Однако остаётся ещё много нерешённых вопросов, причём, почти все из них гораздо сложнее тех, что были решены до сих пор.

Несмотря на немалые успехи ЭП, этому явлению всего 2 года. Подавляющая часть потребительских товаров длительного пользования, находящихся на стадиях распределения и потребления, была выпущена раньше. В этом смысле компании помимо усилий, направленных на разработку ЭП, должны параллельно разрабатывать технологии более эффективного и менее губительного для окружающей среды демонтажа и повторного использования моделей прошлых лет даже в том случае, если это будет малорентабельно.

Следующим вопросом, также остро стоящим на повестке дня, является наличие отходов, которые невозможно переработать надлежащим образом. Сюда относятся такие изделия, как холодильники, в которых фреон используется в качестве охлаждающего или изолирующего материала, содержащие вредные вещества дисплеи на электронно-лучевых трубках для персональных компьютеров, полупроводниковые платы и другие изделия, которые нельзя использовать в том виде, в каком они есть.

Технология повторного использования холодильников включает очередное ручное удаление фреона из всех охлаждающих трубок. Более того, в дополнение к компаниям, специализирующимся на обезвреживании

отходов с содержанием фреона в пузырьках воздуха в изоляционном материале, изучается возможность использования уже существующих, полностью герметичных производственных помещений, что позволит выйти на этот рынок некоторым фирмам, занимающимся этим производством.

Главная проблема заключается в том, что отходы промышленного производства составляют более 88 % всех отходов. Несмотря на то, что ежегодный уровень рециркуляции промышленных отходов равняется 39 % и значительно превышает 8 % для общебытовых отходов (данные на 1993 финансовый год), суммарное количество промышленных отходов превышает это значение настолько больше, что эти две цифры просто бессмысленно сравнивать. Такие отходы являются основным источником загрязнения окружающей среды. Повторяющиеся случаи нелегального отвала промышленных отходов привели в некоторых районах к необратимым процессам в окружающей среде.

Вслед за новым законом о бытовых отходах, который должен скоро вступить в силу, следующим на повестке дня станет вопрос о быстром введении аналогичной системы. Такая система должна будет определить стадии удаления отходов и их последующей обработки, а также определить надлежащий подход к вопросам повторного использования и окончательной утилизации отходов.

ЗАМИРАЮЩИЙ ФОТОН

Нашумевшие эксперименты по замедлению света открывают новые возможности для создания квантового компьютера.

В середине января в мировых СМИ прокатилась волна публикаций, посвященных очередной громкой научной сенсации: двум независимым группам физиков, работавшим в США, удалось полностью остановить в специальной среде луч света. Многие издания, находясь под впечатлением от эффектного словосочетания «остановленный свет», пустились во все тяжкие, сливая в одном флаконе всевозможные научно-фантастические концепции вроде скорой остановки времени и полной ревизии теории относительности.

Между тем, если попытаться разобраться в существе вопроса, воздерживаясь от ненужных эмоций, в итоге получается пока не так уж много: безусловно, достигнутые в США результаты являются большим успехом современной науки, однако, во-первых, они вовсе не сотрясают ее основы, оставляя нетронутым аксиоматический фундамент нынешней физики, а во-вторых, это можно считать, хотя и наиболее громким, но лишь одним из ряда достижений в стремительно развивающейся научной области – нелинейной оптике.

Семнадцать метров в секунду

По словам профессора из Техаса A&M University (College Station, штат Техас) и ведущего научного сотрудника Института прикладной физики (Нижний Новгород) Ольги Кочаровской, одного из крупнейших специалистов в области нелинейной оптики, бум, связанный с использованием специальных газовых сред для изменения привычных свойств света, начался в самом конце 80-х годов, когда с интервалом в месяц в научной литературе появились сразу три публикации, посвященные этому перспективному направлению современной физики. Интерес, проявленный учеными к новой сфере, оказался велик: только за последние пять лет в различных специализированных изданиях было опубликовано более 250 статей на данную тематику.

Первым практическим доказательством эффективности теоретических моделей, активно разрабатывавшихся различными группами ученых на протяжении последнего десятилетия, стали эксперименты датчанки Лин Хау и ее сотрудников (Rowland Institute for Science и Harvard University, Cambridge, Massachusetts), проведенные в начале 1999 года, в ходе которых удалось замедлить скорость световой волны (около трехсот тысяч километров в секунду для вакуума) в натриевом газе более чем на шесть порядков – до 17 метров в секунду. Для этого физики предварительно охлаждали натрий, помещенный в электромагнитное поле, до сверхнизкой температуры одной пятидесятимиллионной градуса по Кельвину (т.е. практически до абсолютного нуля, до $-273,15$ градуса по Цельсию). При этих условиях вещество превращается в так называемый конденсат Бозе–Эйнштейна.

В этом конденсате импульсы «замороженных» атомов стремятся к нулю, что приводит, согласно знаменитому соотношению неопределенностей Гейзенберга, к «размазыванию» их точного местоположения. В результате атомы как бы **перекрываются** со своими соседями, образуя «суператом» с одной, общей для всех частиц волновой функцией. Одно из важнейших свойств таких «суператомов» – их способность быть прозрачными для световых лучей строго определенных длин волн. Используя оригинальную методику обработки конденсата двумя последовательными лазерными пучками, группа Лин Хау получила на выходе световой луч, обладающий такой необычайно медленной скоростью.

Ускорение света

Следующим важным этапом в серии экспериментов по демонстрации необычных свойств света стали прошлогодние опыты Лицзюнь Вана (NEC Research Institute) в Принстоне. По утверждениям американского ученого китайского происхождения, используя схожие методики (лазерный луч пропускаться сквозь наполненную парами цезия камеру), его группа добилась обратного эффекта: колоссального превышения скорости света в вакууме – по данным экспериментаторов, более чем в триста раз! Особенность опыта Вана заключалась в том, что при этом как бы нарушался незыблемый закон причинно-следственной связи – «стороннему наблюдателю» (если, конечно, здесь применим данный термин) могло показаться, что световой луч покидает пределы «газовой камеры» раньше, чем он туда попадает.

Впрочем, помимо того, что «фокус Вана» был воспринят мировым научным сообществом с изрядной долей скептицизма (многие специалисты утверждали, что китайцу не удалось представить весомые доказательства), возможная интерпретация эксперимента тоже далеко не столь однозначна, как этого, быть может, хотелось некоторым любителям «жареных» научных фактов. Дело в том, что световой луч, проходящий через среду, имеет две разные скорости: фазовую (скорость отдельных световых волн, составляющих луч) и групповую (скорость луча как единого целого). И с точки зрения современной физики, нет ничего невозможного в том, что от-

дельные световые волны в луче действительно могут иметь скорость, превышающую скорость света в вакууме.

Квантовый компьютер все ближе

Не прошло и полугода с момента публикации результатов экспериментов Вана по «ускорению» скорости света, как общественность взбудоражило известие о доведении до логического конца опытов по его торможению. Результаты в экспериментах по доведению групповой скорости светового луча практически до нуля параллельно были получены в двух американских лабораториях Гарварда – в Rowland Institute под руководством неугомонной Лин Хау и ведущего местного специалиста профессора Стэнфордского университета Стивена Харриса и в Harvard-Smithsonian Centre for Astrophysics (ведущие сотрудники – американец Рон Уолсворт и 32-летний выпускник МФТИ Михаил Лукин). Группа Лин Хау применяла уже описанную выше методику пропускания светового луча через сверххолодный натриевый газ, тогда как Уолсворт и Лукин использовали в своих экспериментах другую среду – пары рубидия, которые не охлаждались, согласно электронной версии их статьи (она будет опубликована в этот понедельник в *Physical Review Letters*), а нагревались до температуры 70–90 °С в сильном электромагнитном поле. Впрочем, говорить о реальной «остановке света» в ходе этих экспериментов не совсем корректно. По словам Ольги Кочаровской, исходный световой пучок все-таки поглощается атомами (хотя и не в традиционном смысле этого слова), но в среде остается информация о луче, записанная в атомных спинах. «Наиболее интересным и действительно пионерским с научной точки зрения результатом данных экспериментов следует считать именно то, что ученым впервые удалось сохранить информацию, содержащуюся в световом луче, сначала «записав» ее в атомах среды, а затем высвободив эту информацию с помощью нового светового импульса для ее последующей передачи», – утверждает г-жа Кочаровская. До сих пор все попытки добиться сохранения информации, переносимой фотонами, не приводили к желаемому результату. Новаторская методика Уолсворта–Лукина позволила наконец разрешить эту проблему. Световая информация, сохраняющаяся в виде коллективных спиновых состояний атомов среды, в значительно меньшей степени под-

вержена воздействию разрушительных эффектов, чем в случае «традиционной» записи на энергетических уровнях (подробнее см. «Эксперт», № 17 за прошлый год). «Мы надеемся, что в дальнейшем эта техника может быть использована для сохранения и передачи фотонных квантовых состояний, что сделает реальным практическое осуществление проектов по квантовым коммуникациям и созданию квантовых компьютеров», — считает Михаил Лукин.

«Последние эксперименты в Гарварде достаточно убедительно показали осуществимость задачи захвата, хранения и последующего высвобождения волновых возбуждений, переносимых световыми пучками, — подтверждает мнение Михаила Лукина Ольга Кочаровская. На данный момент можно с большой степенью вероятности утверждать, что благодаря своей относительной простоте и универсальности предложенная методика хранения световой информации станет базовой как для дальнейших исследований в нелинейной оптике, так и в столь популярных в последнее время разработках, связанных с проектированием квантовых компьютеров. Впрочем, по моему мнению, говорить о большом технологическом прорыве пока рановато: специфика среды и целый ряд иных моментов накладывают существенные ограничения на прикладное использование данной методики».

ПРОЩАЙ, ГОМО САПИЕНС! ЗДРАВСТВУЙ, СУПЕРЧЕЛОВЕК?

Рассуждая о перспективах человечества, большинство абсолютно не представляет, что ожидает нас в будущем. А прогноз неутешителен — гомо сапиенсу осталось существовать максимум столетие. Затем появится совершенно иной биологический вид, условно его можно назвать суперчеловеком. Такой вывод на основе статистических данных сделал академик Российской народной академии наук, ведущий эксперт ассоциации «Экология непознанного» Юрий Фомин.

Дело в том, что существует ряд фактов, свидетельствующих о неизбежной гибели нашей цивилизации. С одной стороны, это надвигающиеся демографический и энергетический кризисы, с другой — появление все большего числа людей, обладающих неординарными способностями.

Одним из основных статистических показателей является прирост населения, то есть соотношение новорожденных и умерших на тысячу человек. Начиная с 60-х годов нашего столетия во всем мире наблюдается резкое сокращение рождаемости. И сегодня в России на каждую 1000 человек умирает на 6,1 больше, чем рождается. Но если эту цифру можно списать на счет нестабильности ситуации в России, то как объяснить, что в благополучной Германии этот показатель –1,3?

Бичом современности можно назвать бесплодие. Как правило, бесплодию более подвержены жители крупных городов. В этом нет ничего удивительного: еще опыты на животных показали, что при увеличении плотности популяции (то есть количества особей на единицу площади) самки перестают плодоносить. Примерно то же происходит и у людей. А в мегаполисах, где плотность населения достигает 15 тысяч человек на квадратный километр, проживает примерно половина человечества.

Вторая причина – колоссальное количество химических веществ, попадающих в наш организм. Это и консерванты, содержащиеся в большинстве продуктов, и применение удобрений, и результаты деятельности вредных производств.

Например, в Японии использование нового удобрения, ускоряющего рост растений, привело к абсолютному бесплодию мужчин, живущих в этой местности.

Однако помимо химического заражения существует еще одна опасность: мы живем среди электромагнитных излучений. Когда в 20-е годы в Москве на здании Дома союзов была сооружена одна из первых радиостанций, то в близлежащих районах даже в сильные морозы на крышах таял снег, в квартирах тускло светились выключенные из сети люстры. А в США, например, введена норма, запрещающая строительство зданий в радиусе 150 м от линии электропередачи.

Но, пожалуй, наибольшие изменения произойдут с самим человеком. Без сомнения, на данный момент он является высшим звеном эволюции, правда, отнюдь не последним. Сегодня уже можно спрогнозировать, что же это будет за биологический вид, который придет на смену гомо сапиенсу.

Во-первых, его мозг будет работать несколько иначе. Дело в том, что, получая информацию привычными для нас способами – зрительно или

на слух, мы используем возможности мозга лишь на два процента. С другой стороны, в повседневной жизни человеку необходим все больший объем информации. Это обуславливает неоправданно завышенные сроки обучения (зачастую они достигают 15–20 лет!). И тем не менее, большинство имеет очень узкую специализацию.

Все это позволяет предположить, что скоро будет использоваться совершенно иной способ обмена информацией – телепатический. Он имеет два неоспоримых преимущества: исчезновение языкового барьера и неограниченная дальность передачи. Фактически каждый человек станет абонентом единого информационного пространства. Проще говоря, он будет пользоваться опытом и знаниями всех живущих, а возможно, и умерших людей. Естественно, что общество, где каждый способен «читать» мысли, не может иметь привычные нам государственные и социальные структуры.

Кстати, примерно таким образом происходит «общение» у животных. Это было известно и людям, но в традиционных условиях жизни не может быть приемлемо. Однако сейчас появляется все больше людей со сверхспособностями.

Вероятнее всего, «суперчеловек» будет обладать более развитыми органами чувств. Весьма вероятно также возможность восприятия различных излучений. Появление множества новых вирусов, например СПИДа, позволяет предположить, что человек должен обладать повышенной иммуностойкостью. Может быть, одним из путей приобретения этого качества станет именно СПИД, так как те, кто перенесет это заболевание и останется жив, приобретут стойкий иммунитет.

Но существует еще один любопытный аспект. Чем выше уровень технического прогресса, тем больше человек зависит от него. Представьте, что произойдет, если Москву хотя бы на сутки оставить без электроэнергии. В городе не будет света, горячей воды, тепла, остановится большинство предприятий. Фактически это настоящая катастрофа. Единственная сфера, где человек сохраняет автономию, это его мозг. Пока еще извне нельзя узнать, о чем он думает, что знает, к чему стремится. Эти два обстоятельства определяют наши жизненные устои.

Суперчеловек в силу своих способностей теряет автономность мышления. Но вместе с этим значительно снижается его зависимость от других.

Имея доступ в любой момент к необходимым ему знаниям, он сам сможет делать то, для чего мы обращаемся к специалистам.

Как скоро на смену нам придет суперчеловек, сказать сложно. Но, по мнению Юрия Фомина, XXI век станет последним столетием цивилизации гомо сапиенс.

ЧИСТЫЕ ВЕЩЕСТВА

Трудно сейчас назвать крупную научно-техническую проблему, решение которой не было бы связано с использованием материалов особой чистоты.

Для обеспечения все возрастающих энергетических потребностей человечества необходимо развитие ядерной энергетики. Она нуждается не только в чистом ядерном горючем, но и в чистых материалах, гарантирующих эффективную защиту от радиации. Проблема освоения космического пространства немыслима без жаропрочных сплавов и покрытий на основе металлов высокой чистоты.

С чистыми веществами каждый из нас встречается повседневно. Они находятся в радиоприемниках: транзисторы – это германий высокой чистоты. Они в электрических лампочках: только из достаточно чистого вольфрама можно изготовить нить накала. Чистые вещества нужны для производства пластмасс и лекарств.

Что такое чистота вещества

Очисткой веществ человек занимается с незапамятных времен. Известно, что еще в далекой древности воду для питья очищали фильтрованием, при помощи овечьего руна отделяли золото от пустой породы.

Опыт очистки, накопленный в практических ремеслах, впоследствии развили алхимики, много занимавшиеся процессами дистилляции, возгонки, кристаллизации.

Разработанные способы «очищать и разрешать» вещества сделали возможным открытие новых элементов и определение истинного состава ряда веществ. Необычайно плодотворной в этом отношении была первая половина XIX столетия: за это время было выделено и изучено 27 ранее

неизвестных химических элементов. Установление законов химии с их вершиной – периодическим законом – также было обусловлено чистотой объектов исследования и чувствительностью приборов и методов.

В начале нашего столетия чистыми считались вещества, содержание примесей в которых оценивалось десятыми долями процента. А сегодня вполне осуществима очистка вещества до такой степени, чтобы примеси составляли не более стомиллионной доли процента. И есть все основания считать, что в ближайшее время потребуются вещества еще более глубокой очистки: каждая новая отрасль техники в своем развитии повышает требования к чистоте материалов.

Можно ли получить абсолютно чистое вещество? Под этим термином подразумевают химически и физически однородное простое тело или химическое соединение, состоящее из одного определенного вида атомов (ионов) или молекул и обладающее только ему присущим комплексом постоянных свойств.

В реальных условиях абсолютно чистых веществ нет и не может быть. Абсолютная чистота в химии недостижима, подобно абсолютному нулю температуры в физике. Мы можем приближаться к ней, но на пути к ее достижению встречаемся с принципиальными трудностями.

Дело в том, что очистка производится с помощью той или иной химической реакции. А скорость любой реакции пропорциональна концентрации вещества. По мере снижения концентрации примесных атомов уменьшается и скорость их удаления. Отсюда следует, что удаление «последних» следов примесей и достижение их нулевой концентрации теоретически потребуют бесконечного времени.

Другая особенность глубокой очистки связана с сохранением достигнутой чистоты. Не существует такого идеально инертного вещества, атомы которого не участвовали бы в процессах абсорбционного, диффузионного или химического взаимодействия. Эти процессы неизбежно протекают на поверхности образца, приготовленного из очищенного вещества. Соприкосновение с воздухом, влагой, оболочкой, в которой вещество находится, наконец, проникновение космических лучей – все это приводит к изменению его состава.

Поэтому сохранить высокую чистоту часто бывает даже труднее, чем ее достигнуть.

С точки зрения аналитической химии особо чистым веществом считается такое, в котором тем или иным методом современной экспериментальной техники не обнаруживаются примеси. А это значит, что те вещества, что вчера считались особо чистыми, сегодня могут уже не соответствовать этому определению.

В технике вещество считают достаточно чистым, если оно не содержит примесей такого рода и в таких количествах, которые препятствуют использованию этого вещества для данной конкретной цели. Отсюда возникли и названия чистот – вещества реакторной чистоты, полупроводниковой чистоты и пр.

До сих пор речь шла о химической чистоте, характеризующей степень загрязненности вещества чужеродными частицами. Не менее важное значение имеет и чистота физическая.

Даже очищенное от химических примесей вещество может быть загрязнено своими же атомами, такими же по химическим свойствам, но отличающимися от основных лишь своей массой – изотопами. Содержание изотопов во многих производствах не вызывает интереса. Но в отдельных случаях необходимость изотопической чистоты выдвигает особые требования к методам разделения и очистки. Так, для получения тяжелой воды, содержащей изотоп водорода – дейтерий, создана особая технология производства.

Для твердых веществ особое значение имеет строение кристаллической решетки. Алмаз и графит, состоящие из одинаковых атомов углерода, белое и серое олово различаются лишь структурами кристаллов, но с точки зрения физиков, эти различия делают их разными веществами. И действительно, алмаз с примесью графита никак нельзя считать чистым, а примесь серого олова в белом изменяет его свойства.

Нарушения или искажения кристаллической решетки способны вызывать такие же изменения, какие возникают от присутствия примесей. Здесь химическая и физическая чистота тесно связаны между собой: появление примесных атомов провоцирует структурные дефекты в кристалле, а нарушение кристаллической решетки облегчает проникновение примеси.

Даже весьма чистый в химическом отношении металл бывает иногда непригоден, если он состоит из множества кристаллических зерен, пронизан микротрещинами и порами. В таких случаях предпочтительны монокристаллы – образцы с единой для всего их объема кристаллической решеткой.

Для изготовления материалов высокой чистоты обычно используются многоступенчатые процессы с последовательным применением химических и физических методов. Сложность их настолько велика, что, по мнению одного из видных ученых в этой области, академика Н.П. Сажина, «есть все основания считать настоящим научным подвигом разработку технологических методов получения веществ с содержанием примесей менее миллионных долей процента».

Чистота и свойства вещества

Свои истинные свойства вещество может проявлять только в предельно чистом виде. С появлением примеси мы наблюдаем, как говорят специалисты, уже «кооперативные свойства ансамблей атомов».

Еще в начале века английский химик Бейкер обнаружил поразительное явление: различные вещества после очень длительного обезвоживания (в продолжение 8–9 лет) показали резкое повышение температуры кипения. У бензола она повысилась на 26° , у четыреххлористого углерода – на 34° , у брома – на 55° , у этилового спирта – на 60° , у ртути – на 62° . Коренным образом изменяются и химические свойства обезвоженных веществ: окись углерода не горит больше в кислороде, водород перестает реагировать с хлором, смесь кислорода с водородом, которую за бурную реакцию соединения обычно называют гремучим газом, больше не взрывается. Все эти вещества после удаления следов воды теряют свою химическую активность.

Вот какова степень влияния примесей на свойства веществ!

Хром, тантал, молибден, цирконий, титан, вольфрам имели репутацию хрупких металлов, не поддающихся механической обработке. Лишь после того как содержание примесей удалось снизить до стотысячной доли процента, они предстали в новом качестве – пластичных и мягких металлов. Хром, например, не уступает своей пластичностью ковкому железу. А

10 г тугоплавкого вольфрама, нагретого до 500–700 °С, можно вытянуть в тонкую нить длиной четыре километра. Долгое время для хрома не была известна точная температура плавления – в зависимости от чистоты она изменялась от 1513 до 1920 °С. Высокой чистоты хром плавится при 189 °С, но и это значение нельзя считать окончательным.

Железо высшей чистоты (10^{-4} % примесей) теряет способность растворять кислород и другие газы, становится химически инертным. Если столь чистое железо легировать определенными металлами, оно способно выдерживать нагрузку до 600 кг/мм² вместо обычных 17–21.

Алюминий – второй после железа металл по объему потребления – с повышением чистоты изменяет практически все свои свойства. Способностью отражать свет он почти не уступает серебру, притом в отличие от серебра он не темнеет под действием некоторых газов (например, сероводорода). Поэтому им покрывают поверхности технических зеркал, прожекторов, рефлекторов. Чаша самого большого на нашей планете телескопа, установленного в этом году на Северном Кавказе, покрыта тончайшим слоем чистого алюминия. Чистый алюминий не окисляет витамины в пище: им покрывают изнутри кухонную алюминиевую посуду. Но значительнее всего возрастает коррозионная устойчивость алюминия – в 10–25 раз по мере повышения чистоты. Вот почему львиная доля выпускаемого чистого алюминия идет на защитные антикоррозионные покрытия самолетов, судов, на изготовление аппаратуры для химической и пищевой промышленности, на нужды многих других областей народного хозяйства.

Всегда ли чистота – благо?

Во всех приведенных примерах с повышением чистоты материалы как бы освобождаются от недостатков и обретают более полезные и ценные свойства. Но чистота не всегда благо.

Вводимые в чистые вещества дозированные добавки примесей могут вести себя как истинные «друзья», выявляя лучшие черты и свойства материалов. Это относится в первую очередь к полупроводникам. Ничтожно «малая примесь может привести к значительному повышению их электропроводности. Полупроводники, в которых проводимость создана предна-

меренно внесенными примесями, широко используются для изготовления диодов и триодов.

Иногда чрезмерная чистота может принести не пользу, а вред. Для примера вспомним широко известные фотографические материалы. Все они содержат слой желатины с зернами светочувствительного вещества – бромида серебра. Но, как это ни покажется парадоксальным, совершенно чистый бромид серебра был бы вообще лишен чувствительности к свету. Центрами светочувствительности в зернах бромида серебра служат дефекты кристаллической решетки. Успехи производства органических полимеров во многом обязаны повышению чистоты исходных веществ – мономеров. Химикам известно двоякое влияние примесей на синтез органических полимеров. В одних случаях примеси могут затормозить рост полимерной молекулы. Так было, например, с давно известным процессом полимеризации формальдегида. Попытки наращивать молекулярную массу до необходимой величины оставались безуспешными до тех пор, пока мономер содержал следы воды и метилового спирта. Лишь очистив от них мономер, удалось получить полиформальдегид – одну из самых прочных пластмасс.

В других случаях, наоборот, примесные частицы инициируют полимеризацию. И даже если они несколько ухудшают качество полимера, их все же сознательно вносят – без них не обойтись.

Теперь судите сами, чем же являются примеси – врагами или друзьями.

Где нужна чистота

Материалы высокой чистоты еще недавно изготавливались в очень небольших количествах в научных лабораториях для исследовательских целей. В последние два-три десятилетия потребность в них резко увеличилась. Для развития новых отраслей современной техники нужны значительные количества различных веществ особой чистоты.

Атомная энергетика одной из первых предъявила невиданные до тех пор требования к чистоте металлов. Ей понадобились материалы с общим содержанием примесей не более 0,03–0,04 %. Прежде всего речь шла об уране – ядерном горючем. Элементов, обильно захватывающих тепловые нейтроны (гафний, бор, кадмий и некоторые другие), в уране не должно быть больше 10^{-3} – 10^{-4} %.

Не менее высокие требования предъявляются к чистоте конструкционных материалов, непосредственно не участвующих в ядерной реакции. Цирконий, используемый для изготовления внутренних деталей реактора, обладает ковкостью и механической прочностью только при весьма «малом» содержании примесей. В присутствии кислорода (0,7 %) он утрачивает эти свойства, а примесь азота (0,01 %) лишает металл его коррозионной стойкости. Но и тщательно очищенный цирконий был вначале забракован для работы в реакторе на том основании, что слишком активно захватывал нейтроны. Только высокочувствительными методами анализа было доказано, что повинен в этом не сам цирконий, а его неизменный спутник в природе – гафний, трудно отделимый от него из-за почти полной идентичности свойств. Цирконий реакторной чистоты не должен содержать более 0,01 % гафния.

Развитие реактивной авиации и ракетной техники потребовало использования целого ряда цветных и редких металлов, обладающих комплексом свойств: жаропрочностью (механической прочностью при высоких температурах), жаростойкостью (устойчивостью к окислению при высоких температурах) и пластичностью. Только благодаря глубокой очистке удалось получить пластичные, тугоплавкие и жаростойкие металлы и сплавы на их основе. Особенно вредными примесями в этом случае оказались кислород, азот, водород и углерод. Примеси других элементов (мышьяка, олова, свинца и висмута) могут присутствовать в количествах не более 1 г/т или 10 т жаропрочного металла.

В материалах еще более высокой степени чистоты нуждается промышленность полупроводников. Для производства полупроводниковых приборов требуются, кроме химических элементов особой чистоты, интерметаллические соединения, сульфиды, окислы, селениды и множество других сложных соединений. И в каждом из компонентов содержание контролируемых примесей должно составлять не более 10^{-6} – 10^{-8} %.

Насколько техническое применение полупроводниковых материалов зависит от их чистоты, можно проследить на примере германия. Открытый в 1866 году, он более полувека причислялся к металлам, так как при той степени очистки был хорошим проводником электричества.

В производстве чистых металлов и полупроводников большую роль играют вспомогательные материалы (графит, кварц), газы (водород, аргон, гелий), вода и химические реактивы. Чтобы не внести в обрабатываемые материалы примесных частиц, все они должны обладать соответствующей степенью чистоты. Поэтому предварительной глубокой очистке необходимо подвергнуть и их. В свою очередь, эти процессы очистки могут быть осуществлены при помощи других чистых веществ. Создается цепочка производств чистых веществ, где с повышением чистоты одного материала эта же задача сразу встает перед смежными производствами.

Основным рабочим элементом в современных лазерах служат как монокристаллы (искусственный рубин, фтористый барий, флюорит, двуокись титана и др.), так и жидкости и газы. Общее требование ко всем этим веществам – высокая степень чистоты. Допустимое содержание примесей лежит в пределах 10^{-8} – 10^{-9} процента: это один атом примеси на 1–10 млрд атомов основного материала.

Но и это далеко не предел возможной чистоты. Очевидно, в ближайшем будущем микроэлектроника будет нуждаться в материалах, содержащих не более 10^{-10} – 10^{-12} % примесей.

Самое чистое вещество на нашей планете – германий чистотой 10^{-12} – 10^{-13} % – стали получать в начале 70-х годов для приборов, регистрирующих излучения малых энергий. В столь чистом германии один атом примесей приходится на несколько триллионов атомов германия.

В материалах глубокой очистки заинтересованы не только отрасли новой техники. Например, примеси в лекарствах могут ослабить их лечебную функцию и даже стать причиной токсического действия. Примером могут служить антибиотики: они утрачивают свое лечебное действие в присутствии следов цинка.

Можно считать, что стремление к производству чистых материалов характерно для всех без исключения отраслей науки и народного хозяйства, оно выражает общую тенденцию повышения культуры производства.

Методы очистки

Для получения веществ высокой чистоты разрабатываются и используются сложные многоступенчатые технологические схемы. Выбор мето-

дов очистки определяется как свойствами самого вещества, так и требованиями к его чистоте. Методы очистки металлов делятся на три группы: электрохимические, химико-металлургические и физические, включающие в себя кристаллофизические.

Электрохимические методы. В процессе электролиза водных растворов или расплавов с анодов в электролит переходят очищаемый металл и примеси. В определенном режиме процесса на катоде выделяется лишь очищаемый металл и в некоторых случаях – незначительные количества примесей. Так рафинируют бериллий, галлий, торий, тантал, цирконий, алюминий, медь и т. д.

Химико-металлургические методы, применяемые для очистки многих металлов, включают все способы, использующие химическое взаимодействие примесей или самого очищаемого металла с вводимым реагентом. Это в основном удаление примесей в виде малорастворимых соединений или с образованием летучих соединений очищаемого металла. В последнем случае говорят о транспортных химических реакциях. Они обеспечивают перенос очищаемого металла в виде газообразного соединения в другую зону аппарата, где в условиях иных температур и давлений оно разлагается с выделением металла высокой чистоты. Так очищают титан, цирконий, алюминий, кремний и т.д.

Многие физические методы рафинирования основаны на различной растворимости очищаемого вещества (например, растворимого соединения металла) и примесей в тех или иных жидкостях. Один из таких методов – жидкостная экстракция, когда растворенное вещество избирательно извлекается из одного жидкого растворителя с помощью другого, не смешивающегося с первым, в котором при этом остаются и примеси. Так получают чистые хлориды железа, кобальта, никеля, сурьмы, золота, платины, меди, германия.

Дистилляцией (или перегонкой) можно разделить раствор или расплав на его компоненты, характеризующиеся разными значениями давления паров. Наиболее производительно можно отделить примеси ректификацией. На ректификационных установках возможно разделение смеси компонентов, температуры кипения которых различаются лишь на 0,05 °С. Принцип ректификации несложен: когда пары разделяемой жидкости про-

никают через ее слои на тарелках, то менее летучий компонент конденсируется, отдавая скрытую теплоту испарения более летучей, которая испаряется и конденсируется затем на расположенных выше тарелках. Так разделяют соединения циркония и гафния, тантала и ниобия и т.д.

Вакуумной *сепарацией* (или разгонкой) очищают магний от алюминия, кремния, тяжелых и тугоплавких металлов. Этим методом пользуются также для удаления легких металлов из губчатых титана и циркония. Примеси в вакууме возгоняются, освобождая очищаемый металл.

Кристаллофизические методы основаны на различии в составе твердой и жидкой фаз при кристаллизации металла из расплава. Примеси при этом остаются в расплаве. Так удастся снизить их содержание до 10^{-8} – 10^{-9} %. Эти методы важны при очистке полупроводниковых материалов и, прежде всего, германия и кремния, а также многих металлов – железа, алюминия и т.д.

Классы чистоты

До недавнего времени наиболее чистыми веществами считались химические реактивы, используемые для научных исследований и при химических анализах. В таких реактивах содержание основного вещества выражали обычно в процентах, остальное были примеси. По степени чистоты различают реактивы трех квалификаций: чистые, чистые для анализа и химически чистые. С повышением требований к чистоте материалов содержание примесей стали выражать десятичными долями процента – промилле, затем – в «частях на миллион» и равновеликим ей показателем «грамм на тонну». Затем стали пользоваться числом «частей на миллиард», или «миллиграммов на тонну». Сейчас техника очистки близка к применению следующего показателя чистоты – «части на триллион».

В Советском Союзе с 1965 года введена новая классификация особо чистых веществ, выражаемая «числом девяток». Чистые вещества разделяют на три класса, и каждый из них, в свою очередь, делится на два – четыре подкласса. В таблице на цветной вкладке цифры, стоящие за буквенным обозначением класса чистоты, соответствуют числу девяток после запятой в содержании основного компонента (или количеству нулей в числе, определяющем сумму анализируемых примесей).

В научный обиход вошел еще «балл чистоты». Он выражается десятичным логарифмом числа атомов основного вещества, приходящихся на один атом примеси. Например, выражение «чистота 4» означает, что один примесный атом приходится на десять тысяч атомов основного компонента ($\lg 10^4 = 4$).

ГЕНОМНАЯ ГОЛОВОЛОМКА

Ученые дали первичную расшифровку генома человека. Человек оказался довольно простым объектом, и в нем очень много хлама.

В середине февраля две конкурирующие команды биологов опубликовали в ведущих научных изданиях мира – в американском Science и британском Nature – пространные статьи, в которых предложили интерпретации строения человеческого генома.

Авторы шестидесятидвухстраничной статьи в Nature – ведущие специалисты международного консорциума академических центров – Human Genome Project. Работа по проекту началась еще в 1990 году, финансировали его на «паях» американское правительство (через сеть Национальных институтов здоровья) и лондонский Wellcome Trust. «Альтернативная» сорокавосемистраничная публикация в Science – результат творческих изысканий ученых, работающих на Celera Genomics, одну из крупнейших частных компаний на биотехнологическом рынке США. Этот проект по определению последовательности человеческого генома был «запущен» намного позже – в 1997 году.

Битва за «генетический» урожай

Руководители двух независимых проектов сообщили об одновременном завершении работы по «секвенированию генома» (иначе говоря, по установлению последовательностей нуклеотидов ДНК, образующих человеческий геном) еще в июне прошлого года. Сразу же после этого, на специально организованной 26 июня в Белом доме встрече президент Celera Genomics Крэйг Вентер и глава консорциума Human Genome Project Фрэнсис Коллинз подписали «временный пакт о ненападении». Обе конкури-

рующие структуры обязались, во-первых, соблюдать по отношению друг к другу максимальную «политкорректность» (воздерживаться от взаимных нападков, от информационных войн), а во-вторых, по завершении отдельных работ над версиями генома представить научной общественности совместную публикацию.

Если первую часть «джентльменского соглашения» (информационный нейтралитет) стороны до недавних пор в целом соблюдали, то до совместной публикации дело так и не дошло: научно-финансовые амбиции руководителей двух проектов не позволили им прийти к компромиссу. Более «упрямым» оказался, как ни странно, госконсорциум, представители которого на завершающей стадии подготовки материалов к публикации выставили коллегам из Celera Genomics целый ряд явно дискриминационных требований.

Притихшая на время «интеллектуальная перестрелка» после февральских статей в Science и Nature вспыхнула с новой силой: каждая из конфликтующих сторон обвиняет другую в неточностях и недоработках и, разумеется, пытается доказать, что именно ее версия генома – «более полная, более точная» и «содержит меньше ошибок». На сайте Celera Genomics представлена прихотливая подборка цитат из СМИ, общий смысл которых сводится, ни много ни мало, к тому, что эта компания сегодня может считаться «таким же стандартом в биотехнологическом секторе, каким является Microsoft на рынке программного обеспечения».

Новые старые знания

Наблюдаешь со стороны за этими «генетическими сражениями» и невольно возникает вопрос: а не слишком ли много шума поднято вокруг данного события? В целом складывается впечатление, что ни той, ни другой команде, по большому счету, пока похвастаться нечем.

Безусловно, учеными была проделана титаническая работа, вызывают большое уважение рекордные темпы осуществления «сборки» (ассемблинга) генома. Как известно, руководители Human Genome Project еще пару лет назад рассчитывали завершить работу лишь к 2005 году, однако «внезапно возникшая конкурирующая фирма» резко подхлестнула их академические изыскания. Столь быстро получить результаты удалось и бла-

годаря «усовершенствованной компьютерной начинке», выполнившей всю черновую работу по обработке «сырой генетической массы». По ходу сборки генома и той, и другой команде удалось получить весьма интересные данные о строении его отдельных фрагментов, их примерном количестве и процентной доле. Так, по словам президента Celera Genomics Крэйга Вентера, специалисты компании сумели идентифицировать «наверняка» 26588 кодирующих белки генов и определить еще примерно 12000 участков генома, которые также могут быть генами. С этими цифрами в принципе соглашаются и ученые госконсорциума, оценки которых, правда, куда более осторожные – по их данным, пока речь может идти о диапазоне в 30–40 тыс «генных единиц». Эти цифры представляют немалую научную ценность. Ведь до недавнего времени «генетический мейнстрим» оценивал возможное количество генов в человеческом геноме примерно в 100 тысяч. Впрочем, последние данные о столь малом количестве человеческих генов (или, иначе говоря, об «относительной простоте» человеческого генома: для сравнения – у кольчатого червя обнаружено 19 тыс генов) сверхнеожиданными назвать нельзя: еще в 60-е годы американский генетик Джеймс Кроу высказывал гипотезу о том, что у человеческих особей должно насчитываться лишь около 30 тыс генов.

Правда, у идеи простоты человеческого генного материала есть активные оппоненты: один из самых ярых сторонников «недавнего мейнстрима», президент Human Genome Project Уильям Хэзелтайн убежден, что в человеческом геноме должно быть от 100 до 120 тыс генов. Более того, после публикации в Science и Nature д-р Хэзелтайн утверждал, что специалистам его компании уже удалось найти и «отсеквенировать» порядка 90 тыс генных единиц! По мнению опрошенных отечественных специалистов, нынешние публикации американских ученых в целом дали лишнее доказательство уже давно известным фактам о строении генома. Исследование еще раз подтвердило, что сами гены занимают лишь от 1 до 3 % генома. При этом ген «полосатый»: состоит из кодирующих элементов (экзонов) и не кодирующих промежутков (интронов). Такое строение гена позволяет получать различные белки, используя одни и те же основные компоненты. Впрочем, как и предыдущие исследователи, ученые из Human Genome

Project и Celera Genomics, не дали ответа на вопрос, есть ли еще какая-то функция, кроме разделительной, у интронов.

Наконец, самой таинственной зоной генома как были, так и остаются огромные «негенные» участки с бесконечно повторяющимися последовательностями нуклеотидов, многие из них длиной в несколько тысяч пар оснований. Специалисты весьма образно называют их «генетическим хламом» – эдакие «эволюционные останки», «генетическое кладбище», хранящее ставшую ненужной миллионы лет назад для функционирования организма информацию, клетки как бы по инерции продолжают репродуцировать ее из поколения в поколение. Ученые сегодня не исключают, что и этот «мусор» может на самом деле нести некую полезную генетическую нагрузку (например, выполнять все те же «регулирующие функции» – популярный в современной генетике эвфемизм, за которым, по сути, скрывается отсутствие сколь-нибудь достоверного научного знания).

Карлики во Вселенной

В общем, несмотря на обилие представленных статистических данных красочных иллюстраций, любопытных рассуждений и предположений о возможных объяснениях смысла тех или иных фрагментов генома, ситуацию, в которой находятся на данном этапе наследований ученые, без особого риска преувеличения можно сравнить со следующим «сценарием». В результате блестящей разведывательной операции землянам удалось «похитить» у инопланетян две одинаковые «машины времени», затем кропотливо разобрать их до последнего винтика. Но в результате они так и не поняли по какому принципу, собственно, эти аппараты работают (отдельные элементы конструкций вроде бы напоминают что-то земное, но остается загадкой, почему они расположены именно в таком порядке и за что именно отвечают).

Ученым удалось открыть входную дверь в сокровищницу генетической информации: далее поджидают тысячи потайных комнат, для проникновения внутрь которых придется снова и снова подбирать кодовые комбинации шифра, а затем многократно ошибаться, пытаясь объяснить возможное предназначение их содержимого.

Впрочем, самих авторов публикаций о человеческом геноме нельзя обвинить в головокружении от достигнутых успехов: ученые честно признаются, что находятся в самом начале «генетического туннеля» Так, биологи Human Genome Project, отмечают, что «пока у нас нет возможности корректно интерпретировать полученные данные», а по словам главы Celera Genomics Крэйга Вентера, «сейчас мы похожи на умственных карликов, пытающихся объяснить строение Вселенной».

ШИФР РИСА

В молекулярной биологии – очередная сенсация.

Ученые прочли геном риса

Молекулярная биология, крайне щедрая в последние годы на научные сенсации, «выдала на-гора» очередной продукт своих изысканий. На специальной пресс-конференции в пятницу 26 января представители двух биотехнологических компаний – швейцарской Syngenta AG и американской Myriad Genetics Inc. – объявили о том, что им удалось полностью расшифровать геном риса, наиболее простого по генетической структуре представителя зерновых культур.

Элементарный сорняк

Темпы работы генетиков впечатляют: прошло лишь немногим более месяца с того момента, как стало известно о полной расшифровке генома *Arabidopsis thaliana*, наиболее изученного представителя растительного мира. *Arabidopsis* – миниатюрное растение семейства горчичных, по сути сорняк, который считается у молекулярных биологов, работающих на «растительном фронте», чем-то вроде аналога лабораторных мышей, столь любимых их коллегами, специализирующимися на исследованиях животного мира. Компьютерный анализ генома этого растения, осуществленный на базе совместных исследований большого интернационального коллектива ученых, задействованных в стартовавшем в 1996 году проекте по его расшифровке, установил наличие в нем порядка 25 тыс. генов (в том числе около 15 тыс. уникальных, то есть не дублированных), а также 125 млн

нуклеотидов, или пар оснований (составных частей ДНК). Причем, по оценкам генетиков, не менее сотни из найденных генов присутствуют и во всех других организмах, что позволяет надеяться на получение на базе анализа генома *Arabidopsis* информации, полезной для изучения более сложных геномов других растений.

«Картирование» (от английского mapping – биологический сленг-термин) последовательностей нуклеотидов риса представлялось естественным продолжением этого направления молекулярно-биологических исследований. Дело в том, что рисовый геном, содержащий 430 млн. нуклеотидов, – следующий по сложности после генома *Arabidopsis*. Но быстрота, с которой тандем Syngenta – Myriad Genetics добился результата, сильно удивила специалистов. Участники альтернативного проекта – International Rice Genome Sequencing Project (IRGSP) рассчитывали докопаться до истины не раньше 2003 года. Представители IRGSP, в котором были задействованы специалисты из 11 стран, пытаются «сохранить лицо» и утверждают, что их исследования «более точны и будут содержать более полную информацию о геноме». Пикантность ситуации придает следующее обстоятельство: крупнейший корпоративный спонсор IRGSP – американская Monsanto Co – один из главных конкурентов Syngenta на мировом рынке.

Большая геномная свалка

Прочтение последовательности генома риса дает возможность вдоволь поэкспериментировать в лабораторных условиях с пересадкой генов наиболее ценных сортов в другие, менее урожайные или менее устойчивые к различным вредным воздействиям внешней среды сорта. Кроме того, теперь для ученых значительно упрощается процесс изучения генетически более сложных зерновых культур, поскольку между их геномами и геномом риса много общего. И вполне возможно, что уже не за горами «картирование» столь любимой Никитой Хрущевым кукурузы (насчитывающей порядка 2.5 млрд пар оснований) и даже уникальной по сложности пшеницы (состоящей из более чем 16 млрд пар оснований, что в несколько раз превышает число нуклеотидов в человеческом геноме). Так, Национальный научный фонд США, в рамках которого в прошлом году был инициирован проект по тотальной дешифровке функций генов представителей

растительного мира, поставил перед задействованными в нем учеными амбициозную задачу – через десять лет создать компьютерную модель идеального «виртуального растения», на базе которой можно будет с высокой точностью прогнозировать и контролировать результаты воздействия различных условий окружающей среды на жизнедеятельность растительных организмов. Впрочем, основная проблема в подобных генетических исследованиях заключается в том, чтобы понять, за что именно отвечает каждый конкретный ген. Знание полной структуры последовательностей нуклеотидов отнюдь не ведет к автоматическому пониманию функций, выполняемых генами. Задача осложняется еще и тем, что так называемые полезные в информационном плане гены составляют в среднем лишь от 1 до 3 % генома (эта доля варьируется в различных организмах), а остальные 97–99 % в основном рассматриваются современной наукой как «ненужный материал» (другой популярный синоним – «большая геномная свалка»), так как ученым пока не удалось разобраться, за что они отвечают (эдакое «мусорное наследие» генетической эволюции, исследование которого пока считается малоперспективным занятием).

Поэтому говорить о том, что швейцарско-американский тандем окончательно разгадал генетическую тайну риса, на самом деле несколько преждевременно. Во-первых, по признанию самих ученых, им пока удалось получить «карту» лишь 99,5 % последовательностей, и вовсе не факт, что оставшиеся полпроцента – это мелочи (зачастую именно этот «нечитаемый остаток» и содержит наиболее ценную информацию, трудно поддающуюся дальнейшей дешифровке). А во-вторых, от получения полного генетического текста до его полного понимания должно пройти еще немало времени – даже по оптимистическим оценкам самих участников проекта, на это уйдет еще как минимум несколько лет; скептики же полагают, что серьезный практический результат будет получен не ранее начала следующего десятилетия.

Азию накормят

Как бы то ни было, получение полной последовательности нуклеотидов ДНК риса, безусловно, следует считать большим успехом современной молекулярной биологии. Причем уже сегодня многие западные ком-

ментаторы сходятся во мнении, что прочтение рисового генома – это важнейший прорыв в сфере разработки генетически модифицируемых растительных организмов, который может стать катализатором роста объемов и повышения качества продукции мирового сельского хозяйства. К результатам исследований ученых, привлеченных к проекту компаний Syngenta и Myriad Genetics, уже проявили большой интерес представители Всемирной организации продовольствия (FAO) и International Rice Research Institute, крупнейшего мирового научного центра по изучению свойств риса (Филиппины). По данным РАО, темпы прироста численности населения Земли в последнем десятилетии XX века существенно опережали темпы прироста общемирового производства риса, важнейшей сельскохозяйственной культуры Азии, на долю которой приходится около половины жителей нашей планеты. Причем в 90-е годы средний ежегодный прирост урожая риса упал до 1 % по сравнению с 2,5 % в 70–80-е годы. Открытие западных ученых сможет, по мнению экспертов, переломить негативную тенденцию.

Представители Syngenta сразу же заявили о том, что готовы на безвозмездной основе предоставить наиболее заинтересованным в их исследованиях государственным учреждениям (прежде всего в азиатских странах) полученные данные и квалифицированную помощь в «продвижении продукта». Правда, некоторые наблюдатели усмотрели в этом хитроумный ход, рассчитанный на получение в будущем контроля над азиатскими рисовыми плантациями. В традиционно алармистском ключе выступил и всегда держащий нос по ветру Greenpeace. Директор Greenpeace по Юго-Восточной Азии Вон Эрнандес считает, что определение генетического кода риса чревато целым рядом опасных последствий, главное из которых – «дальнейшее усиление контроля частных биотехнологических компаний над генетическими ресурсами человечества и, тем самым, над производством продовольственных продуктов».

Впрочем, серьезный биотехнологический бизнес иронически относится к заявлениям «зеленых». Для него главное в подобных научных достижениях – рост интереса инвесторов к акциям компаний-разработчиков (уже на следующий день после официального оглашения на пресс-конференции достигнутых результатов котировки акций Myriad Genetics поднялись на Нью-Йоркской бирже почти на 15 %) и вопрос окупаемости инвестиций.

ПСИХОЛОГІЯ АЮРВЕДИ ДЛЯ ВАШОГО ЗДОРОВ'Я

Ледве зустрівши весну, багато хто з нас починає хворіти. Для людей, що ослабіли за зиму, весняна погода стає непростим випробуванням.

Недаремно в перекладі із стародавньо-індійської «аюрведа» – «наука про життя», життя в гармонії з природою, в якій, як і в нашому організмі, в кожен сезон переважає певна стихія. У березні–квітні, що співпадають у медицині Індії-Тибету з сезоном весни, панує «Кафа» – холодна, вогка сльота, що охолоджує наші тіло і душу, викликаючи весняні простуди і загострення запальних захворювань сечостатевої системи і ревматологічних хвороб. Щоб це хвороботворне бездоріжжя «розтопити» і «підсушити», необхідно зігрітися, розпалити вогонь душі гарячою їжею.

Згідно з медициною Індії-Тибету все їстівне має один з шести смаків: кислий, солоний, гострий, солодкий, гіркий і терпкий. Перші три посилюють жар, три останніх – зсередини охолоджують людину. Виходячи з цього принципу, фахівець з східних систем оздоровлення і радить будувати свій раціон. За аюрведою найкраща для весни їжа – це каші (особливо з ячменю і вівса). Крупу перед приготуванням краще небагато підсушити або підсмажити на сковороді.

Ви переконаний м'ясоїд?

Тоді віддайте перевагу баранині (за східною класифікацією вона – одна з найгарячіших), рибі і м'ясу водоплавних птиць (у них багато жиру, який розпалює наш внутрішній вогонь). А ось свинина – продукт холодний. Вже якщо нею зараз і ласувати, то неабияк присмачивши перцем. Весняний час – взагалі час гарячих (гвоздика, перець, імбир, кардамон, куркума) і гірких (полин, барбарис, насіння ялівцю) прянощів. Зараз ці приправи можна додавати в будь-яку страву, поступово збільшуючи їх кількість. А всю м'ясну їжу їсти не у смаженому і вареному, а в запеченому вигляді з апетитною сухою скоринкою. Любителі шашликів, наступив ваш час!

Чай з імбиром. І ніякого вина!

Не складе труднощів підібрати до такої закуски зігріваючі напої. Віддайте перевагу зігріваючій ялівцевій горілці, віскі, перцівці, рому і

джинів. Всі ці напої (природно, в розумній кількості) чудово допомагають протистояти весняному бездоріжжю. Чого не можна сказати про коньяк.

І вже зовсім не підійдуть для цієї мети напівсолодкі, а також марочні десертні вина.

Не варто відмовляти собі в чаюванні. Тільки навесні додайте в чай щіпку імбиру, а в каву – кардамон (підійдуть також гвоздика, кориця, мускатний горіх).

За затишком і за запахом тайги

Прекрасним доповненням до пряної, запашної аптечки може стати похід в лазню. Тільки якщо при осінніх і зимових простудах (згідно з аюрведою) потрібно йти в російську лазню, то при весняних – у жарку, суху фінську сауну.

Тепер – про запахи, їх теж ігнорувати не варто. Бо так само, як все, що ми п'ємо і їмо, зігріваючою і охолоджуючою властивістю володіє і те, що ми з вами нюхаємо. Пригадайте, яким є запах жита – він дає вашій душі відчуття тепла, радості і затишку. Напевно це і хвойні аромати: сосни, ялиці. На них і орієнтуйтеся, а також на зігріваючі аромати розмарину, гвоздики, чабрецю, лепехи.

СУЧАСНІ УЯВЛЕННЯ ПРО БІОСФЕРУ ТА ЇЇ МЕЖІ

Живі істоти (рослини, тварини, мікроорганізми) живуть на поверхні Землі, в її атмосфері, гідросфері, верхніх шарах літосфери, утворюючи оболонку або сферу життя – *біосферу*. Вперше цей термін вжив австрійський вчений Е. Зюсс у 1875 р., але поширився він після праць нашого видатного вченого, засновника та першого президента Академії наук України, В. І. Вернадського. Він довів, що живі організми відіграють дуже важливу роль у процесах, які відбуваються у всіх сферах Землі. «Якби на Землі було відсутнє життя, – писав учений, – обличчя її було б таким же незмінним і хімічно інертним, як нерухоме обличчя Місяця, як інертні уламки небесних світил». За мільярди років існування Землі живі істоти значно змінили склад її атмосфери, гідросфери й літосфери, створивши, по суті, зовсім інше середовище життя.

Людина як біологічна істота також є складовою частиною біосфери. Вона не може існувати в іншому середовищі, ніж те, що утворилося на планеті за її довгу історію – не може дихати повітрям іншого складу, не може пити води, забрудненої шкідливими домішками, не може жити при іншому, ніж сьогоденне, напруженні планетного магнітного поля і т. д. Негативно діє на здоров'я і психіку людини зміна звичайних умов її існування, заміна природних ландшафтів «кам'яними джунглями» міст – перенаселених, перенасичених хімічним смогом, електромагнітними полями, шумом, насильством.

Пристосовуваність живих організмів вражає. Живі бактерії виявлено в гарячих гейзерних джерелах з температурою води 98 °С, а також у тріщинах антарктичних льодовиків, де температура рідко коли піднімається вище 0°. Бактерії живуть у глибинних водах Чорного моря, насичених сірководнем, деякі бактерії виявлено навіть в атомних реакторах. Живу спору бактерії було виявлено в одній із трубок американської космічної станції, яка три роки знаходилась на поверхні Місяця, – вона потрапила туди з Землі й зберегла життєздатність, незважаючи на перебування в умовах космічного вакууму, різких коливань температури і високого рівня радіації.

Одним з проявів біологічної активності організмів є швидкість їх розмноження. За ідеальних умов (теоретично) вона може досягти швидкості звуку. Французький вчений К. Лінней якось підрахував, що і мухи можуть з'їсти тушу антилопи з такою ж швидкістю, як це робить лев (враховуючи швидкість розмноження мух).

7. СЛОВОСПОЛУЧЕННЯ

Словосполучення (складені прийменники, складені сполучники, і так далі), які найчастіше використовуються в англійській науковій літературі

Таблиця 7.1 – Типові зразки словосполучень

above all syn. first of all first and foremost for one thing in the first instance in the first place	перш за все
according to in accord (ance) with syn. as consistent with in conformity with in compliance with in keeping with in line with	відповідно до; по; згідно з відповідно до
a good deal of syn. a great deal of plenty of	багато
a great number of a lot of	безліч, велика кількість
along with	разом, разом з
apart from syn. all but aside from except for other than save for with but with the exception of	все окрім, за виключенням окрім

Продовження таблиці 7.1

as against syn. (as) compared with/to	у порівнянні з
as a consequence of syn. as a result in consequence in the issue	в результаті
as a matter of fact syn. in fact in point of fact	фактично, насправді
as a result	в результаті
as a whole syn. on/upon the whole at large	в цілому
as compared to/with as consistent with	у порівнянні з
as contrasted to/with syn. as opposed to by contrast to/with in contrast with	у протилежність чому-небудь
as early as syn. as for as back as as long ago as	ще, вже (про час)
as far as	наскільки, оскільки, до
as far back as	ще в (дата), вже в
as for syn. as regards as to in respect of in/with regard to in point of in relation to relating to with/in reference to with respect to in the matter of	що стосується відносно

Продовження таблиці 7.1

as if syn. as though	неначе, неначебто
as judged by	судячи з
as opposed to	у протилежність чому-небудь
as regards	що стосується, відносно
as soon as	як тільки
as stated above as mentioned above	як сказано вище
as to	що стосується, відносно
as well as	а також (і), також як
at all	зовсім, взагалі
at all costs syn. at any cost at all hazard by all means	за будь-яку ціну
assuming syn. supposing	якщо, припустимо, що
at all events syn. at any rate in all events	в усякому разі
at any cost	за будь-яку ціну
at any rate	в усякому разі
at first	спочатку
at best	за найкраще
at hand syn. in hand on hand	наявний (близько під рукою)
at issue	що розглядається, про яке йде мова
syn. in question under consideration	
at large syn. at length	детально, в цілому

Продовження таблиці 7.1

at last syn. at length	нарешті
at least syn. at any rate in/at all events in any case	принаймні
at length	нарешті
at most	найбільше
at once	відразу, негайно
at random syn. at (a) venture	наугад, довільно
at the beginning	на початку
at the close syn. at the end	в кінці
at times syn. now and again now & then on occasion once & again	інколи
along with	разом з
(to) be available (for)	мати в наявності
because of syn. by reason of by/in virtue of consequent on due to in consequence of on account of on the score of owing to	через, внаслідок
(to) be due to	бути обумовленим, бути слідством чого-небудь, бути за- пропонованим

Продовження таблиці 7.1

(to) be good syn. to be true to be valid	бути дійсним
(to) be identified as syn. to be referred to as to be termed as	називатися
(to) be in accord with to be in agreement with	узгоджуватися, відповідати
(to) be in charge of syn. to be responsible for	бути відповідальним очолювати
(to) be in contrast with/to	перечити
(to) be inferior to	не перевершувати, поступатися
(to) be referred to	називатися, посилатися на
to be termed as	називатися
(to) be valid syn. to hold good to hold true	бути дійсним
to be variable from... to syn. to range from... to to vary from... to	змінюватися в межах від... до
(to) be worth (while)	коштувати, мати сенс
by a factor of ...	у ... разів (більше)
Besides	крім того
by all means	щоб то не стало, звичайно, безумовно, неодмінно, обов'язково
by contrast to/with	в порівнянні з, у протилежність чому-небудь
by any means	будь-якими засобами (способами), обов'язково

Продовження таблиці 7.1

by dint of syn. by means of by way of by/through the agency of through the medium of through the use by virtue of	за допомогою, дорогою
by no means syn. on no account in no case	ні в якому разі ніяким чином
by the way syn. among other things in passing	між іншим
by then	на той час
by/in virtue of syn. due to thanks to on the strength of	завдяки чому-небудь через що-небудь
cut and dried	трафаретний, шаблонний
cut and try method	експериментальний метод, метод проб і помилок, метод послідовних наближень
considering syn. concerning regarding respecting	відносно
concerning	що стосується
chiefly by syn. mainly by largely by	переважно
depending on/upon	залежно від

Продовження таблиці 7.1

due to	внаслідок, завдяки чому-небудь
during the course of syn. in the course of	протягом, під час
despite	не дивлячись на, всупереч
early in syn. at the beginning	на початку
each other syn. one another	один одного
even if syn. even though	навіть якщо
ever since syn. since then	з тих пір
except for syn. apart from all but aside from other than save for with but with the exception of	окрім, за виключенням, якби не
except in so far as	за винятком того, що
far and away syn. by far	значно, поза сумнівом
failing	через відсутність, за відсутністю, через брак
first and foremost syn. above all first of all for one thing in the first instance in the first place	перш за все
far and by	загалом, взагалі кажучи
first of all	перш за все

Продовження таблиці 7.1

following	услід за
for all that	не дивлячись на все це
for one syn. for example for instance to take an example	наприклад
for one's sake	ради кого-небудь
for one thing syn. first and foremost above all first of all in the first instance in the first place	по-перше
for that matter syn. for the matter of that	що стосується цього; у цьому
for the benefit of syn. for the sake of on behalf of	для, ради чого-небудь
for the matter of that	що стосується цього; у цьому
for the most part	головним чином, переважно
for the present of syn. for once this time	цього разу, поки
for the purpose of syn. for the reason of with a view to with the view of in order (that) to	з метою; для того, щоб
for the reason of	з метою; для того, щоб
for the rest	щодо іншого
for the sake of	для, заради чого-небудь
for the time being syn. for a while	поки, на деякий час

Продовження таблиці 7.1

for this (that, which) reason	з цієї причини
for want of syn. for lack of	через відсутність, за браком
from now on	надалі
from time to time syn. now and again now and then	час від часу
given given that syn. on condition that granted	за наявності, даний, вказаний за умови, що; якщо є; якщо
granting granted	за умови, беручи до уваги
half as much syn. half as large twice as little	удвічі більше, удвічі менше
hardly any syn. hardly at all next to nothing	майже нічого
however much	скільки б ні
however	проте
if any syn. if anything if at all	якщо взагалі (є, потрібний)
if for no reason than	хоч би тому, що
in accordance with syn. as consistent with in conforming with in compliance with	відповідно до
in heaping with in line with	

Продовження таблиці 7.1

in a manner syn. in a sense in a way	в деякому розумінні; до деякої міри
in a rough way syn. about	приблизно
in some measure syn. to a certain degree	до деякої міри; частково
in addition to syn. over & above	у доповненні до; крім того; до того ж
in/at all events syn. at any rate	в усякому разі
in all respects syn. at all points in every count in every way	в усіх відношеннях
in any case	в усякому разі (випадку)
in as much as	оскільки; з причини того, що
in behalf of	ради
in case (of)	в разі, якщо
in comparison with/to	в порівнянні з
in compliance with	відповідно до чого
in conformity with	
in connection with syn. relative to	у зв'язку з
in consequence of	унаслідок, у результаті
in fact	фактично
in favour of	у користь; за; переважно
in lieu of syn. in place of	Замість
in line with	відповідно до
in no case	ні в якому разі

Продовження таблиці 7.1

in order for in order that in order to	для того щоб
in passing	між іншим
in place of	замість
in point	що розглядається
in point of syn. in respect of with respect to	відносно
in reference to	відносно; що стосується; посилаючись на
in/with regard to in relation to in respect of	відносно; що стосується; щодо
in series syn. in succession	послідовно
in so far as	оскільки
in spite of	не дивлячись на
instead of	замість
in terms of	враховуючи; з точки зору; у вигляді, на основі, у функції, за- лежно від, в одиницях
in the first instance	перш за все, спочатку
in the first place	
in the following syn. in what follows	нижче, надалі
in the following way	таким чином
in the issue syn. as a result	у результаті
in the long run syn. after all finally	врешті-решт
in the matter of	що стосується

Продовження таблиці 7.1

in the neighborhood of syn. in the vicinity of	поблизу (близько) чого-небудь; біля
in the sequel syn. in the following	надалі
in the vicinity of	поблизу
in the wake of syn. subsequent to	услід за
in the way of	відносно
in view of	у вигляді
in these respects syn. with this connection	у зв'язку з цим;
in/by virtue of	через що-небудь; завдяки чому- небудь
in what follows	нижче, надалі
it follows	з цього виходить
it was not until that	тільки, і лише
in contrast to/with syn. unlike to be not like in as opposed by contrast to/with	у протилежність; у порівнянні з
let alone syn. not to mention to say nothing of	не говорячи вже про
little more than syn. nothing but	лише
nearby syn. in the neighborhood of in the vicinity of	поруч, ближче
next to nothing syn. hardly any hardly at all	майже нічого

Продовження таблиці 7.1

no matter (how, what, when, etc)	незалежно від того (як, що, коли, т.д.)
none the less	проте
no sooner then	як тільки
not at all not the least	ніскільки
not to mention	лише після того, як; лише тоді, коли
not until (after)	лише, лише
nothing but	не що інше, як
nothing else than	інколи, час від часу
now & then	час від часу
now that	тепер, коли
of concern	представляючи інтерес
of consequence syn. of importance of significance	важливий, такий, що має значення
of course syn. by all means to be sure	звичайно
of great moment	важливий, такий, що має велике значення
of late	за останній час
of reference	стандартний, еталонний, порівняльний
off hand	без підготовки, відразу
off the point	не по суті, не за темою
on a short notice	відразу, без зволікання
on account of	через, унаслідок
on condition that syn. given that	за умови що
on hand syn. at hand in hand to hand	що розглядається

Продовження таблиці 7.1

on no account	ні в якому разі
on the score(of)	унаслідок
on the verge of syn. on the point of	близький до, на грані
on/upon the whole as a whole	в цілому, загалом
open to objection open to question	сумнівний, спірний
other conditions (things) being equal	за інших рівних умов
other than syn. all but	окрім, крім, за виключенням
out of date	застарілий
out of place	недоречний
over & above	до того ж, в додаванні
owing to	унаслідок, завдяки
plenty of	багато
present-day syn. up-to-date	сучасний, новітній
rather than	не скоріше ніж; замість того, щоб
relating to	що стосується, у відношенні
relative to	у зв'язку з, відносно
safe for	за виключенням
short of	майже до
since then	з тих пір
so far	поки, до цих пір
so far as so long as	оскільки
subject to	відповідно до, залежно від
subsequent to	слідуючи за, після
thanks to	завдяки, унаслідок

Продовження таблиці 7.1

the fact is (that) syn. the point is the thing is	річ у тому, що
the fact that	те, що
the point is	
through/by the agency	шляхом, за допомогою
through the medium	
through the use	
thus far	до цих пір
to advantage	з успіхом
to all appearance(s)	судячи з усього
to date	до теперішнього часу
to full advantage	повністю
to hand	що є (близько), розглядається
to the effect that	в тому сенсі, що; так аби
to the extent (of) to the extent that	до; аж до; у межах в тому сенсі, що
to the letter	буквально, точно
to the point	по суті
to the point of to the point that	до такої міри, що
to this effect to this end syn. will this end in view	для цієї мети, з цією метою
under way syn. in progress	здійснюваний зараз
unless otherwise indicated (men- tioned, specified, stated)	якщо не вказано особливо
until recently	до недавнього часу
upon/on the whole	в цілому, загалом
up to	аж до
up to date syn. present day	сучасний, новітній
up to the present	до теперішнього часу

Закінчення таблиці 7.1

up to this point	до цих пір
well nigh	майже
whether it be	будь то
which is to say	тобто
with a glance to	враховуючи
with a view to	з метою; з тим, аби
with but see	за виключенням
with due regard for	враховується належним чином
with provision for	враховуючи
with reference to	відносно, що стосується, поси- лаючись на
with regard to	відносно
with respect to	відносно
with the view of	з метою
worthy of note	заслужуючий на увагу
whereupon	унаслідок чого, після чого

8. ДІЄСЛОВА-ОПЕРАТОРИ

Найуживаніші дієслова, що використовуються в технічній літературі

Таблиця 8.1 – Найуживаніші дієслова

1.	to affect → to influence → to act (on)	впливати
2.	to allow to allow for	дозволяти враховувати
3.	to alter > to vary (in, or from.to.) > to change > to transform > to modify	змінювати (ся) перетворювати, (видозмінювати)
4.	to amplify* > to increase > to grow > to rise > to raise > to enhance > to magnify	підсилювати, підвищувати, зростати
5.	to assume	1. приймати 2. допускати, припускати
6.	to assure	гарантувати, забезпечувати
7.	to be ascribed	бути обумовленим
8.	to be attributed to	бути обумовленим, бути зв'язаним
9.	to be involved	залучатися, бути втягнутим
10.	to be available	бути в наявності
11.	to be identical (in) (to) > to be similar in > to have the same	бути ідентичним у чомусь ~ з чимось аналогічним , схожим
12.	to be of importance/ significance	мати значення
13.	to be plotted against	графік залежності; ~ у функції
14.	to cause	служити причиною, викли- кати
15.	to consider > to take into account	розглядати, враховувати
16.	to consist of > include > contain > to house > to involve > to make up	залучати, складатися, містити
17.	to consist in	полягати

Продовження таблиці 8.1

18.	to decrease	зменшувати, знижувати
19.	to depend on	залежати
20.	to develop	розробляти, створювати
21.	to design	конструювати
22.	to differ from to differ by to differ in	відрізнятися від відрізнятися на (величину) відрізнятися по
23.	to denote > to determine > to define to detect > to find	позначати, визначати виявляти, знаходити
24.	to entail	спричиняти за собою
25.	to estimate > to calculate > to determine > to define > to value	визначати, оцінювати
26.	to exhibit	проявляти
27.	to ensure	забезпечити
28.	to enhance > to magnify (see 4)	підсилювати, збільшувати
29.	to feed > to supply > to charge > to force	подавати
30.	to find	знаходити, встановлювати
31.	to follow	1. слідувати за... 2. перебіга- ти, підкорятися 3. контро- лювати, просліджувати
32.	to function > to operate > to act > to serve as	функціонувати, працювати, виконувати
33.	to get > to receive > to obtain	отримувати
34.	to give > to present > to provide	давати, наводити
35.	identify	виявляти
36.	imply	передбачати, мати на увазі, означати
37.	involve	залучати, наводити до..., бу- ти пов'язаним з, охоплюва- ти, брати участь, відбуватися, бути (містити, передбачати, укладати, мати на увазі)

Продовження таблиці 8.1

38.	to improve, to refine	удосконалити, покращувати
39.	to invent	винаходити
40.	to investigate > to examine > to study > to test	досліджувати
41.	to increase > to amplify	підсилювати, підвищувати, зростати
42.	to lead to	приводити до ...
43.	to measure > to calculate > to compute	вимірювати, обчислювати, визначати
44.	to mean	означати, мати на увазі
45.	to make allowance (for)	враховувати > робити зниж- ку (на)
46.	to make prvision for	передбачати, забезпечувати
47.	to modify	видозмінювати
48.	to obtain	отримувати
49.	to observe > to occur > to take place > to be found in	статися, мати місце
50.	to predetermine predetermined	визначати наперед заздалегідь заданий
51.	to provide with ...is provided to provide for	забезпечувати, забезпечувати пропонується передбачати
52.	to perform	виконувати
53.	to produce > (to make)	виробляти, робити
54.	to reduce > to decrease > to lower > to diminish	зменшувати, знижувати
55.	to result from to result in	бути слідством (бути резуль- татом) чого-небудь приводити до чого-небудь
56.	to represent	зображати, означати, представляти
57.	to refer to	посилатися на

Закінчення таблиці 8.1

58.	to relate to > *to belong to	відноситися *належати
59.	to select > to choose	вибирати, відбирати
60.	to serve 1) (as...) > 2) to serve to*	1) виконувати, реалізувати 2) використовувати, застосовувати * сприяти, бути
61.	to show	проявляти, виявляти
62.	to specify	передбачати, визначати
63.	to simplify	спрощувати, наводити до (мат.)
64.	to stand to stand for	витримувати позначати
65.	to study	досліджувати
66.	to supply to supply with	подавати забезпечувати, підводити, жити
67.	to subject to	піддаватися дії
68.	take to be taken as	приймати приймати за...
69.	to treat > to machine	1) обробляти, піддавати дії; 2) спец. збагачувати (вугілля, руду); 3) розглядати
70.	to undergo > to subject	піддаватися, випробовувати
71.	to underpredict	занижувати
72.	to unite	об'єднувати, сполучати
73.	to use > to apply > to make use of > to employ	використовувати, вживати
74.	to vary syn. to range from ... to	змінювати (ся)

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АНГЛІЙСЬКОГО ТЕКСТУ**

Навчально-методичний посібник з англійської мови
для студентів, магістрів та аспірантів усіх спеціальностей

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