МИНИСТЕРСТВО ОБРАЗОВАНИЯ И НАУКИ РОССИЙСКОЙ ФЕДЕРАЦИИ

ФЕДЕРАЛЬНОЕ АГЕНТСТВО ПО ОБРАЗОВАНИЮ

САНКТ-ПЕТЕРБУРГСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ
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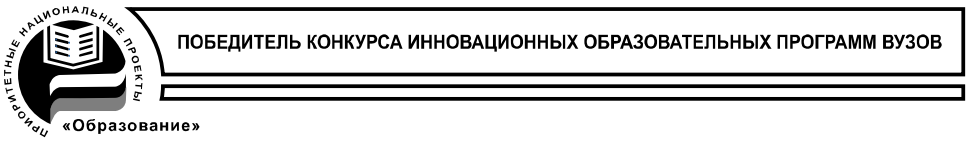

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ИНОСТРАННЫЙ ЯЗЫК В ПРОФЕССИОНАЛЬНОЙ ДЕЯТЕЛЬНОСТИ

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Рассматриваются трудности перевода научно-технических текстов с английского языка, чтения математических и химических формул, букв греческого алфавита. Подобраны отрывки из публикаций по различным разделам науки и техники. Приведён оригинальный текст «Environmental concerns having global impact», предназначенный для самостоятельного перевода. Справочный материал содержит толковый словарь экологических терминов, таблицу сопоставления единиц измерения в метрической системе с единицами, используемыми в англоязычных странах.

Для студентов специальностей 230202, 050501.

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В 2007 году СПбГУ ИТМО стал победителем конкурса инновационных образовательных программ вузов России на 2007–2008 годы. Реализация инновационной образовательной программы «Инновационная система подготовки специалистов нового поколения в области информационных и оптических технологий» позволит выйти на качественно новый уровень подготовки выпускников и удовлетворить возрастающий спрос на специалистов в информационной, оптической и других высокотехнологичных отраслях экономики.

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Содержание

ВВЕДЕНИЕ

Для будущих специалистов, подготавливаемых в СПб(ГУ)ИТМО, принципиально важным является приобретение компетенции в правильном, точном переводе научных и технических публикаций на иностранных языках, в особенности английской и американской научно-технической литературы.

Настоящее учебное пособие разработано с целью расширения словарного запаса и развития навыков чтения и перевода технической и научной литературы на английском языке.

В разделе «Специальные вопросы грамматики» кратко изложен грамматический материал, связанный с неличными формами глагола и оборотами с ними.

Раздел «Отрывки из научно-технической литературы» представлен в виде сборника отдельных предложений и абзацев, взятых из оригинальных текстов по электронике, электротехнике, авиации, металлургии, медицине, физиологии, биологии, химии, физике и т. д.

Текст «Environmental concerns having global impacts» познакомит с актуальными на данный момент экологическими проблемами.

Толковый словарь экологических терминов на английском языке будет полезен для студентов естественнонаучных специальностей (в частности, подготавливаемых по специальности «Профессиональное обучение. Охрана окружающей среды и природопользование»).

В приложении содержится справочный материал по чтению букв греческого алфавита, математических формул и выражений, химических формул. Приведены таблицы единиц измерения массы, длины, площади, объема, температуры, времени, используемых в метрической системе, и соответствующих единиц, применяемых в Великобритании и США.

Разработанное учебное пособие рекомендуется для самостоятельной работы студентов, но также может оказать помощь преподавателям в подготовке и проведении групповых аудиторных занятий.

1. СПЕЦИАЛЬНЫЕ ВОПРОСЫ ГРАММАТИКИ

В приведённом в данном разделе изложении некоторых вопросов грамматики английского языка для облегчения перевода инфинитивных оборотов в отрывках из научно-технической литературы вводится термин «глагол-характеристика» для обозначения глаголов, обязательных для оборотов «подлежащее + инфинитив», «дополнение + инфинитив». Это позволило выработать формулы для этих оборотов. Также выявлены сочетания «глагола-характеристики» с *as* + причастие (инговая форма), разработана их формула и даны примеры на их близкую аналогию с инфинитивными оборотами. Это значительно облегчает перевод подобных предложений и расширяет круг «глаголов-характеристик», многие из которых приведены в прилагаемом списке.

1.1. Герундиальный оборот

Формула: предлог + притяжательное местоимение или существительное + инговая форма (герундий). Соответствует в русском языке дополнительному придаточному предложению.

Если между предлогом и инговой формой (герундий) стоит притяжательное местоимение или существительное, то это герундиальный оборот, и в таком случае местоимение или существительное переводятся как подлежащее, а герундий – как сказуемое дополнительного придаточного предложения.

I did not know *of* her *having* been ill – “Я не знал, что она была больна”.
Did you hear *about* many students *going* to Leningrad? – “Вы слышали, что многие студенты едут в Ленинград?”

Примечание 1. Иногда в герундиальном обороте существительное стоит в притяжательном падеже.
There are unmistakable proofs of Pauling’s having been wrong. – “Имеются несомненные доказательства того, что Полинг ошибался”.
Примечание 2. Герундиальный оборот не всегда обязательно переводить придаточным предложением. В таком случае герундий переводится существительным.
The possibility of ethylene *being* converted into aromatic hydrocarbons is slight. – “Возможность того, что этилен превратится в ароматические соединения, незначительна”, или “Возможность превращения этилена в ароматические соединения незначительна”.

Примечание 3. Being (инговая форма от глагола to be) иногда может опускаться.
The explanation lies in the product (being) more stable. – "Объяснение заключается в том, что это вещество является более устойчивым (в большей устойчивости этого вещества)".

1.2. Абсолютный причастный оборот – инговая форма

Это причастие в функции обстоятельства (или обстоятельный причастный оборот), но с самостоятельным подлежащим. Сравним:
Причастие в функции обстоятельства:
Having come home I had my tea. – "Придя домой, я выпил чаю".
Абсолютный причастный оброт:
My wife having come home I had my tea. – "После того, как жена пришла домой, я выпил чаю".

Формула абсолютного причастного оборота: подлежащее + инговая форма (при отсутствии личной формы глагола). Стоит до или после «костяка» (ПСД) главного предложения.

В отличие от русского языка, в абсолютном причастном обороте «обстоятельность» выражается не лексически (словами), а грамматически (грамматизация лексики). В русском языке этот оборот соответствует целому обстоятельственному предложению со своим подлежащим, сказуемым и словами, указывающими на характер (тип) обстоятельственной связи. Поэтому для перевода абсолютного причастного оборота на русский язык необходимо вводить слова (союзы), согласно следующей классификации:

- Причем, а, и
- Так как, потому что, поскольку
- Хотя, если
- Когда, после того как (с перфектом)

Выбор союза диктуется контекстом. Например:
The temperature being 100° water boiled quickly – "Так как температура была 100°, вода закипела быстро"
The temperature being 10° water boiled quickly – "Хотя температура была 10°, вода закипела быстро (например, в вакууме).
Примечание 1. В абсолютном причастном обороте инговая форма глагола to be (being) может опускаться.
The work (being) finished we went home. – "Когда работа была закончена, мы пошли домой".
Примечание 2. Абсолютный причастный оборот может начинаться с предлога with, который не переводится.

With the isomerization preceding the reaction, the yields were very low – “*Поскольку* до рекции проходила изомеризация, выходы были очень низкие”.

1.3. Инфинитивные обороты и их эквиваленты

Обязательным признаком этих оборотов является наличие «глаголов-характеристик». Под этим термином подразумеваются глаголы, которые (в большей или меньшей степени) только характеризуют отношение говорящего к высказыванию. Например: “*Говорят*, что он работает”; “Я *люблю*, когда он смеется”; “ Мы *думали*, что Вы не придете”.

Глаголы-характеристики играют очень большую роль в английском языке, поскольку они являются обязательным элементом следующих широко распространенных оборотов:

- Дополнение с инфинитивом
- Подлежащее с инфинитивом
- Дополнение с инговой формой
- Дополнение с as + инговая форма
- Подлежащее с as + инговая форма

Поскольку в неличных формах глагола часто опускаются формы to be и being, вышеуказанные обороты нередко можно обнаружить только по глаголу- характеристике, поэтому при чтении и переводе английской научной литературы очень важно найти глагол-характеристику. Многие глаголы могут выступать как обычные смысловые глаголы и как глаголы-характеристики. Сравним: “Я люблю сливы” “Я *люблю*, когда Маша ест сливы”. В первом случае глагол «люблю» является обычным смысловым глаголом, во втором – он характеризует отношение говорящего к высказыванию. Ниже приводится около ста сорока глаголов и глагольных сочетаний, которые могут выступать в английской научной и технической литературе в качестве глаголов-характеристик или их эквивалентов.

To accept, to acknowledge, to admit, to advertise, to allege, to analyse, to announce, to anticipate, to appear, to appreciate, to be apt to, to argue, to assert, to assign, to assume, to believe, to calculate, to be certain, to characterize, to choose, to cite, to claim, to class, to classify, to comment, to compute, to conceive, to conclude, to consider, to construe, to count on, to declare, to deduce, to deem, to define, to demonstrate, to deny, to depict, to describe, to designate, to desire, to determine, to devine, to diagnose, to disclose, to dislike, to envisage, to establish, to estimate, to evaluate, to expect, to explain, to fancy, to fear, to feel, to find, to formulate, to give, to guarantee, to guess, to happen, to hear, to hold, to idealise, to imagine, to be inclined, to indicate, to intend, to interpret, to know, to label, to learn, to like, to be likely, to list, to look to, to look upon, to mean, to measure, to

mention, to note, to notice, to observe, to obtain, to order, to perceive, to permit, to picture, to place, to point to, to postulate, to prefer, to predict, to presume, to pretend, to propose, to prove, to put forward, to be proved, to quote, to rate, to rationalise, to read, to realise, to recalculate, to recognise, to refer to , to regard, to remember, to report, to represent, to repute, to require, to reveal, to rumor, to say, to see, to seem, to show, to speak of, to state, to suggest, to summarise, to suppose, to support, to suspect, to be sure, to symbolise, to take, to think, to think of, to treat, to turn out, to understand, to be unlikely, to view , to vizualise, to want, to wish, to work out, to write.

В сложноподчиненных предложениях в русском языке глагол-характеристика обычно стоит в главном предложении, а основной глагол – в придаточном: “Я *люблю*, когда он смеется”, “ *Полагают*, что она здесь”; “Мы *считали,* что эта работа завершена”.

В английском языке наряду с такими предложениями широко распространены обороты, в которых как глагол-характеристика, так и основной глагол выступают в одном простом предложении. Эти обороты называют: «дополнение с инфинитивом” и “подлежащее с инфинитивом “.

Так как в современном английском языке одно и то же высказывание можно передать как оборотом, так и сложноподчиненным предложением, надо знать, какие структурные изменения необходимы для замены одного типа предложения другим.

1.4. Дополнение с инфинитивом

Название этого оборота свидетельствует о том, что при замене двух предложений одним подлежащее второго предложения становится дополнением, а сказуемое второго предложения – инфинитивом. Возьмем пример: I know that she has come. - “Я знаю, что она пришла”. При замене:

1) Опускаем союз that, так как вместо двух предложений имеем одно.
2) Подлежащее второго предложения становится дополнением, так как в первом предложении уже имеется подлежащее.
3) Сказуемое второго предложения становится инфинитивом (неличной формой глагола), так как в первом предложении уже имеется сказуемое.
4) Получаем оборот «дополнение с инфинитивом».

I *know* her to have come. – “Я знаю, что она пришла”.

Формула: подлежащее + глагол-характеристика + дополнение + инфинитив. При переводе на русский язык этот оборот надо развернуть в два предложения следующим образом:

1) После глагола-характеристики вводим союз «что» (чтобы).

2) Дополнение становится подлежащим второго предложения.
3) Инфинитив становится сказуемым второго предложения.

I *know* her to have come. – “Я знаю, что она пришла”.
We *wanted* them to go away. – “Мы хотели, чтобы они ушли”.

Примечание 1. После глаголов to see, to hear («видеть», «слышать») инфинитив употребляется без частицы to.
I see her run (= to run). – “Я вижу, что она бежит”.
Примечание 2. Глагол to be может опускаться.
I *thought* the place (to be) occupied. – “Я думал, что это место занято”.
Примечание 3. Иногда в этом обороте опускается дополнение, если подлежащее и дополнение оборота совпадают. При переводе вводится соответствующее личное местоимение в качестве подлежащего второго предложения.
These scientists believe to have discovered a new compound. – “Эти ученые полагают, что *они* открыли новое соединение”.
Примечание 4. Этот оборот употребляется также и с глаголом-характеристикой в неличной форме.
Knowing my friends to be busy I decided to call on them myself. – “*Зная*, что мои друзья очень заняты, я решил сам навестить их”.

1.5. Дополнение с as + инговая форма (причастие)

Формула: подлежащее + глагол-характеристика +дополнение + as + инговая форма.

Этот оборот сходен по значению с оборотом «дополнение с инфинитивом» и переводится на русский язык, как правило, аналогичным образом, двумя предложениями.
We *think of X as* being a straight line. “Мы полагаем, что X является прямой линией”. They *regard* these exercises as being too simple for them. “Они считают, что эти упражнения слишком просты для них”. The author *showed* these compounds as having different structure. “Автор показал, что эти соединения обладают другой структурой”. The chemist is usually *inclined* to regard the appearance of this product signifying that the reaction is over. “Химик обычно склонен считать, что появление этого продукта означает завершение реакции”.

1.6. Подлежащее с as + инговая форма

Формула: подлежащее + глагол-характеристика + as + инговая форма.

Этот оборот сходен по значению с оборотом «подлежащее с инфинитивом» и переводится на русский язык, как правило, аналогичным образом, двумя предложениями.

X can *be shown* as containing admixtures. “Можно показать, что X содержит примеси”.

Y *is taken* as indicating a new route to this compound. “Считают, что У указывает новый путь получения этого соединения.”

X *is postulated* can be considered as being of great importance. “Можно считать, что эта реакция имеет большое значение”.

Примечание 1. Иногда в одном предложении встречаются одновременно как дополнение или подлежащее с инфинитивом, так и дополнение или подлежащее + as +инговая форма, что позволяет судить о их идентичности. Например:

Kekule conceived valence *as being* a property of atoms and *to be* a constant for each element. “Кекуле полагал, что валентность является свойством атомов и является константой для каждого элемента”. This catalyst was regarded *as affording* good results and *to involve* no difficulties in operating. “Считали, что этот катализатор дает хорошие результаты и не представляет трудностей при работе”.

Примечание 2. Как и при инфинитивных оборотах, being (инговая форма глагола to be) может опускаться.

I regard it as (being) probable. “Я считаю, что это возможно”. This may be taken as (being) result of overheating. “Можно считать, что это результат перегрева”.

Considering the hydrolysis as (being) first order reaction it is possible to draw some conclusions. “Считая, что гидролиз является реакцией первого порядка, можно прийти к некоторым выводам”.

More than one of mistake may be thought of as (being) present. “Можно подумать, что имеет место больше, чем один тип ошибок”.

2. ОТРЫВКИ ИЗ НАУЧНО-ТЕХНИЧЕСКОЙ ЛИТЕРАТУРЫ

В этом разделе собраны отрывки из оригинальных публикаций по различным отраслям науки из американской и канадской литературы.

Для облегчения правильного перевода предложений глаголы-характеристики выделены курсивом.

1. The results of the two experiments *seem* to indicate that isomerization did take place.
2. The equations will be derived on a statistical basis.
3. During the Great Patriotic War our women replaced men at the factories, the latter having gone to the front.
4. The article to be translated is available at any library.
5. The scientists and engineers of many countries are *known* to be busy constructing a man-made satellite, but it is the Soviet Union that has first launched it into the space.
6. The speaker discussed many problems *said* to be extremely important for designing, constructing and handling new types of machines.
7. There are few papers dealing with this subject.
8. The main component was quasi-diploid, *with* only a few departures from the normal diploid karyotype.
9. This demonstration is the more convincing the greater the variety of adsorbate vapors.
10. BALB mice generally did not experience a fulminant toxemic death but became progressively ill and finally expired. Females of the BALB strain were somewhat more resistant to infection than males.
11. Thus the non-sweating skin could be *thought of* as a semipermeable water barrier which follows the osmotic pressure relationships *with* water passing inward or outward depending on solute concentrations, vapor pressures and temperatures.
12. These poles must have existed in the original magnet.
13. A new, nonflammable inhalation anesthetic has been produced from a fluorine compound once *considered* too unstable to be of value.
14. Many flying balloons are *reported* to have been observed in the air.
15. 15 The building of the house is *reported* to be finished by the end of this month.
16. The author of the paper *claims* to have been the first to arrive at such a conclusion.
17. Such minerals *are likely* to occur in some other places as well, the probability of discovering them being however limited to certain areas.
18. The signal cannot be *guaranteed* to be of sufficient amplitude.

19. When man is heated to an unusual degree, a marked vasodilatation takes place over and above that which is normally observed.
20. For a system to be in complete equilibrium, it is necessary that there be mechanical equilibrium.
21. This substance reacts one tenth as fast as the other one.
22. This pause is sufficient for the baskets to receive their load of castings from the oscillating conveyer.
23. The coefficients in the Fokker — Planck equations are *found* to depend on the law of interaction.
24. The two types of models considered are not *supposed* to be applicable to all metals. They do represent extreme cases. Other models would be more complicated, but could be handled by similar methods, greatest complication deriving from the collision term.
25. In their treatments, the electric field is *assumed* to be classically prescribed, although the electronic motion in the gas is treated by quantum perturbation theory.
26. From the equations all but one of the unknown functions can be eliminated by successive substitutions.
27. The suggestion is both attractive and interesting but the work is not sufficiently advanced for any definite opinion of its validity to be formed.
28. The approach has three aspects, that of general theoretical principles, that of known results and conclusions, and that of the basically known, but now refined, experimental method, and the computational procedure.
29. The study of the metabolic pathways of the Morris tumor with isotope methods is in progress.
30. The tumors were allowed to grow for 12—14 days after implantation, at which times they were excised for study.
31. In addition, the weak band was noted by some workers and assigned tentatively to an additional NH absorption.
32. The above mentioned figures give us a general idea of the amount of work done during the recent years.
33. The third case to be considered concerns a ring which is flexible in its own plane. The applied force is *considered* to be parallel to the X axis.
34. This type has been *described* as relatively expensive compared to others.
35. It was not, however, until the sixteenth century that the blast furnace process was finally adopted in Sweden.
36. The cerium-sulfate complex ions are *believed* to involve sulfate ion and not bisulfate ion.
37. Admittedly channel selection could be made fully automatic, but the slight advantage gained thereby hardly justifies the considerable added complication.

38. The gain-frequency characteristic is shown in Fig. 5, the high frequency cut-off being due to the stray capacitance across the anode load.
39. To date, propellers of nickel-aluminum bronze as large as 50 tons have been cast for commercial use.
40. Putting it another way, the negative potential energy of the molecule is augmented by electrostatic energy and the contribution is greater, the closer are the unlike charges.
41. It is noteworthy that the hydrogen bond makes it possible for electrons to travel in a circular path.
42. This explanation *seems* to be borne out by the absence of a pinhole when the clean, deoxidized shot was added to the mold.
43. The principle of the method discussed here is the same as for a liquid but the operation *seems* to be somewhat different.
44. One big advantage of in-circuit testing is that by determining which transistors are good, you can concentrate on just the portion of the circuit that tests bad.
45. Our experiments have led to the tentative conclusion that these mixed solvent systems facilitate cellulose reactions.
46. The authors suggested that denaturation by physical-chemical means may have occurred during preparation of the gamma globulin, using the electronic system.
47. The 2D21 thyratron has been the only component to fail in either installation. It *seems* to require replacement about every 4,000 to 5,000 miles.
48. No particular vibrational mode can be suggested at present which might account for this correlation which must therefore be *regarded* as a tentative one.
49. They *regard* these exercises as being too simple for them.
50. Digital memory unit for analog computers uses a magnetic tape transport that moves the tape in small discrete steps rather than continuously.
51. The following experiment was done to determine the effect of length of exposure on the degree of receptor modification at a constant temperature.
52. Multiplication can be performed as a series of repeated additions, and division can be accomplished by repeated subtractions.
53. Further evidence bearing on the correctness of a tentatively assigned electrode reaction can be secured.
54. Depression of the febrile response, particularly, may be due to toxic vasomotor disturbances rather than to an effect on pyrogen production.
55. For example for a ground plane, 0.150 by 0.020-inch strip can be substituted for two wires.
56. Figure 2. These yield curves were taken from typical photocathodes rather than from the best which have been produced.
57. It is to be emphasized that these correlations are purely empirical in nature.

58. The amount of light radiated by an atomic bomb is so great that it is beyond our imagination.
59. It is in this respect actually that the theory differs from that discussed above.
60. Among other alloys under investigation are molybdenum-rhenium and niobium-zirconium.
61. The product is affected little by temperature and contributes little to the net effect.
62. It must be remembered, however, that in these specimens a second phase exists whose concentration might be *expected* to vary with temperature.
63. It was found that the proportion of iso- to normal paraffins could be estimated with sufficient accuracy for the purpose in view by comparing the respective peak heights in the elution diagrams.
64. The object of heating and ventilating a building is to provide a healthy and pleasant home.
65. Fig. 2 is a chart of present-worth factors for annual income received in a lump sum at the end of each year, the interest being compounded annually.
66. We should take measures to maintain the temperature at the same level during the entire process of decomposition.
67. Cytoxan was *found* to have limited ability to suppress growth of established human tumors.
68. Only a few of these articles contained descriptions that *appear* to be similar to the findings in my cases.
69. For a reasonable degree of blackening, however, it is necessary for a total integrated dose of at least 50—100 mR to be received by the film. At the radiation levels here being considered this involves exposure times of 100 hours and upwards for each measurement.
70. This catalyst was *regarded* as affording good results and to involve no difficulties in operating.
71. Because of the large gaps in knowledge it will be necessary to make certain assumptions and these have *been chosen* to be as nearly in consonance with the generally accepted facts and opinions as is possible.
72. Incidentally, the chromatogram gave no evidence for the presence of the N-hydroxy metabolite of 2-FAA, but not much of this compound would be expected after a single dose of the carcinogen.
73. The data revealed that plasma volumes were well above the normal range, in contrast to the levels seen in other forms of hypertension.
74. For complex dials, adhesive characters can be combined with inking — in which case the adhesive characters should be applied after the inking.
75. To-day it seems certain that a given ion does have a definite mobility, one that does not change with time.
76. The above experiments confirm theory qualitatively. The discrepancy in quantitative comparisons was due to several factors.

77. She was *fancied* to have gone away.
78. If, in time, the industry we know reaches a plateau, the potential revolution in power conversion may well give rise to another period of extraordinary growth.
79. Discussion of this work has not been *considered* to be within the scope of this chapter.
80. The ideal non-linear reactor can be *shown* to have a theoretical efficiency of 100% when operating in a circuit that has infinite impedance to all harmonics other than the one desired.
81. Although systems employing a continuous sheet of film are more widely used now, for the sake of clarity, in the following descriptions the film is *considered* to consist of discrete elements.
82. The paper read concerns the properties of some compounds obtained by our Research Institute.
83. Only those substances which can be *considered* as being mixtures have a depressed melting point.
84. The truth of Joule's discovery is to be found in everyday life.
85. It is a logical step to combine some of the electronic instrumentation methods already described with a data processing and computing system.
86. Each corner is *understood* to be the location of carbon atom.
87. India *appears* to have been acquainted with iron and steel from an early age.
88. The microscope and orthicon are both selected to operate well into the ultraviolet spectrum, which means that all lenses must be quartz.
89. The silicon photocell may be used in either reverse biased operations, or in unbiased operations. In the former, it acts as a photodiode. In the latter case, its self-generated power is used.
90. This may be taken as being result of overheating.
91. In any event, current theories either empirical or electronic do not *appear* to account for this result.
92. The author *showed* these compounds as having different structure.
93. It is these ions which actually transport the current.
94. Fig. 9. A cytoplasmic vacuole containing viral particles both free and in process of formation at its margin. When examined at sufficient magnification, virus on the surface of the cell, at the upper left, was *seen* to be tagged with ferritin.
95. Obviously, the transformer must not only provide a 250-Ω primary tap, it must also have a secondary tap to match the voice-coil impedance — and be *rated* to pass 20 watts of power.
96. This method, previously *mentioned* as affording good results, is widely used.
97. Unit cell may contain one, two, or, occasionally, more than two layers.
98. The book *known* to be difficult is here.

99. This inhibition may be due to protamine binding to the surface of the pancreatic duct, thereby preventing protein secretion.
100. This system, since it no longer needs the error voltage to maintain the corrected frequency is not troubled by a change in signal strength or absence of signal.
101. Hercules Powder Co. is also *rumored* close to production, and Avisun Corp. has produced ethylene-propylene rubber in evaluation quantities, but has not disclosed its plans for full-scale production.
102. In the case of feeble magnets the magnetic field is so weak that it may be *considered* confined to a small region near the magnet.
103. After impact, the bars are *assumed* to act as a single solid infinite bar *with* the resulting disturbances travelling in both the positive and negative directions from the origin.
104. This hydrolysis is *taken* to proceed following the above scheme.
105. Promising additional elements considered for ternary systems were aluminum, silicon and carbon, which were *expected* to form the compounds UAl_2, U_3Si and UC, respectively.
106. The first step in obtaining oil is to find its field.
107. In the studies to be described, 1 unit of bacteria represented 0.5 ml of the stock preparation.
108. With this provision, the system can be *expected* to give good base-line stability.
109. One may *assume* the information to be correct.
110. Since the high fluid level could have been caused by downhole-equipment leaks, it is necessary to determine production at 80% efficiency based on the old cycle.
111. *Considering* the hydrolysis as being first order reaction it is possible to draw some conclusions.
112. This discrepancy, which is not important in the calculation being made here, is probably due to a variation in the properties of the photosurfaces and/or to experimental error.
113. The data obtained cannot be *regarded* as evidence of the postulated reaction for the system greatly complicated by other reactions.
114. They *acknowledged* the reaction to be exothermic.
115. The result applies whether or not a thick central web is present. It is to be noted that here the torsion constant is increased by 27 per cent due to the presence of the interior web material.
116. Fawsitt *explains* this as being due to the equilibrium between urea and ammonium cyanate in aqueous solution.
117. The basic engineering concepts of straight cylindrical bearings are important in selection of bearings for steel mill applications, for it is an accepted fact

that the straight cylindrical bearing gives the greatest radial load carrying capacity for a given annulus of any antifriction bearing available.

118. The FAE determination disclosed higher content of fatty acid in endotoxins than could be accounted for by either the «lipid W» or «lipid A» determinations. Lipid A has been *reported* to contain only about 50 per cent of fatty acids.
119. The problem to be solved at this stage is an entirely geometric one.
120. This equation is readily *seen* to be of the same form as Eq. (14).
121. It is not claimed that this is really what happens in the practical case, but these figures can be used to indicate to what extent the small-signal theory is reliable.
122. The experiment that is being conducted is of great interest and is *thought* of as being highly promising.
123. This article must have been translated from Russian into English.
124. This picture is useful but it can hardly be *said* to account completely for the remarkable properties of rubber.
125. The presence of the RFLS in hyperimmune sera of any type would be *expected* to participate in quantitative precipitin analyses, unless the antisera were first absorbed with immune precipitate from an unrelated immune system.
126. While such empirical observations may have their uses we cannot, however, *expect* them greatly to advance our knowledge of fundamental combustion processes.
127. Since cholesterol is *believed* to be a precursor in the biosynthesis of adrenocortical steroids, the cholesterol content of adrenal glands has been employed as an indication of their prior secretory activity.
128. The methaphetamine dose was carefully selected to provide a moderate, but unequivocal, effect.
129. These inhomogeneities are *estimated* to represent carbon content variations of less than 0.1 mg from one to the next.
130. To determine the correct primary impedance tap which will deliver the desired amount of power to the loudspeaker when the transformer is connected to a 70-volt transmission line, the following formula may be applied.
131. Romagnosi's experiment with the influence of a voltaic pile on a magnetic needle was *interpreted* by Govi (1869) as an electrostatic rather than an electromagnetic effect.
132. Svedberg has *placed* the limit of resolution with the light microscope as being at about 0.2 μm.
133. In view of this influence of screening, the dipole moments of the solvent molecules can be *expected* to be one of the important factors governing the relative magnitudes of conductances in these systems.

134. He was afraid of the results not proving conclusive.
135. The Haber process consists in uniting two elemental gases to make a compound.
136. A boy and a young man were *reported* to have been seen leaving a station.
137. This suggestion cannot be *considered* as established.
138. The presence of the anodic wave is attributed to the uncharged species of II being oxidized in a reversible manner to III.
139. We *interpret* the above results as indicating a lowering of the effective pK of the adenine amino group as a result of its linkage with uridine.
140. Binding of a hydrogen ion *appears* to be accompanied by a dissociation of the complex.
141. The proportion of bound lipid removed *appeared* to be about one-half of the total regardless of the amount present in the starting material.
142. The purpose of electric lighting is to provide general illumination.
143. Non-hydrolytic lipid IIa was *found* consistently to possess activity of at least the same order of magnitude as that of lipid A. Its FAE content (e. g., 26.4 per cent) was similar to that of preparations of lipid A from aqueous ether extracts.
144. The chemist is usually inclined *to regard* the appearance of this product as signifying that the reaction is over.
145. The spectral distribution of the incident radiation is *taken* to be that of a black body at 5800° K in order to approximate solar radiation.
146. No line is to be seen when its intensity is *predicted* to be zero.
147. Unfortunately, C_5 in Equation (4) is *found* in klystrons to be eliminated by assumption (6).
148. Despite the foregoing evidence, the observations of Bennett, Petersdorf, and Keene are frequently *cited* as contradicting the endogenous pyrogen hypothesis.
149. Magnesium oxide is *reported* to be a scorch retarder and stabilizer which improves retention of properties during high-temperature exposure.
150. Otto cycle engine. In cases where the exhaust pressure is less than the intake pressure, cycles are analyzed as for the supercharged case, the method described by Bonamy being used in preference to that by Hottel et al.
151. The geologist's first task is to locate geological conditions suitable for the existence of oil.
152. Hydergine is *known* to abolish the renal vasoconstriction induced by epinephrine and it prevents the renal hyperemia induced by pyrogen.
153. In order to be near the mid-region of adrenal secretory capacity, the experiments to be described in the section that follows were, done with 0.01 unit of ACTH.
154. Boyle was the first to have a clear concept of «element», «compound» and «mixture».

155. In 1934 the statement was retracted and the degradation products *declared* to be devoid of significant activity.
156. Rich deposits of iron ore having been discovered, we began to build a blast furnace.
157. Distribution of chromosome number was particularly stable through 5 months of cultivation, there being little variation about the low ploid modes.
158. Hence we must consider the optimization of the noise figure anew, but now with the extra requirement that the bandwidth should not become smaller than a given value.
159. Regardless of the measure chosen, endotoxins extracted at low temperature by the aqueous ether method were *found* to contain fewer lipids than phenol-water or TCA extracts.
160. The property of plastics being superior to that of wood, the designers are *believed* to be working at the problem of re-placing the latter wherever possible.
161. Having overcome all the difficulties on the way of improving the performances of the engine, there is every reason to *believe* it to replace the old one.
162. Of the numerous methods of conducting similar experiments to be found in literature, the following are among those which have *been proved* to be most useful.
163. One cannot fail to see other countries tending for mutual cooperation.
164. This rule is *believed* to hold good for other cases as well.
165. They are *said* to have already taken necessary measures against further spreading of this infection.
166. The decline in the levels of pyridine nucleotide-linked dehydrogenases of the adrenal and the subsequent increase ran in parallel with histological evidence of damage and repair, respectively to be described below.
167. Some mistakes must have been made in assembling the parts of the machine.
168. Peripheral stimulation of cold is associated with vasoconstriction and increased metabolic rate. This action can be *viewed* as an overriding of the effects of the central receptors by the peripheral stimulation.
169. *With* the isomerization preceding the reaction, the yields were very low.
170. The work on these ternary compounds was initially concerned with those having a cubic structure, in particular, the rocksalt and zincblende types.
171. We *know* the first central electric power-stations to have been built for the supply of electric light.
172. The above formula is for a column operating under total reflux, that is, *with* no distillate being removed.
173. The reaction was *feared* to take a different course.
174. Eighty-five per cent hendecanol — 15 per cent liquid paraffin thus gives a reasonable, if somewhat involved separation of the nitrogen bases.

175. Only 2 species, common ragweed and cocklebur of 100 or more Ambrosiaceae of North America are *reported* as having been introduced into Japan.
176. The loss of area is *believed* due to a filling or blocking off of catalyst pores.
177. It is usual for any new device to be preceded by other related devices. This tachometer, for example, bears some resemblance to a miniature Van de Graff generator.
178. Included in this paper are the calculations which will permit a correction for direction of stress.
179. However, a component of the stress gradient vector would then be required to be introduced into the z component of the equation of motion, unless other considerations *show* it to be negligible.
180. *With* the experiments having been carried out, we started new investigations.
181. As with most research, the electrophysiological investigation of learning has raised more questions than it has answered. From the mass of experimental data new conceptual problems have emerged. Some random examples may be briefly noted.
182. Whatever the nature of the metal, the slower the rate of cooling the larger will be the size of the crystals after solidification.
183. Eq. (22) is simply a rearrangement of Eq. (20), *with* summation substituted for integration.
184. Balancing is done by adjusting the position of rods.
185. As shown by Weart and Mack, a normal eutectic has three definite structures: the grain structure, the colony structure, and the eutectic mixture structure, each being contained by the one preceding it.
186. The number of electrons per square meter of surface between the plasma and the vacuum is *estimated* from the average lifetime and the flux to be as follows.
187. To summarize the findings of this tremendous work would require many pages.
188. As the tabulated data and calculated results are voluminous, 98 extractions in all being involved, we have chosen simply to describe the manner in which the computation was made and show the calculated distribution coefficient graphically.
189. The acute angle φ between the bisectrix and either optic axis was *measured to* be 1.3° for the bulk crystal specimen B.
190. The boiling point of the fractions *assumed* pure corresponded to the boiling points of known pure materials.
191. There are unmistakable proofs of Pauling's having been wrong.
192. It is necessary to ensure that the preliminary reaction is essentially complete.
193. When purchasing a line-matching transformer, the following considerations have to be examined.

194. Because of the way we must collect the facts, the survey of generating plants does not include all current programs, nor does it contain only current plant construction.
195. A large number of ternary compounds have been examined, and of these $AgSbTe_2$, with the rock-salt structure was *found* to be the most promising for power generation.
196. While this procedure necessarily reduces the precision of the data, nevertheless the precision *appears* adequate to establish the kinetics with reasonable assurance.
197. For the present we shall *consider* only diffusion and the rate of the electrochemical reaction as controlling factors.
198. One cannot *expect* a complicated problem like that of using solar energy to be solved in a year or so.
199. The extra stress due to the presence of a magnetic field discontinuity at the surface of a plasma *treated* as a compressible dissipationless conductor is *found* to be expressible as an equivalent body force.
200. No cells of this type were observed in the parental population, and the component *appears* to have arisen during the cloning operation.
201. At this point the writer *finds* it desirable to change to a coordinate system which is more convenient than the one used in Reference.
202. Davy *recognized* the gas from the reaction of boracic acid and fluorspar as a new gas containing boron and fluorine.
203. The present era, which is distinguished by the utilization of metals in enormous quantities, may be *said* to have begun in 1860.
204. Prior to discography the patients in this series with degenerated disks as well as the patients with absolutely normal disks were suspected of having a herniation.
205. Jameson and Salmon *interpreted* the parallel tie-lines in the metastable ferric system as due to the fact that $H_6[Fe(P0_4)_3]$ which was separated out initially acted as a cation-exchanger.
206. He may have gone to the library because he failed to find the necessary book at home.
207. These observations are consistent with the findings of Roberts et al. that the glutamine levels of tumor tissue are far below those in normal tissue.
208. However, the separation is under total reflux, and so, using the safety factor of 1.5 to 2, we *obtain* 15 to 20 plates as being a safe value to use for the actual separation.
209. Now it is obvious that the rejection of foreign species tumors is due to the immune answer to heteroantigens as is the rejection of any heterograft.
210. Winter and summer rates of insensible perspiration are *known* to be quite different as has been confirmed recently by Nakayama et al.

211. Within this time the maximum change in conductivity was to be observed. Part of this change decays again *with* a time constant ranging from minutes to hours depending, as the magnitude of the decay did, on the surface potential of the crystal and the pressure of the surrounding gas.
212. Our solution (2) holds as long as A<1. For A>1, the electron flow is no longer unique, the hydrodynamical concept breaks down, and we must allow for dissipation of the plasma waves as described by Dawson (1959) and Buneman (1959).
213. This group being inert to most reagents, it is impossible to hydrolyze it.
214. The compound *described* in the literature as having the following structure has been *shown* by Russian chemists to possess qualities of great interest.
215. In the presence of this compound, which is *shown* to direct the reaction along the radical mechanism, there was formed a mixture of two products, no other products having been found.
216. She must have forgotten all about it otherwise she would have come.
217. If all the melt, *considered* to be homogeneous, is kept at the same temperature, solidification will begin at certain positions in the body of the melt, called «nuclei». These nuclei may be *assumed* to be very small to be visible.
218. The ammonia which is formed is *considered* to be and has been quite definitely *established* as representing the amide nitrogen of the protein molecule.
219. The missile and space industry demands that new and more complex products be introduced in a shorter time than previously allowed.
220. The doubling of the voltage is due to E, in the horizontal circuit being out of phase with E, in the vertical circuit.
221. Since both neoplasms are known as nonmucin-producing, it was felt that the positive reaction was probably due to some unknown substances associated with cellular degeneration.
222. These substances differ only in being mirror images.
223. The final drive speed to the capstan is 68 rev/min and the period taken from «switch on» to full speed is quite short due to the drive system presenting a very light load to the motor. This ensures that the possibility of a word being missed during starting or stopping time is remote.
224. There have been 3 instances during the past 4 years in our clinic in which portions of the internal carotid artery were *found* to be filled with a recent thrombus.
225. In order that a body be in equilibrium under the action of any number of forces, two conditions must be satisfied.
226. The edited master in single channel form is first played at its correct speed on machine A, one channel only being used and its output fed via a channel selector switch to machine B running at «book speed».

227. Should a sulphate be present in the mixture, organic matter will reduce it to a sulphide.
228. A reconnaissance Victor can map the entire Mediterranean in a single sortie, giving an accurate count of the number of ships there. It is still the largest aircraft to have exceeded the speed of sound.
229. The sera which did show antinuclear activity against the cultured cells *appeared* to react with all the chromosomes of the cells.
230. With proper design, the cell between two switched conductors will emit light and the remaining cells will appear dark.
231. The first problem we shall investigate is that of calculating the chance of the electron passing over a distance X parallel to the electric force without becoming attached to a molecule.
232. The assumptions upon which the equations have been developed have been simple and have *considered* heat flow in only one direction, i. e., normal to the skin surface.
233. The agenda of the conference exhausted, the delegates began leaving for their homes.
234. Among the biological substances released during stress are the corticosteroids. The «oxidative performance» of diaphragms of rats which had been given a large single dose of cortisone was significantly enhanced.
235. For the detection of any small difference more careful measurements have to be made.
236. It is essential that the substance be chemically pure.
237. As size effects are not the controlling factor, one must *look* to the electronic contribution made by each atom as related to the position of the element in the periodic table.
238. It is not essential that the surface of the metal should reach its melting point in order that it may be polished.
239. The possibility of ethylene being converted into aromatic hydrocarbons is slight.
240. Iodine adsorption has been used as a measure of surface activity of magnesium oxide by Merck Marine Magnesium Division since 1943. It is one of the tests we use to control production of elastomer and other grades of magnesium oxide.
241. Wartenberg *recalculated* the heat of formation of boron trifluoride to amount to 250.1 kcal per mole.
242. Because of the importance which has been placed upon this evidence, it has been reexamined in the present study.
243. *With* a one-turn loop around the case, the capacitance value of the tank capacitor will tune the standard FM broadcast band, 88—108 MHz .
244. On the other hand 9-phenanthrol apparently resembles the remaining phenanthrols in being largely phenolic.

245. Using less glass, a costly ingredient, the squared-off design weighs only 30 pounds as compared to 33.5 for types in current use.
246. The fraction of surface available *works out* to be as follows.
247. The loaded end of the ribbon (the force being directed downward) is between the reader and the plane of the graph.
248. Furthermore, one need not even know how to make the reaction in question occur.
249. The near infrared part of the spectrum will be *taken* to extend from 0.5 to 20 μm.
250. This is often *found* not to be the case.
251. *With* these possibilities in mind we may proceed to review the experiments employing rhythmic stimuli as CS.
252. The results show a sharp drop in fatigue strength *with* only small amounts of decarburization ranging up to 0.0015 in. per surface.
253. A third weeding projection *is* provided if component leads are to be welded to the rail.
254. After a careful study we came to the conclusion that the formula *appeared* much more complicated than the one we had been using before.
255. Were there no loss of energy by friction, the motion would continue indefinitely once started.
256. The filters required to convert these rectangular waveforms to sinusoidal waveforms are relatively simple because there are no unwanted components at frequencies lower than the one required, or less than one octave above it.
257. There was no hope of their solving this complex engineering problem this year.
258. I would be very glad to take part in this conference if I were invited.
259. In two patients with bilateral lumbar sympathectomy, radiant heating of the legs did not evoke reflex vasodilatation in the hands as had been the case prior to operation.
260. This phenomenon is accounted for by the sudden rise of temperature.
261. This is too often the case in inorganic “ion” analysis.
262. For the estimations use will be made of a hypothetical reference model.
263. There are very few people, if any, who follow this old method.
264. For contact to occur along the length of a particle the water film must recede in a time of about 1msec.
265. What criteria should be used before *labeling* a patient as having porphyria?
266. These two substances are *known* to be so much alike that one should find some difficulty in telling one substance from another.
267. If you had followed the procedure described, the experiment would have been a success.

268. About a 2% increase in the phasic discharge above the background or static firing levels would be *perceived* as warmth and a change of 6% above the background level *perceived* as cold.
269. Kekule *conceived* valence as being a property of atoms and to be a constant for each element.
270. The diagnostic criteria in primary aldosteronism have changed little since the classic description by Conn.
271. This phenomenon is the more pronounced the more non-homogeneous the metal.
272. In fact the best yield of XIII (57%) was obtained under this condition, the yield of VIII being only 12%.
273. It is this kind of investigation and presentation of results that can be invaluable in pointing the direction for future development of the whole industry.
274. Of the temperatures and pressures occurring in an internal combustion engine, those that *are likely* to be of most interest to the designer or research worker occur immediately after combustion: that is, they are the peak values.
275. Removal of the protective group gave a 3-mono-ketone *characterized* as having the 5-configuration by the rotatory dispersion curve.
276. I did not know of her having been ill. Did you hear about our delegation going to London?
277. This causes the metal diaphragm to move back and forth, thereby setting up sound waves.
278. This reaction can be *considered* as being of great importance.
279. The explanation lies in the product being more stable.
280. Alcohol, well established to increase the risk of cancer in the upper alimentary tract, has been but little studied.
281. The satellite is in a 100 per cent sun-time orbit *with* the transmitter assembly located on the sun side of the satellite normal to the sun vector.
282. For convenience in the design of the panels, connections are made in pairs, the input plug having three pins, and being attached to two single pin output plugs.
283. The ionic character of the bonds in SiF_4 and SuF_4 is *calculated* to be approximately the same.
284. It is hydrogen, one of the elements composing water, that attracts the attention of scientists in the whole world.
285. Probably the first indication of there being more than one kind of fluid motion was obtained from the appearance of the free surface of flowing water.
286. Previously the only way of effecting the reaction in saturated compounds was by heating with concentrated sulphuric acid.

287. This was followed by an infrared analysis of the sodium chloride formed, which contained the sodium monoxide impurity.
288. If you run into a wide-band detector that is badly aligned, the safest thing is to obtain the service manual and align the detector as recommended.
289. There are a few papers dealing with this subject.
290. X can be *shown* as containing admixtures.
291. Samples of several human and horse sera were incubated for 24 hours at 37° C with streptococcal extract in a dilution (1:200) *known* to provide a high degree of opalescence.
292. Y is *taken* as indicating a new route to this compound.
293. Uniform composition is *said* to make the organic material desirable as a coating for the steel pipe. High solid content causes it to set rapidly.
294. However useful it may be, it cannot be employed to advantage unless it can be obtained in adequate quantities and at reasonable price.
295. To be particularly considered are the following reaction mechanisms.
296. Hence, it is necessary to specify the solvent when *speaking of* a certain optical isomer as being the d-isomer or l-isomer.
297. The time necessary for the sun to move a complete circle around the galactic center is some 200 million years.
298. We *think of* X as being a straight line.
299. This addendum may well be *considered* as a supplement to the original communication.
300. In any case, it is questionable whether small samples extreme uniformity should be a basis for making data suspect.
301. It is probable that the coordination number of the magnesium ion is somewhat less than that of the other ions of the alkaline earth group.
302. We had to repeat the experiment to check up the results obtained.
303. He may have to stop his experiments.
304. In general, small animals depend more on the metabolic response than do the larger animals which are more prone to develop greater insulation and conserve body heat.
305. He would have got all the necessary equipment if he had joined the expedition.
306. If desired, the film may be deposited in discrete elements, usually circular, by placing a suitable mask over the substrate.
307. No satisfactory formula for calculating the surface area of a particle from its diameter has been devised.
308. On some wide-band discriminators you may find only two peaks. In that case, choose the one which produces the cleanest sound.
309. Had the checking up of the experimental data not taken so much time, we should have completed our work long ago.

310. It is the physical property of the substance that is *known* to attract the attention of our scientists.
311. For example, a progesterone cream was *advertised* as having life giving principle because it contains a placental hormone.
312. It is desirable on occasions to have a group that is somewhat less basic.
313. X is *postulated* as arising form excessive heating.
314. This method, previously *mentioned* as affording good results, is being widely used.
315. This type of carbon ion has been *observed* to undergo the Stevens 1,2-shift of methyl group only at relatively high temperature.
316. A rough idea of what is *thought* to be taking place is given by the formula below, the dotted curved arrows indicating the movement of single electrons and not of electron pairs.
317. New polyhydroxyanthraquinones were synthesized and some of them were *found* applicable as mordant dyes.
318. The diastereoisomers of these substances are designated by the prefixes L-allo and D-allo, the latter denoting the configuration of the α-carbon atom.
319. Bohn also obtained the blue dye and *recognized* the substance as having a condensed-ring system.
320. Such groups were further subdivided depending upon whether the longer or shorter chain occupies the 2-position.
321. At least three hexadecenoic acids have been *stated* to occur in the natural oils, which raises the question to as whether they are structurally identical or are different acids.
322. The centrifugation was continued with distilled water for the same number of times as before, the last centrifugation yielding in nearly all cases a dilute colloidal solution of the polymer.
323. *Taking* these forms for simplicity as being individuals rather than the canonical extremes of a mesomeric hydrid we get.
324. It is difficult to assess these effects numerically, but advocates of this interpretation consider that, *with* all the adverse influence acting jointly, an inefficiency factor of about 10^7 could be *understood* to be present.
325. For the sake of clarity the reactions have been separated as steps, but actually are to be *pictured* as taking place almost simultaneously by a circulation of electrons, the intermediate stages never actually becoming free as individual molecular species.
326. Although the 4,11-state of NO has been *predicted* by Mulliken to be a bound state, it is considered separately because insufficient spectroscopic data are available.
327. We *expect* the delegation to arrive in a few days.
328. He *remembered* to have once carried out this reaction.
329. It is a difficulty to be avoided wherever possible.

330. Steel castings are extremely difficult to machine unless annealed.
331. Hardness may be defined as the ability of a substance to resist penetration.
332. Copper to be used for tubing has high corrosion resistant qualities.
333. The process to be treated subsequently in more detail is known as ionization.
334. There is a tendency for corrosion to enter the metal along the surfaces of sliding.
335. Smith and his coworkers failed to determine this reaction, these authors having dealt in their investigation with compound B, mistakenly *thought* by them to be compound A.
336. Carrying out the reactions of addition of chlorine gives the corresponding esters.
337. Comparing the reactions one finds the directing action of this group to be opposite to that of other groups, the character of the former group being thereby proved.
338. Recent neutron scattering data will be *seen* to yield an upper limit on the following polarizability.
339. The possibility of explaining the anisotropy on the basis of ordinary, scattering theory does not *appear* to be excluded.
340. It may *appear* to have been unnecessary to discuss the formula for the polarizability both by the method of optical dispersion and by the perturbation calculation which starts with Eq. (2). The reasons for outlining the reasoning are as follows.
341. The neutron may be *considered* in fact as being exposed to a time-dependent electric field.
342. Notice that the time to solve Eq. (27) for several column input matrices on the right side will be only slightly greater than the time required to solve Eq. (27) *with* only one column input on the right side.
343. The association of the disubstituted phosphine oxides is probably similar, and the shift of the P—H stretching frequency can be *interpreted* as reflecting the change of electron affinity of the phosphorus atom.
344. The blackening of photographic film by *x*-radiation is frequently used for monitoring purposes and has the advantage that very localized measurements are possible, thus overcoming the difficulties mentioned above for ionization chambers.
345. This second master can be in two spool, or endless loop cassette form, the latter probably being the most convenient. This is then played back at a fixed multiple (say 4) of «book speed» by a machine using multiple replay amplifiers, simultaneously, their outputs being fed to the final copy-making machine also running at the same speed.
346. In the usnolic acid series, spirans (I) are attacked by ozone in the expected fashion to give coumaranones (II), but in the grisan series ozonolysis (in

methyl acetate) of spirans (III) gives anomalous results, the products having been assigned structures of type (IV).

347. The maintenance of a temperature within a prescribed range under conditions of varying thermal loads can be termed temperature regulation. This does not necessarily mean maintenance of constant heat content; that is, no heat storage.
348. Since the relationship between opalescence and cholesterol release is evidently profoundly influenced by extract concentration, the progress of the two induced changes in serum with time was systematically compared at several different concentrations of streptococcal extract.
349. The use of amplification makes possible the satisfactory reception of signals from waves that would otherwise be too weak to give an audible response.
350. The problem of space-charge cancellation is not unique to the thermionic energy converter, but is common to high-current electron tube devices for rectification and switching purposes.
351. Our present knowledge of photoemitters makes it possible to estimate the efficiencies which might be obtained from such devices and to discuss some of their advantages and disadvantages.
352. The input signal was *taken* to be a fast wave at the cyclotron frequency, which meant that all the electrons had orbit radius s and the same time phase of rotation, *assumed* to be zero.
353. *Assume* in the first place s to be very large, which means that g_c approaches zero. Then eqns. (18), (20) and (21) become identical with eqns. (8) and (9). Indeed, when $g_c = 0$ the stability of the circuit is not a problem and we should once again expect to find the case of $g_c \geq 0$.
354. The best procedure is that which gives the greatest reduction, and this maximum reduction may be *taken* as a measure of the return to be expected from applying extremum control to a given plant in a given situation.
355. As in liquids, the atmospheric pressure at any given point is equal in all directions but we *know* it to decrease as altitude increases.
356. It is assumed here that the resistivity, thermal conductivity, and thermoelectric power are constant within a branch over the temperature range considered and, consequently, that the Thomson coefficient can be *regarded* as zero.
357. The Gattermann reaction and the method explored by Bisagni, Buu-Hoi, and Royer were both used for this conversion and *found* to give comparable yields. The latter being much the more convenient, it is now preferred.
358. It is assumed that set pulses have been applied to three of the stages so that binary number 11001 is stored in the register. The shaded stages are *assumed* to be in the binary 1 condition, and the unshaded stages are *assumed* to be in the 0 condition.

359. On this view the constitution of the cation of the coloured salts is that of a free radical, there being one less electron than is needed for a compound of normal valence.
360. Single tumor fragments of S-189 and Ca-755, weighing approximately 15—20 mg., were implanted subcutaneously by trocar. Leukemic cells were inoculated intraperitoneally, *with* 0.1 ml. of diluted ascites fluid containing 10^5 L1210 leukemic cells.
361. If the Fourier spectrum of the field is used to calculate the neutron polarization, one deals with frequencies of the order of the reciprocal of the collision time.
362. At higher energies electric dipole radiation can be *expected* to give rise to D state in the continuum.
363. A possible reason for increasing the estimated A might be *supposed* to be that the observed G is influenced by retardation effect and may therefore be too small.
364. Since the optical-model potential cannot be *expected* to take into account all interactions of the neutron with the nucleus an explanation along conservative lines of low-energy nuclear physics may *turn out* to be adequate.
365. Aberrant data may occur without necessarily resulting in unusual values for the average or the range, the measures usually considered in a quality control program — it is possible that a single animal may be atypical without unduly affecting the average or range.
366. Just prior to this transfer it could be seen that heteromorphic cell sheets were forming. This was especially evident in the 800-r cultures, where a number of focal areas of growth were developing, having obvious morphological differences.
367. Working under hard conditions were all the early students of this new field of chemistry.
368. Plotting these frequencies against the sum of the phosphoryl shift constants of the other two substituents, excluding the oxygen, gives a smooth curve. Trivalent species would not be *expected* to obey this relationship.
369. During later months a diploid level component appeared in PK 1—1. Two explanations for this are possible, one being that a diploid component arose from the heteroploid by chromosome loss, the other being a contamination from an outside source. It was not possible to distinguish clearly between these two possibilities.
370. Chalk is made up of the shells of little animals. They must have been tiny thing, for you can only see the shells with a very strong glass.
371. They succeeded in obtaining good results working with quicksilver, it being *known* to be a very dangerous metal.
372. Having extracted the acid, they continued experimenting.

373. There being an admixture in the parent compound, the overall yield *proved* to be low.
374. The data obtained are *considered* as not being adequately represented by equation 1.
375. I feel so wonderful, she said, about just being *supposed* to have killed the lion.
376. On the basis of the product being a single isomer, the intermediate radical *appears* to react with iodine.
377. To support this view it *seemed* important to study a reaction which is *known* to proceed readily in the above conditions.
378. The equal spacing between components *appears* to make double flip-flops possible in most configurations.
379. The essence of the spin-spin processes is that a jump from resonance V_α — $>V_\beta$ can be made, the balance of energy being taken up by a large number of transitions.
380. The Boltzmann expressions for the transition probabilities are *shown* to have been applied under conditions for which they are not valid.
381. As is usual with non-linear dynamical systems the equation for the distribution function cannot be solved independently, a solution requiring a knowledge of the binary correlation function, which in turn is determined by an equation involving ternary correlations, and so forth.
382. X-radiation of PK 1—2. Having obtained information as to the homogeneity and chromosome constitution of the low ploid stemline of PK l—2, we introduced chromosomal variants into the population by means of x-ray treatment.
383. We have arbitrarily *labelled* edema «severe» when the limb has been one inch or more greater in circumference than the other, and especially if it extended above the knee, when the patient has attributed disability to it, or finally, when the examiner has used that expression in recording it. Contrary considerations have led *to label* other instances as mild.
384. We succeeded in getting Mr. Arthur and Walker's opinion on this question, the former being a scientific worker of a well known laboratory and the latter director of a large plant.
385. The data of Tables II and IV establish beyond question that the kidneys of endotoxin-poisoned mice are functionally impaired. Since urea, the predominant non-protein constituent accumulation in the blood of the intoxicated mice is *known* to be distributed throughout body water, it became important to assess total body NPN.
386. The sulfite liquors of the paper mill are being worked up into industrial alcohol.
387. Any deviation from ideality may be due either to the heat of dilution not being equal to zero, or the entropy of dilution not being given by R — In N_1.

388. The present report concerns the induction of a rheumatoid factor-like substance (RFLS) in 2 groups of rabbits immunized with either formalin-killed E. *colli* or B. *subtilis* that were grown in synthetic media free from any source of contamination with animal protein.
389. Our aim has been to work out general methods of synthesis of various compounds, starting with those involving, for example, the following radicals.
390. In the course of our investigation we have synthesized a great number of substances, some data being listed in Table 3.
391. *With* the above principles of thermocouple construction in mind, data largely taken from the recent work of Rosi, Dismukes, and Hockings are presented on the evaluation of compound semiconductors and alloys for power generation over specific temperature ranges.
392. *With* two diametrically opposite solar-cell groups mounted on the satellite, there was equal chance for the normal to one of the groups to form an angle greater or smaller than this value with the sun vector.
393. The ground state of K^{40} is *known* to have spin 4, the first excited state at 29^{4} keV is *expected* to have spin 3, and both are *expected* to have negative parity. The transition between these two states should therefore be predominantly dipole.
394. Although a variety of factors, in addition to virus, have been *recognized* as being important in the pathogenesis of cancer only limited information is available which serves to characterize the initial stages of the leukemic process.
395. Our preliminary results do not suggest that caloric restriction is apt to provide a very profound increase in life span of mice bearing L1210 leukemia.
396. The histological type of a particular cancer therefore *seems* to be the combined result of the relative potency of the carcinogenic action and the reactive status of the host organism.
397. The oral drugs, known chemically as sulfanylureas and biguanides, have greatly reduced the need for insulin injections in many diabetics. All of them were *found* to be more effective than insulin in lowering cholesterol synthesis in the rat liver tissue.
398. The total energy E is *assumed* to be constant in all these calculations, i. e., the energy stored in the induced rf- fields internal and external to the ferrite is *assumed* to be small compared with the stored energy of the cavity.
399. The atomic scattering factor or form factor may be *thought of* as a measure of the scattering due to the individual atoms.
400. Perhaps on the basis of this notion most of the recent effort expended in attempting to prove existing tables of these factors has been limited to using better atomic wave functions.

401. Essentially, in this model the crystal is *assumed* to be entirely ionic *with* no exchange between charge clouds of adjacent ions.
402. Unless these two particles scatter coherently in «hard» interactions, the small deuteron binding energy should not be *expected* to keep them together.
403. However, the hypothesis of Siekevitz and Potter has been criticized on the grounds that AMP did not stimulate oxygen consumption as quickly as did ADP.
404. In modern aviation greater and greater speeds are being attained, entailing, however, a substantial increase in air resistance.
405. It will be seen later that, with sensible values for the operating parameters, this statement remains substantially true when large-signal effects are taken into account.
406. The effect of the pumping field will be to change the radius and phase of the orbit in a manner depending on the value of Θ_0. Strictly speaking the axial velocities will also be changed, but this effect will be ignored for the time being.
407. The newborn elephant and the fallow deer can run with the herd shortly after they are born. By the age of 6 weeks, the infant seal has been taught by his mother to navigate his watery world for himself.
408. It is concluded that from both the classical and the quantity algebra viewpoint, only units are affected by rationalization and not quantities.
409. It was Clausius who in 1857 established the kinetic theory of matter according to which molecules are in constant motion, the motion itself being heat and their velocity being dependent on the temperature.
410. The purpose of this study was to evaluate the importance of three variables: distribution ratio, film thickness, and diffusion in the mass-transfer term.
411. Based upon observations in 5 surgically proved cases of primary aldosteronism, laboratory tests were sought that might prove useful in diagnosis.
412. Had we informed proper agencies interested in building such a machine we should have received their necessary assistance.
413. Also included in the tentative specification is a table which lists the relative weldability, formability and toughness of the six proposed grades based on their respective chemical limits.
414. There are several ways to check tape speed. The quickest is with a stroboscope. Several firms make this instrument. One very small one is placed on top of the capstan idler. Another is a strobe disc, about the same general dimensions as the familiar strobe disc used to check record changer speeds.
415. Experiments have shown that isomerization does not take place during the reaction of substitution bromine by lithium, but that it is the organolithium compound which is isomerized after formation.

416. Every output socket is connected to an interrogation gate input, its other input being from the ΔZ tristable corresponding to the socket. It will be realized that the flow of signals is from the input to the output socket. This is of no concern to the programmer, who can legitimately *regard* the flow as of ΔZ pulses from the output to the input sockets.
417. Due to the non-coincidence of the geographic and magnetic poles and to the presence of magnetic materials in the earth, the compass needle does point to the true North in only a few places on the earth's surface.
418. The refractive index of amorphous selenium at a wavelength of 2.5 microns has been *reported* to be 2.46 or 2.44 by different authors.
419. The possibility of *demonstrating* specific parts of the intestinal tract as being responsible for the intoxication seen in Eck-fistula animals was explored in two ways. In one series, a single branch of the portal vein was partially and then completely obstructed; several weeks later, portacaval anastomosis with ligation of the portal vein at its entrance to the liver was done.
420. Before going further, it is desirable to outline some of the basic features of regulating and control systems in somewhat more detail than was done by Burton. The technology in this area has developed greatly since 1940 and good texts on the subject are now available.
421. Data obtained for cooling conditions and presented in Fig. 15 may be *considered* as in satisfactory agreement with the generalization of their results, although there is slight evidence that holding at 1065 F has increased the amount of bainite formed during subsequent cooling. The data, however, are not conclusive.
422. Although vasoconstriction does not enhance body insulation by an order of 10 in man (or other land warm-blooded animals) upon cold exposure, it does assist in maintaining a degree of thermal insulation in the face of exercise and shivering and thus helps to conserve body heat.
423. On close examination of a piece of granite we *find* it to be composed of several kinds of minerals having different degrees of hardness, different colours, and different properties in general.
424. Lubricants are employed in engineering practice for two reasons: to diminish friction surface of machine parts, and to diminish friction between a cutting tool and the material being cut, and at the same time serve to dissipate the heat developed in the operation.
425. The engineer *wants* the workers to use soft rubber for electrical insulation.
426. We *know* physical changes to be caused by heat.
427. Warm blood is then circulated into the cold peripheral tissues and returned to the deep tissues at low temperature thus causing a temporary lowering of the deep temperature. In some instances this fall in internal body temperature may be great enough to stimulate the central cold receptors and evoke strong shivering.

428. This difference represents the heat flow into the thermocouple, which, together with the measured electrical output, enabled the efficiency to be calculated.
429. There have been rumours that more efficient carburators have been invented which are *said* to have increased the gazoline milage of automobiles by as much as 100 per cent.
430. The atomic bomb explosion may blow a hole in the ocean a mile in diameter, the size depending on the amount of plutonium used in the bomb.
431. History offers many examples showing that interference of one state in the internal affairs of another has always resulted in differences and often in wars.
432. Essentially the apparatus consisted of two capillary tubes of different diameters in communication with a wider tube through which the liquid under investigation could be introduced.
433. We *know* the velocity of a particle to be continuously changing if this particle has a nonuniform motion; in each successive time interval the particle acquires some increment of velocity.
434. Human erythrocytes from donors with blood group typings A and AB treated with an adenovirus type 1 suspension exhibited the same decrease in agglutinability against the test viruses as did group 0 erythrocytes.
435. Fraction C, of which the lipid A content had been markedly lowered, still retained 3.0 per cent nitrogen and thus contained appreciable protein which might have exerted an influence in the biological activity of this preparation. For this reason, further studies were conducted as detailed below.
436. All serological procedures utilized sera which had been heated to 56°C for 30 minutes. Sera for hemagglutination tests were absorbed with 1 volume of washed, packed sheep erythrocytes per 2 volumes of serum. Unless otherwise stated, all dilutions were made in phosphate buffered normal saline (pH 8.0).
437. Significant rises of serum potassium levels over control levels were seen in all cases of primary aldosteronism by the third day of spironolactone treatment.
438. The same phenomenon was observed by Arago and Seebeck in differing forms, using filings, soft iron, and steel needles. They found that the soft iron ones were difficult to magnetize permanently but the steel ones retained their magnetism permanently.
439. The manganese content of the residue was corrected for the amount combined with sulfur to obtain the percentage in the carbide. In this calculation all sulfur in the residue was *assumed* to be combined with manganese, and the fraction of the sulfur in the steel that is retained in the residue is based on the analysis of seven residues from each of the two steels.

440. It has been suggested that the range of existence of X is very limited, centered about a composition corresponding to integral numbers of each atom in the unit cell. Such an arrangement is suggestive of an ordered system which indeed was *found* to be the case in Fe — Cr — Mo by Kasper.
441. If no energy were lost during the transformation, the input and output would be equal and the machine would be perfect as it would change the form of the energy and lose none.
442. The missile to be analysed is *idealized* as a long beam-like structure that has a finite number of lumped masses, mass moments of inertia, flexural stiffnesses over a short interval of length, and shear stiffnesses over a short interval of length. The masses are *assumed* constant at some particular time which means that the mass change during the time for a single vibration is small and negligible.
443. Consequently, the proper bias conditions are no longer satisfied for some part of the ion emitter. As a result the system is forced into the Z-state and the collector current becomes small.
444. Consider a plane-parallel converter diode where both ions and electrons are emitted with Maxwellian velocity distribution from one electrode and are collected by the other.
445. It should be stated that we are assuming throughout this chapter that the primary condition that the system be stable is already satisfied.
446. The material damping is considered in a manner which *seems* to be as exact as it can be without the use of nonlinear equations.
447. Although few data could be obtained, this phenomenon is further shown by the virtual absence of temperature effect on the Walden product, the values obtained at 45° from limiting equivalent conductances in tri-p-totyl phosphite being almost identical with those at 65°.
448. The rating for a compound employing these bands was the highest of its ratings relative to the historical or the current control average. Such a rating should be *interpreted* as an indicator of possible, rather than definite, proof of anti-tumor activity.
449. He *believed* the results of this test to have been plotted in the diagram.
450. Hardness and tensile strength tests are *shown* to be rather indirect attempts to measure the strength of the bonds existing between the atoms of the metal.
451. To obtain one ton of uranium it would be necessary to quarry at least 40.000 and possibly 250.000 tons of uranium ore.
452. An absence of glucose-6-phosphatase has also been reported in the Novikoff hepatoma by Weber and Cantero. It has, however, been *shown* to be present in the transplanted hepatoma originally induced by chrysoidin.
453. This suggests that adaptations, probably in the form of mutation-selection, can occur in the quasi-diploid components as well as in the components of

higher ploidy which have been *considered* as genetically more versatile by Levan.

454. Finally, this investigation has provoked several questions which are unanswerable at the present time. What is the specific attraction between antigen and activated cells that causes them to leave the blood stream and concentrate in the mesenchymal tissue? Does the antigen seek out the cell or vice versa? At what level in cellular development does a cell acquire its specific reactivity?
455. Although vascular responses to cold have generally been *considered* as serving the body economy by increasing body insulation and thus decreasing loss of body heat, it is clear that this is but one of the many cardiovascular reactions to cold exposure.
456. The patient in case 3 was *considered* to have had the nephrotic syndrome for about 16 months and a diagnosis of chronic membranous glomerulonephritis was made on microscopic examination of the renal biopsy.
457. For reasons discussed in the text, this «free» ferritin, seen only at very long intervals after ferritin administration, is *thought* to be a newly synthesized or endogenous protein rather than the exogenous tracer. Magnification 80,000.
458. Rabbits made granulocytopenic with nitrogen mustard have been *shown* to generate serum endogenous pyrogen when given a fever-producing dose of bacterial endotoxin. This finding is in accord with the hypothesis that endogenous pyrogen plays a central role in the pathogenesis of endotoxin fever.
459. If a single drop of water were magnified to the size of the earth, each molecule contained in it would be no larger than a football.
460. The blood was obtained from the marginal ear vein. Rabbits which failed to develop a leucopenia of less than 1000 cells per mm^3 were given a second and occasionally a third injection of nitrogen mustard (3 to 7 mg) and were followed in the same manner.
461. The data in Table 1 and results of other experiments involving tests for various host responses, while indicating that the quantity of lipid present in endotoxins did not parallel their host reactivity, were not *considered* conclusive since the content of bound lipid had been determined by only one method.
462. Groups of rabbits were given graded doses of the endotoxin under test so as to obtain data for calculating the dose required to produce a fever index of 40 cm^2, a value which was *shown* to fall on the linear portion of the dose-response curve.
463. Since the data of Bernardini and Goldwasser are generally *believed* to indicate proportionality of *G* to the pion momentum in this energy region the retardation effects are not *likely* to be very strong because if they were the threshold law for *S* pion ejection would be obeyed poorly.

464. It is true, however, as Wilkinson pointed out, that fast transitions are more *likely* to have been observed than slow ones.
465. Such fluctuations, being sensitive to the exact location of channel boundaries, would not be *expected to* reproduce in successive determinations.
466. Direct calculation of the position in a square well or oscillator potential is insufficiently accurate, absolute level positions being most sensitive to the details of initial assumptions.
467. The prepared fractions were analyzes for total lipid, unesterified and total cholesterol, lipid phosphorus, and total nitrogen. Direct protein analyses were not carried out because, in trials using several commonly employed methods, the opalescence and fatty nature of the fraction recovered from extract-treated sera had been *found* to interfere with such analyses.
468. The motor actuates a hydraulic valve that causes the controlling piston to move in the direction necessary for correction. If the edge of the material pushes the sensing lever to the left, for instance, the piston is made to move to the right until a zero voltage is produced.
469. It must be emphasized that the unequivocal differentiation of myocardial infarction and pulmonary embolism requires that serial measurements of the 3 parameters be started within 2 days after the onset of symptoms.
470. In addition, the low density fraction from one of the incubated extract-serum mixtures (horse 1—88) was subjected to paper electrophoresis after prestaining for lipoprotein. Included in the same run were prestained samples of the unfractionated test and control mixtures containing this particular serum.
471. Associated with the slow creep of metals at elevated temperatures is another general phenomenon in metals known as relaxation.
472. An LD_{80} dose of endotoxin fails to alter the urinary nitrogen excreted after an injection of cortisone while a toxic but sublethal dose of endotoxin either prevents completely or lowers in proportion to dose the elevation in nitrogen excreted after an ACTH injection. It is the latter effect that serves as the previously described assay for endotoxin.
473. In contrast, all that is required at the outer, or inflow, boundary is that the gas flowing into the vortex have the same w as that leaving, namely, w_c . It is neither necessary nor in general possible for the value of w in the vortex adjacent to the inflow boundary to equal w_c.
474. One may, on the other hand, *regard* the technique of using deviations as a revolutionary innovation which streamlines all network and transistor calculations by placing a powerful new mathematical tool in the hands of the circuit designer.
475. Until then only the lodestone was *held* to be the source of magnetic power. A new and more powerful agency for creating magnetism had thus been

discovered. By mathematical analysis Ampere predicted electrodynamic behavior, subsequently proved by experiment.

476. Cathodic protection procedures require a low voltage direct current. Thermoelectric generators *appear,* therefore, to be suited to this application, as their output is d-c in the desired voltage range.
477. Results thus far obtained do suggest, however, that this novel approach may lead to definite advantages over the established techniques of laboratory abrasion testing.
478. Thus, an intact hypothalamus and sympathetic nervous system *seem* to be required for a normal febrile response and complete extirpation of the posterior hypothalamic gray matter prevents the pyrogenic action in most instances.
479. Nature of Transferable Pyrogen. In order to determine whether the pyrogen transferred in the above experiments consisted primarily of the originally injected endotoxin or of newly formed endogenous pyrogen, its fever-producing effect was compared in normal and endotoxin-tolerant recipients.
480. In what follows, the biochemical alterations are used as a basis for discussion of possible mechanisms involved in 4 separate processes: (a) cessation of production of infective virus, (b) inhibition of mitosis, (c) production of cell damage, and (d) viral interference.
481. The ground station will be at Rumford, Maine, and will be comparable with that used for Project Echo. In this case the radio frequencies are *proposed* to be in the neighborhood of 4.000 and 6.000 mc.
482. This change was apparently not precipitated by adjustments in circulatory dynamics, nor was it related to reticuloen-dothelial stimulation.
483. All life ultimately depends on absorption of light, for it is the absorption of sunlight by the green leaves of plants which keeps the plant and animal world alive.
484. On the other hand, neither myelography, nor even surgery can adequately differentiate normal disks from degenerated disks in patients who complain of back and leg pain. Myelography adds little or no information to plain lumbosacral x-rays so far as degenerative disk disease is concerned.
485. Our experience suggests that the presence of a bruit is strong evidence of a partially open but stenosed internal carotid artery; and subsequent arteriograms usually support this opinion. The absence of a bruit, despite transient episodes or a persistent neurologic defect, suggests most frequently a complete occlusion. Again, this has been supported by arteriography.
486. On the whole, high-volatile coals, when stored for normal periods, do not suffer greatly, so far as the coking properties are concerned, whereas low-volatile coals frequently give trouble through heating and deterioration during storage.

487. Evidence was presented that human tubercle bacilli may be lysed by bacteriophage. Also, a report was given concerning the bacteriophage-typing of various strains of atypical or unclassified mycobacteria. It was proposed that this procedure might eventually *prove* to be as useful as the bacteriophage-typing of various strains of staphylococci and enteric organisms.
488. Such a well should be frequently checked with the dynamometer and fluid level. Once the leakage has begun the efficiency will continue to decline. When a point is reached where fluid begins to rise in the well bore and the well is being pumped 24 hours per day this economic limit has been reached and the pump should be changed.
489. Pharmacological tests have provided no basis as yet for the qualitative difference in these clinical actions. Most often, the same pattern of results is seen with the two drugs in the laboratory.
490. As a basis for our experiments, we have tentatively taken the view that agitations and depressions result from abnormalities in motivational and reward processes — agitation from pathological overactivity of reward processes and depression from underactivity.
491. Although the values for total lipid are of limited accuracy, they nevertheless tend to indicate that esterified cholesterol and phospholipid probably are the only lipids present in significant concentration among the low density products. A small amount of lipid unaccounted for in the low density products from the human serum may represent released triglyceride.
492. However, transistors may pose problems of their own. In the case of this audio generator, for example, the problem of providing a constant output without introducing distortion and temperature instability had to be faced and resolved. Also, the use of transistors often increases equipment cost. That is hardly the case here.
493. After only 1 minute's exposure at 22°C the 10^{-1} dilution of adenovirus type 1 suspension had reduced the agglutinability of the cells by a significant amount.
494. Contact for 2 hours was necessary for the$10^{-2.5}$ dilution to effect significant receptor modification.
495. As to a possible relationship between inhibition of protein synthesis and cessation of virus production, the following can be said. The continued presence after the 6th hour of large amounts of antigen in cells does not necessarily mean that the supply was sufficient to permit further virus production.
496. In view of evidence indicating an adverse role of adrenergic vasoconstriction in the development of shock, it may reasonably be postulated that the deleterious effects of endotoxin are due not to a direct tissue toxicity *per se,* but rather are secondary to an increased responsiveness to adrenergic stimuli.

497. The question may still be raised, however, as to why leucopenic animals, which have less transferable pyrogen in their sera during endotoxin fever than normal animals, exhibit undiminished febrile responses to the endotoxin. How is such a pyrogen-fever dissociation accounted for, if the pyrogen is responsible for the fever?
498. The striking relationship between the time at which DNA and protein synthesis becomes completely inhibited, and the onset of marked cell damage, strongly suggests that the degeneration and ultimate death of cells may well be due to the profound metabolic derangements which develop in virus-infected cells.
499. In pseudorabies virus-infected rabbit kidney cells in culture an increase in DNA occurs, accompanied by proliferation of cell nuclei. Amitotic nuclear division is followed by cellular degeneration. It is of interest that x-ray irradiated cells show no increase in DNA and no nuclear division despite active multiplication of the virus.
500. The random distribution of large numbers of ferritin molecules throughout the basement membrane and the absence of visible channels or pathways suggests that the increased permeability of this layer in the neurotic animal is due to a fine, generalized defect.
501. Additional studies on the sites of RNA synthesis in NDV-infected cells were carried out with tritiated cytidine. The experimental procedures used were identical with those just described, with one exception: following fixation, cells were digested with DNAase, 30 μg per ml of PBS, for 1 hour at 37°C. The cells were then refixed in acetic alcohol, dried and processed for autoradiographs.
502. The discovery that steady potential shifts are subject to conditioning as well as the report by Rusinov that localized slow potential variations are seen in the visual area when a defense reflex is elicited by light stimulus lend further support to the notion that standing potentials are somehow involved in establishment of new functional linkages.
503. Although humoral hemostatic defects may appear from time to time after acute hemolytic reactions involving canine anti-A, it is apparent that the physiologically most significant and consistent abnormality is that due to throm-bocytopenia. Such a reaction, occurring at the time of experimental surgery can lead to a marked increase in blood loss, and at times, loss of animals.
504. The formation of the indole is often accompanied by the production of much tar, but in other cases it takes place remarkably easily. Thus the phenylhydrazone of cyclohexanone gives an almost quantitative yield of tetrahydrocarbazole when boiled for a few seconds with glacial acetic acid.
505. Gold plating has been used for the majority of components, the theoretical attenuation for gold being only about 20% higher than that for copper. A

plating of a few microinches is sufficient at these frequencies, and the process also results in an attractive exterior finish.

506. In the 83 years since it first was reported, the Eck fistula has been reasonably successful in hiding its secrets as well as in giving rise to many additional questions fundamental to an understanding of the functions of the intestine, liver, and brain. At present, it offers a fertile field for reinvest legation of many previous studies with the present improved technics and for extension of the many leads that other investigations have suggested.
507. The satellite provided a communication path only when it was mutually visible at the two terminal stations. On an average day 6 of the satellite's 12 orbits around the earth passed through the area of mutual visibility. The average useful time per pass was 12 minutes, the maximum being about 16 minutes.
508. The investigation of the reaction product of mesityl oxide with phosphorus trichloride in the presence of acetic anhydride *gave* the proved structure of the intermediate as being identical with the product discussed in Section XIII, and obtained from diacetone alcohol.
509. The entropy of dimethyl peroxide can be *deduced* from entropies of cis-but-2- ene (71.9) and n-butane (74.1) to be about 73 $cal \cdot mole^{-1} \cdot deg^{-1}$. The entropy of the methoxyl radical has been *taken* as 54.7 $cal \cdot mole^{-1} \cdot deg^{-1}$ by comparison with the entropy of methyl fluoride (53.3). The rate constants for the combination of unlike small radicals in the gas phase have been *found* to be very close to twice the geometric means of the rate constants for the combination of the two like radicals for almost all the systems studied.
510. The chief power of a magnet to attract or repel is concentrated at certain poles— located at the ends of bar magnet — one being known as a north pole and the other as a south pole.
511. Researchers and corrosion engineers are studying the use of a TE generator for cathodic protection of gas mains. By tapping a gas main to provide heat energy, and installing a thermoelectric generator for the electrical energy required for mitigation of corrosion, they hope to furnish electrical current at a reduction in cost.
512. It is worth noting that the rate of return for this project is virtually the same for annual and continuous compounding.
513. In this example, the forecast was *considered* to be net income. Sometimes it is preferable to forecast gross income *with* operating costs remaining constant throughout. This is accomplished by subtracting the present worth of operating costs.
514. The hypothesis suggested would account for the known facts as regards the sensations of warmth, cold, and pain and the stimulation of these sensations by electrical, mechanical, chemical, and thermal stimuli. It would also *point to* the differences in the protein structure of the peripheral nerve endings as

being possible sites for the differences which might account for the differences in their responses to stimuli.

515. The kinetic energy possessed by falling water can be transformed into electricity. If we were to make a close study of such transformations, we should find that a definite quantity of energy of one kind always gives a definite equivalent quantity of another.

516. As can be seen in Fig. 3, and as has been emphasized above, the development of marked cell damage is a late phenomenon in virus-cell interaction, and is not directly related to production of infective virus. It is of interest in this connection that influenza virus, which fails to produce any infective progeny in HeLa cells, nevertheless causes degeneration and death of cells.

517. The sodium content was determined by reading the optical density at 0.589 μm, whereas potassium was measured at 0.768 μm. The sodium content determined may be higher than was actually present in the cells because of the sodium chloride in the suspending medium.

518. Fairly intensive alloy studies are under way on all four refractory metals, and a considerably large number of promising alloys have already evolved. While few of these have as yet achieved commercial status, many have advanced to at least the point of pilot production or advanced laboratory scale-up.

519. Generally, these symptoms were seen in 8-day-old young rats, the first signs being a marked scaliness of the tail and reddening of the tail tip. The practice of incorporating crude shark liver oil in the stock ration as a source of vitamin A, which also is *known* to be a rich source of unsaturated fatty acids, was stopped. It is pertinent to mention that the skin lesions of essential fatty acid deficiency are *known* to be enhanced by a lowering of the relative humidity.

520. In any discussion of space vehicles, whether they be of the transitory type such as missiles, or whether they be orbiting or stationary satellites, certain limitations are immediately apparent that do not exist with ground-based equipment.

521. Table 2 lists yields for several radiations. In this table g(H) denotes the sum of the radical-type reducing species whether it is the hydrogen atom, the solvated electron or some as yet unknown entity. Yields are slightly different in heavy water and depend somewhat on pH.

522. Our first experiments compared the effects of chlor-promazine and imipramine. The results were somewhat disappointing, as both drugs were *found* to inhibit self-stimulation. Chlorpromazine was about ten times more potent as an inhibitor than imipramine. These results coincided with published pharmacological findings.

523. Whereas in earlier experiments homograph rejection was frequently mistaken for tumor-specific resistance, recent experiments which were performed on inbred mice, under conditions excluding, as far as possible, genetic differences between host and tumor, may point to the existence of a true tumor-specific resistance.
524. A more logical correspondence is obtained by *taking* displacement as equivalent to potential difference and momentum to current. From these analogues the ones proposed by Firestone can be arrived at by differentiating the mechanical variables with respect to time. Then displacement-potential difference becomes velocity-potential difference and momentum-current becomes force-current.
525. Since the human fetus must be born when its brain has reached the limit of size compatible with its admission through the birth canal, such maturation or further development as other mammals complete before birth the human mammal will have to complete after birth. In other words, the gestation period will have to be extended beyond birth.
526. The fact of instability of heavy nuclei throws light on the question as to why there are only ninety-two elements in nature; in fact any nucleus heavier than Uranium could not exist for any period of time and would immediately break into much smaller fragments.
527. Since a large number of the circuits are to be pulsed at the same time, direct operation of pulse power amplifiers would put an excessive peak-to-average requirement on the power supply and distribution system. To average the power, a small capacitive energy reservoir is included in each pulser.
528. No significant changes in either “oxidative performance” or “potential” were observed when normal animals were given endotoxin. On the other hand, the challenged tolerant group exhibited a significant depression of activity measured as «oxidative performance» when compared with the untreated tolerant animals.
529. In this communication, early and marked inhibition of incorporation of precursors into DNA and protein of infected cells will be described. Continued incorporation, at a decreasing rate, of uridine into RNA will also be described. The inhibitory effects of NDV infection on DNA synthesis and mitosis will be compared with the effects of 5-fluoro-2-deoxyuridine (FZDR) on these processes.
530. The temperature measurements in these experiments were good enough only to make approximations, but if the activation energy for the warmth receptor be calculated for the phasic response it comes out in the order of 200,000 calories per mole and only the group of reactions having to do with protein denaturation has so high an activation energy. This is the same order of magnitude as that associated with pain sensation and burning of the skin.

531. The prevailing concept *considers* cancers as biologic manifestations which develop in response to carcinogenic stimuli and which assume, once produced, complete biologic independence from the causal agent, thereby becoming disease entities per se.
532. At this point of the experimental work, however, sufficient evidence had been accumulated to indicate very strongly that the innate resistance of mice to the infectious agents did not depend upon whether mice were predisposed to leukemia, but was determined by other genetic factors characteristic of each strain of mice.
533. The name electronics is *known* to be derived from the word electrons, the electron itself being the basic unit of negative electricity and all electric currents consisting of electrons in motion.
534. Another aspect to be borne in mind when considering «talking books» is the complexity of the copymaking apparatus which governs the time taken to make a batch of copies. Should a two-spool system be chosen, rewinding all the copies of the «book» periodically prior to reissue must be taken into account.
535. As one might expect, makers of business machines and home appliances use heat treated steels in stress-bearing parts as do automotive manufacturers. Although cost is just as important a factor as it is to the automakers, the pattern of usage is somewhat different because these two industries make such a wide variety of products.
536. If these nucleotide-linked peptides were applied on the amino-acid analyzer it might be expected that they would be eluted very rapidly. Some of our unidentified peaks may well be the nucleotide peptides.
537. A paroxysmal atrial tachycardia in a young person without heart disease is rarely a grave emergency, and will often break spontaneously if the patient is put to bed and given an effective sedative.
538. It can scarcely be maintained that the objections raised against the carcinogenic significance of tissue responses produced by chemicals in the connective tissue of rats should be limited to connective tissue located in the subcutaneous area.
539. It is generally recommended that diphtheria-tetanus toxoid be administered on entering school and once again 3 to 4 years later, and that subsequently the «adult type» tetanus-diphtheria toxoid be given at 4-year intervals to maintain immunity to these 2 diseases.
540. Because this tachometer requires that its rotating element be connected to the device whose speed is being measured (as do all others except the pulse-counting type), one of the desirable characteristics sought was that of low rotor inertia. For this reason rotors were constructed in two different ways.
541. It has long been considered that S-180 is much less sensitive to host weight loss that is Ca-755. This presumption is correct if one judges from the effect

of a given absolute weight loss in experimental groups of S-180-bearing mice, rather than the difference between a treated group and its concurrent control.

542. Evidently, a fuel with a lower ignition temperature, all other conditions being equal, will ignite more quickly than one with higher ignition temperature.
543. The non-volatile monomer is *said* to reduce fire and health hazards as opposed to commonly used solvents and crosslinks with the resin, eliminating the possibility of solvent entrapment. In addition, the solution has excellent storage stability.
544. Perhaps one of the biggest problems is ventilating ducts. They act as speaking tubes, carrying noise from one area to another. Conversations overheard from office to office or from one toilet room to another are *likely* to cause embarrassment, at the very least.
545. This series of operations is completed in accordance with a pre-set cycle and all slides and units are controlled by an electro-hydraulic system, the oil reservoir and pump, feed valves, and electrical equipment being housed in a cabinet installed adjacent to the machine.
546. From what has been said so far, one might think that alternating current has little advantage over a direct current.
547. For drilling or tapping units, for which high speeds are required, provision is made for taking drive from the pinion shaft in the main transmission, to enable a step-up ratio of 3 : 1 to be obtained. A facing head can also be supplied, for securing to the nose of the milling sleeve.
548. The satellite is in a 70 per cent sun-time orbit *with* the transmitter assembly located on the shadow side of the satellite, normal to the sun vector. This is a transient condition *with* the transmitter assembly never receiving direct solar energy, but receiving reflected solar radiation 70 per cent of the time.
549. The satellite is in a 100 per cent sun-time orbit *with* the transmitter assembly located on the shadow side of the vehicle normal to the sun vector. This is a steady-state position *with* the transmitter assembly receiving no direct solar energy.
550. The satellite is in a 70 per cent sun-time orbit *with* the transmitter assembly located on the sun side of the satellite, normal to the sun vector. This is a transient condition *with* the satellite receiving direct solar energy 70 per cent of the time.
551. Unless other conditions are stated specifically, we shall use the term «state» to represent an equilibrium state.
552. The satellite is in a 100 per cent sun-time orbit *with* the transmitter assembly located parallel to the sun vector and perpendicular to the plane of the orbit. This is a transient condition *with* the transmitter assembly receiving no direct solar energy.

553. On the other hand, tissues such as adult rat brain and muscle, which do not form fatty acids from glucose to any extent, *appear* to utilize this hexose solely via the Embden-Meyerhof pathway.
554. It is to be hoped these interesting experiments will initiate a series of similar investigations, which may offer a final solution to the most important problem of tumor-specific resistance.
555. Since there are no means of access or connection to the satellite in its packing container, the system had to be complete within itself and to begin to operate automatically when placed in orbit.
556. Virtually all modern headphones fall into one of three generic groups: magnetic, crystal or dynamic. In all the units we checked, only one was *found* to fall outside these categories — it being a variable-reluctance device.
557. Incidentally, a bent spindle in one of the tape reels can cause the same symptom, so watch out for this, too. Sometimes, you can spot this quickly by observing the reel as it turns If the spindle is off center, the reel will wobble up and down. However, try several different reels just to be sure. A plastic reel will often wobble naturally from being stored in hot places.
558. It is the sun shining on the drops of rain, as they fall, that makes those beautiful colours in the rainbow. It is because every little raindrop is a round ball of water, that the bow itself is curved or round.
559. It should be kept in mind that tissue culture media cannot be *expected* to reproduce exactly the conditions of the *in vitro* environment. It follows that certain variants will be elected and that stable populations even of cytologically diploid cells should be suspected of being genetically diverse and different from the cells of origin.
560. In the event of any pair of bars not completing its normal full travel, the machine is automatically stopped so that remedial action can be taken. The standard feed mechanisms, which have a travel of 7 inches, can be used either singly or in pairs, for two simultaneous movements at one station.
561. It was thought that a semi-positive vertical flash mould would modify the flow pattern and eliminate the cracking. This was not so, it being found that although the mould design could do much to reduce the cracking, it could not completely eliminate it.
562. The usual procedure when operating the machine is to select the next channel after each convolution of the tape to provide one long programme. Alternatively, any channel may be selected at any time if there are separate items of interest or one channel can be repeated continuously.
563. The concentration of the reactants *appeared* to have little effect on the amount of sulfate and radioactivity hydrolyzed by Taka-diastase.
564. The eventual return of hypokalemia further suggests the continued excessive secretion of aldosterone, which presumably would not be the case in potassium depletion from other causes.

565. There may be some increase in random red cell destruction during this entire period, but the bulk of the red cells that are to be destroyed are probably removed from the circulation during the first several days after infusion of the antibody.
566. There are, however, exceptions, or features which do not fit such a simple picture, and it is these that are being viewed in the light of the recently discovered properties of viral nucleic acids.
567. We would have to devote an entire article to names were we give due credit to all those working on the particular projects mentioned here.
568. It has been shown that emphasis is necessary in step 2a because the choice it includes has not been adequately recognized in the past. It is this step which essentially determines the form of the system of equations and the magnitude of the derived units.
569. Simultaneously, the side area projected normal to the sun increases as does its average operation temperature. The combined effect of these area and temperature changes is shown in Table II in terms of the power output of the solar collector corresponding to the average operation temperatures at each value of alpha.
570. That the maximum febrile response in rabbits is limited by a definite hyperthermic «ceiling» is indicated by the comprehensive dose-response measurements recently reported by Keened, Silberman and Landy.
571. There is little doubt that all the azo compounds reported are the trans isomers, but their geometry has not been established independently.
572. After cessation of diurezic therapy, which may have contributed to potassium depletion, one would not *anticipate* observing a prompt shift from urinary potassium wastage to retention during sodium restriction.
573. Morphological studies of the tumor cells after poly-lysine treatment demonstrated that the plasmalemma was continuous, which indicated that cell lysis had not occurred.
574. A contribution of bacterial endotoxin to the development of irreversibility in experimental hemorrhagic shock has been postulated, but neither the importance of this factor nor the mechanism involved has been fully established.
575. In general, resistant cells were smaller, *with* less cytoplasm than sensitive HeLa cells. Occasionally, cells differing from the typical epithelial type were found.
576. The second quantitative relationship concerns the amount of endogenous pyrogen, which may be present in the donor's circulation, over and above that needed for the production of maximum fever.
577. The results presented in Tables 1, 2, 4, and 5 and Charts 1 and 2 may *appear* surprising in that they indicate that S-180 and Ca-755 are approximately

equal in their response to an equal degree of induced host weight difference between adlibitum control and starved animals.

578. Equation 16 finds experimental confirmation over a much wider range of geometries than that for which analytical solutions of equation 15 are available, and may be *assumed* generally true for space-charge — limited discharges of the kind considered.
579. Power could be transmitted over several miles by a series of belts, but the loss due to friction and other causes would be so great that only a small proportion of the power would remain to be used.
580. Commercial nameplates — be they of anodized aluminum, etched aluminum or just plain paper — are generally made through either screen or offset printing.
581. The electrical manufacturing industry would be helped very considerably if more of the insulation manufacturers gave reliable technical information on their products.
582. Professor A.B.Pippard of Cambridge University, England, said theoretical problems have now been largely solved, but production barriers have to be surmounted before cryotrons and similar devices are put to practical use.
583. The action of the pump field is to convert some of their original axial energy into transverse orbital energy. Thus the axial velocity and the apparent pumping frequency will be changed and synchronism between the electron in its orbit and the orientation of the field will be lost.
584. Serum bilirubin concentrations may be slightly elevated in patients with heart failure and hepatic congestion but a sudden increase in serum bilirubin in cardiac patients has long been *known* to signify the occurrence of pulmonary infarction.
585. Several different types of crystal materials were tried as 4 to 2 mm converters. Welded contact germanium diodes, operating essentially as non-linear resistors, offered the best efficiency.
586. Hart and Heroux observed that mice exposed to cold increased their oxygen consumption by sevenfold without appreciable change in the blood acid level, whereas running mice with a threefold to fivefold increase in oxygen consumption had pronounced elevations in lactate.
587. Evidence of the altered responsiveness persisted throughout a period in which spontaneous paroxysmal activity was abolished and self-re-excitation, to judge by the unit record, was absent. By excluding reverberating impulses as the basis for the long lasting change in cellular behavior the isolation experiment made it necessary to search for structural alterations.
588. The unique property of DMBA in damaging adrenal is due to the fact that it alone among the hydrocarbons tested possesses the necessary geometry vis-a-vis the inner adrenal cortex. The steric factor assumes primary importance in DMBA-induced adrenal damage.

589. The authors stated that occipital units had been studied but the data have not yet been reported. In any event the implication is clear that sensory or association areas are more *likely* to be crucial. Considerable support for this assumption has been derived from experiments using agencies causing localized interference with normal neuronal function.
590. Thus there *seems* to be a possibility that epinephrine may play some role in the thermal sweating response in man but its action in temperature regulation is not clear at this time. However, in the horse, L-adrenaline *seems* to be the chief transmitter agent for stimulating the sweat glands and its local action is not modified by prior intradermal injections of cocaine or adrenergic blocking agents.
591. Often a set that needs a special part that must be ordered from the manufacturer comes into the shop. This means that the set will be stored until the part arrives. During this waiting period I find that the knobs and hardware have a tendency to disappear, and much time is wasted trying to find substitutes.
592. This is a theoretical argument, but if a device is rated for a particular dissipation and a particular peak current maximum, then provided the external circuit conditions are adjusted to prevent these maxima being exceeded, it would *seem* immaterial whether the current were switched on by gate action, or by anode breakover effect.
593. These facets of the vasomotor transfer of heat have been recognized for many years and thermal conductivity measurements have been used mainly as indices of blood flow rather than absolute measurement of blood flow. For example, Hertzman et al. making estimates of both local tissue perfusion and thermal conductance found these two correlated well with each other but not in a one-to-one ratio.
594. Magnetic-head requirements have become stricter as a result of the trend toward better frequency response, higher packing densities and lower tape speeds. Gaps of 0.0005 inch were *considered* small a few years ago, but today's high-resolution heads have gaps five to ten times narrower.
595. Besides being a function of speed, the output of the drag cup generator is also a function of the voltage applied to the primary winding. Whereas this is not a disadvantage in the usual sense, it does require careful regulation of the applied voltage. Furthermore, the fact that the output is an a-c voltage can cause additional components to be used and time delays to occur in certain application.
596. The regular solution equation with QI400==4700cal/g — atom fits the present data quite well, but the experimental results are too limited and the scatter is too large to indicate whether or not the heats of formation accurately follow this equation. Since the regular solution equation is the simplest which will represent the present data within the experimental

uncertainty, it is *thought* to be the best choice until more accurate data become available.

597. As rate control is sensitive to the rate of change of the temperature it recognizes at once the magnitude of the imposed thermal load. For this reason the rate control is sometimes known as «anticipatory» control.
598. Various workers found similar tie-lines which persisted up to 20% of phosphoric oxide, but it was shown that such tie-lines were but one of a number of stages that the system went through before stable equilibrium was attained.
599. It may be noted, incidentally, that considerably more free sulfate (150 and 144 moles in the two experiments) appeared than can be accounted for by the hydrolysis of the carcinogen metabolites.
600. Serial homologous transplantation of the tumors to both conditioned and unconditioned animals was attempted in a number of cases. The latter was not successful, but transfer to other conditioned hosts was achieved.
601. This concentration was detectable in most instances as early as 4 days after embolization. The occurrence of this clear-cut pattern early in the course of the disease is most fortunate since it allows therapy to be started without delay, thus preventing further potentially fatal embolic episodes.
602. The presence of thromboplastic substances in red cells has been confirmed in this laboratory. This activity resides in the phospholipids of the red cell ultrastructure, and *appears* to be due primarily to the presence of phosphatidyl serine.
603. The results obtained with the urea clearance test are presented in the last line of Table IV. The poisoned mice retain about three times as much urea as normal mice, thereby indicating a suppressed kidney function. Retention of 76.3 per cent neglects the nitrogen that accumulates above control values in the blood and intestines.
604. In view of the recent increase in reported cases of infectious hepatitis, and the demonstrated possible resemblance of this type of drug-induced hepatotoxicity to that disease, it *seems* logical to hypothesize that at least a portion of these reported cases are drug induced rather than of viral etiology.
605. The subcritical isothermal transformation of the beta phase is the basis upon which heat-treatment of many commercial titanium alloys is founded. The decomposition of the beta phase has been *observed* to be similar in the alloy systems of titanium with vanadium, chromium, iron, manganese, molybdenum, and columbium, as well as in alloys containing combinations of these beta-tabilizing elements.
606. Carbon contents in different heats varied from about 0.05% to 0.1%. This carbon variation can be attributed to the melting and casting technique, or to carbon adhering to remelt scrap which may have been charged in the crucible. No significant differences in other impurity contents were apparent.

It is not now known whether these impurities have affected the mechanical properties of these alloys.

607. At elevated temperatures uranium under irradiation is subject to dimensional changes due to growth and/or swelling. Alloying element additions have been *shown* to improve this behavior. In the present study an evaluation has been made of the effects of a number of alloying element additions on the high-temperature mechanical and physical properties that might have a bearing on the dimensional stability, such as creep hardness, tensile properties, and microstructure.

608. It was found that one could inject soluble immune complexes repeatedly without adverse effect on the rabbits. The effect of soluble complexes on hemolytic complement level was *found* to be variable even when prepared under the same conditions and in the same degree of antigen excess. At times, the soluble complexes were *found* to have no apparent effect on complement levels while at other times, they produced a noticeable reduction in complement liter when injected intravenously into normal rabbits.

609. Readings of about 50 test quantities on the line will be taken by the data logger and recorded every 20 minutes. Whenever test readings fall outside predetermined limits, the data logger will scan and record readings every 2 minutes until the values fall back into line.

610. We have not reached conclusions regarding treatment of patients with degenerated disks. It is quite evident, none the less, that establishing an exact diagnosis will allow disk degeneration to be more intelligently investigated and treated.

611. The increase due to endotoxin averaged 18 per cent and ranged from 6 to 46 per cent. Within the ranges studied, 1 to 8 x 10^{-6} gm/ml endotoxin and 10 to 50 per cent blood, there *appeared* to be no correlation between the concentrations of these materials and the magnitude of the augmentation by endotoxin.

612. We can then first choose the working point of the negative-conductance device such that Y is as small as possible. By varying the transformer ratio Y does not change. By increasing the transformer ratio the bandwidth will finally always become smaller than the value required for the particular receiver we are dealing with since the transformed value of the capacitance of the negative-conductance device is also increased.

613. Twisting the wire into a helical form, or solenoid, and having a current flow through it caused it to behave like a magnet having a north pole at one end and a south pole at the other. If such a coil were to be freely suspended and still carry current, it would pivot so that its magnetic field would align itself with the field of the earth's magnetism and so duplicate the behavior of a compass needle.

614. Carcinogens may be *defined* as being chemical and physical agents which are capable, under proper conditions of exposure, of producing in animals, including man, cancers which would not occur without the intervention of these agents. Carcinogens thus do not merely produce a significant increase in cancer incidence when administered at any dosage level, by any route of administration, and to any species or strain, but elicit cancers located ordinarily at sites associated with induced carcinogenesis.
615. Subscripts r and n indicate rational and nonrational, respectively. The denominators may be omitted if the symbols in the numerators are *understood* to mean measures rather than quantities. This leads to the conventional form of the measure equation with coherent units.
616. The active antigenic fraction, in spite of revealing many properties similar to viruses, was not infectious. It was *believed* to be an autocatalytic cellular component with proliferative activity. In his review Hauschka discussed the possibility that some isoantigenic components of the Brown-Pearce sarcoma might have influenced experimental results of Kidd and his collaborators.
617. To investigate whether inagglutinability of virus-treated erythrocytes was due to the modification of receptors with consequent lack of adsorption of hemagglutinin or due to failure of red cells with attached virus to form characteristic agglutination patterns, experiments were done to determine if test virus hemagglutinin adsorbed to the treated cells.
618. In the fourth case, *diagnosed* as probable membranous glomerulonephritis, the pattern of fluorescence observed in the treated kidney sections was quite different from the patterns described in the previous three cases. Sections exposed to conjugated anti-human globulin showed specific fluorescence in short thin segments of glomerular capillary walls. This was *noted* to be confined almost entirely to peripheral portions of the glomeruli.
619. Thauer has *noted* this difference between blood flow data and thermal data as being one of the unsolved problems of temperature regulation. There *seem* to be two factors of importance in controlling the convective heat transfer of the blood; i. e., the amount of the blood flow and the pattern of blood flow.
620. Froese and Burton have measured the tissue insulation of the human head at temperatures between 32 and -21°C and *found* it to be constant at a value of about 0.4 to units. They note that the tissue insulation of the fingers exposed to cold may increase sixfold whereas that of the head does not, indicating the practical need for head covering in order to prolong tolerance time in the cold.
621. Frequently, we wish to know more about a filter's rejection properties than is given by the 3 db bandwidth and the Q. Sometimes, the 6 db, or quarter power point, bandwidth is *stated* to give more information about the rejection characteristics. Fig.5 again shows the region near the pole at S_1

where it is assumed that the approximations made above hold over a slightly wider area.

622. Impedance measurements were made on the full-scale antenna above a ground plane to determine the proper length which would give a pure resistive load. A length of 25.5 inches was *found* to give a resistance of 40 ohms. This is an excellent match for the transmitter impedance of 36 ohms.

623. The a-c impedance at the various taps of the bias distributor must be sufficiently low to prevent crosstalk between cells. This can be accomplished by making the resistors in the bias distributor small. The 4,000-ohm resistors used here were *found* to be quite satisfactory.

624. This apparent discrepancy is due to the marked dilution of the donor pyrogen in the recipient's blood stream. Naturally, the smaller the volume of serum transferred, the more *likely is* the recipient to remain afebrile. In other words, a negative passive transfer test cannot be *construed* as indicating the absence of endogenous pyrogen in the donor serum. The test is useful only for detecting relatively large amounts of circulating pyrogen.

625. Careful examination of the small-signal theory shows that the maximum efficiency to be expected from an electrostatic quadrupole amplifier is of the order of 25%, or up to 33% if collector depression is used. Also, to produce a high efficiency a high gain per pitch is required, so that a large signal amplitude can build, up before the differing axial velocities produce relative displacements of the electrons.

626. This limitation might be *expected* to be made more severe by glucose due to stimulation of the oxidative shunt and perhaps indirectly through the formation of DPNH. Assuming glucose inhibited respiration by decreasing TPN^4, one would expect that glucose would stimulate respiration in the presence of bicarbonate and that 1AA might increase the inhibition.

627. For stable operation of the amplifier s must not be too near to zero. For the negative conductances that are available at the moment, a stable amplifier is already rather difficult to make if $s = 1$ and this *proves* in many practical cases to be a more stringent requirement than the bandwidth. In the next section we shall therefore treat, as an example, the calculation of the minimum noise figure *assuming s* to be constant.

628. It seems that the total effective carcinogenic burden of an individual is, in part, determined by the various factors mentioned; to another part it *seems* to depend upon the degree of synergistic, antagonistic, or indifferent interaction of the various carcinogens and upon their interplay with noncarcinogenic endogenous and exogenous factors acting in the host organism.

629. Proceeding on the premise that the opalescence produced in serum by streptococcal extracts might be due to low density lipids or lipid-protein complexes liberated from their normal associations with serum lipoproteins, an experiment was undertaken to determine whether such products

could be separated from extract-treated sera by ultracen-trifugal flotation at normal serum density.

630. However, the connection problem for all devices was complicated by the fact that each conductor in the bundle had to be isolated for 60-cycle current instead of being electrically tied to the others. The method does not result in radio-frequency isolation between conductors in a bundle, however, since by-pass filters at the line terminals keep all conductors at the same potential for high-frequency currents.

631. The reason for this vehicular dependence is that the antenna current distribution and impedance depend upon the nature of the surroundings. The vehicle on which the whip is mounted actually becomes a part of the antenna circuit and represents a sort of counter poise for the, whip. Therefore the antenna impedance will vary for different vehicles and mounting positions. If the mounting position is changed the matching networks have to be retuned for optimum performance.

632. Other simple methods include the following: if a resistor or capacitor is somewhat low, adding a small resistor in series or a small capacitor in parallel can produce the desired increase. To reduce these components if too high, a larger resistor in parallel or larger capacitor in series can achieve the desired result. With such methods and a reliable means of checking frequency, there is no need for an unusually precise means of determining resistance or capacitance.

633. In the work now to be described, it was observed that a single dose of 7,12-dimethylbenz(a)anthracene caused extraordinary changes in the rat consisting of adrenal apoplexy and massive necrosis in the two inner zones of the cortex while other regions of the adrenal glands were uninjured. In addition to the selectivity of the anatomic site of damage, there is high specificity of the molecular structure of the polynuclear aromatic hydrocarbon exerting this adrenocorticolytic effect.

634. An open-pleural biopsy, which was performed in 122 patients suffering from idiopathic pleural effusion, was *found* to be valuable as a diagnostic procedure. Of particular interest was the report that, after a period of observation from 0 to 8 years, none of the 61 patients in whom the pathological findings were *described* as nonspecific pleuritis have as yet developed evidence of pulmonary tuberculosis.

635. The results of this measurement for the two GaAs junctions are shown in Figure 12. Q is plotted as a function of photon energy. The response tends to saturation at the higher photon energies. By extrapolating the data toward the apparent saturation values, the diffusion lengths in the skin are *calculated* to be 0.5 and 0.6 μ. The lifetime is thus 10^{-10} sec, if one assumes a diffusion constant of 25 cm^2/sec.

636. With this arrangement he has obtained urea output from the skin over a 20-minute period which he *calculates* to be equal to that of one kidney. Weiner and Van Heyningen cast doubt on the possibility that the skin might thus serve as a substitute for a kidney by producing evidence which suggests that the urea and the lactate in sweat may be derived from the metabolism of the sweat glands. For example, alterations in blood electrolytes, lactate, or other substances found in human sweat do not *seem* to alter the sweat content.
637. With a station of moderate strength, the signal should be audible for at least 100 kc on each side of resonance. (Of course, the a/c is disabled throughout this process). The tuning should be about the same whether you tune in the station from the upper or the lower side. If it *seems* sharper from one side than the other, the response curve is not symmetrical and a complete realignment of the *if* is justified.
638. Because of the past failure to obtain, by the application of this biologic concept of cancer, any reliable specific diagnostic test for cancer and any effective chemotherapeutic agent against cancerous tissue, one is left wondering whether it is not appropriate and timely to put to work in this research the many facts and observations on environmental carcinogenesis and cancers, and to return to those scientific principles which brought success to the control of infectious diseases.
639. Interest in an n-type thermoelectric material for use in the temperature range above that of the Bi_2Te_3 alloys led to an examination of the system PbTe — SnTe, which had been *shown* to exhibit complete solid miscibility. It was known from previous work that PbTe is useful in this temperature range, and it was considered that solid-solution alloying with SnTe would provide a higher figure of merit by decreasing the lattice thermal conductivity.
640. Temperature differences are as characteristic of internal body temperature as of the skin and measurements of rectal temperature can be affected by the relation of the large veins carrying cool blood from the lower extremities to the thermometer location in the rectum. Temperature in the bone marrow of the tibia of man has been *measured* to be 4°C lower than the rectum suggesting the lack of a uniform temperature requirement for the hematopoietically active bone marrow.
641. The clinical diagnosis of pulmonary embolism in older patients is difficult, the signs and symptoms often being attributed either to heart failure or to bronchopneumonia. Moreover, the high incidence of acute myocardial infarction in this group adds further diagnostic difficulty. The present triad allows this difficult differential diagnosis to be made precisely even in geriatric patients with preexisting heart disease.
642. Audio current through the coil varies the magnetic flux in the gap and causes the disk to vibrate and produce sound. The operating principle is much the same as that of the magnetic headphone, although the physical construction

is somewhat different. The variable-reluctance headphone gets its name from the changes in reluctance of the magnetic path as the metal disk vibrates. Only one manufacturer currently produces a headset of this type.

643. The operation of much of the TIROS instrumentation is subject to ground control. Thus, a means is available to determine from the ground the total instrumentation energy requirements in a given orbit. During orbits in which ground illumination is unsatisfactory for taking television pictures or the satellite is out of communication range of the two ground stations, little or no equipment was programmed and the major power drain was the continuous load.

644. By means of an improved method photographs have been obtained of three macromolecular substances *known* from physical-chemical investigations to have rod-like configurations in solution. The results show that the rod-like structures are preserved upon deposition permitting a determination of average diameters, average lengths, and length distribution. The results of such determinations of diameter and length are *found to* be within 0-40% of those obtained from physical-chemical measurements and the distributions of length are in agreement with those deduced from the various average.

645. Another striking and rather frequent exception from the criteria characterizing cancers is represented by basal-cell carcinomas of the skin, which may develop following an occupational or environmental exposure to sunlight, coal tar, and arsenicals. Basal-cell cancers of the skin do not produce metastases and thereby lack one of the most important properties of malignant growths.

646. Since the reaction is between the serum and the nucleus of the cell, and since it is histologically demonstrable, we have inquired whether the chromosomes are involved in the reaction. One might *expect* them to be, partly because of the character of the known antigens referred to above and partly because of the extent of the nuclear reactions — that is, the reaction is not confined to the nuclear membrane.

647. The experiment was quickly repeated and confirmed in many other laboratories. In a detailed study Jasper and Shagass were able to demonstrate nearly all forms of Pavlovian conditioning including simple, differential, delayed, cyclic, trace and backward «reflexes». Pseudoconditioning or «sensitization» was ruled out by showing that the conditioned alpha blocking was selective for the stimulus which had been paired with light and was not produced by an equally intense signal which had never been reinforced.

3. ENVIRONMENTAL CONCERNS HAVING GLOBAL IMPACTS

3.1 Biogeochemical cycles

To understand the significance of some of the factors which cause environmental concerns, particularly on a global scale, it is necessary to understand biogeochemical cycles. **Biogeochemical cycles** are models of the position and behaviour of materials, usually elements or compounds, on a local or global scale under the influence of living organisms, physical earth processes and chemical earth processes. It is possible to distinguish between three types of cycle:

1 Local cycles involve the less mobile elements and have no mechanism of long-distance transport. They are characterised by the absence of leakage from one ecosystem to another. Examples of elements that participate in local cycles are phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), copper (Cu), zinc (Zn), boron (B), molybdenum (Mo), manganese (Mn) and iron (Fe).

2 Global cycles have a gaseous component which allows the element or compound to be transported over great distances in the atmosphere. This includes elements and compounds which may also participate, in a different state, in local cycles. Elements of significance here are carbon (C), oxygen (O), hydrogen (H), sulphur (S) and nitrogen (N), often in a variety of gaseous compounds (e.g. carbon dioxide (CO_2), water (H_20), oxides of nitrogen (NO_x), methane (CH_4), sulphur dioxide (SO_2).

3 Sedimentary cycles, in which particulate material of all sorts is transported by water or sometimes wind.

It is usual for biogeochemical cycles to be described in model form with two components:

1 Biogeochemical pools (pools for short) are the quantities of the chemical being modelled in a recognisable portion of the globe or ecosystem (e.g. the atmosphere, the soil, phytoplankton).

2 Transfer rates (or fluxes) are the rates of transfer of the chemical from one pool to another.

This can be understood more easily by examining real models. Two examples, phosphorus and carbon, are given below.

The local **cycling of phosphorus** based on data from a study in a mature stand of maple—birch woodland *(Acer saccharum - Acer rubrum - Betula allegheniensis)* in Nova Scotia, Canada, is shown in figure 1.1. As this particular model uses information from several studies, the overall balance of the model can be taken as an approximation only. It does show, however, that phosphorus is relatively immobile, an important feature of this element's behaviour when it

comes to examining its role in environmental problems. This model is not too complex, and because its data are derived from studies of small areas, the units used to express pool size and transfer rates are comprehensible.

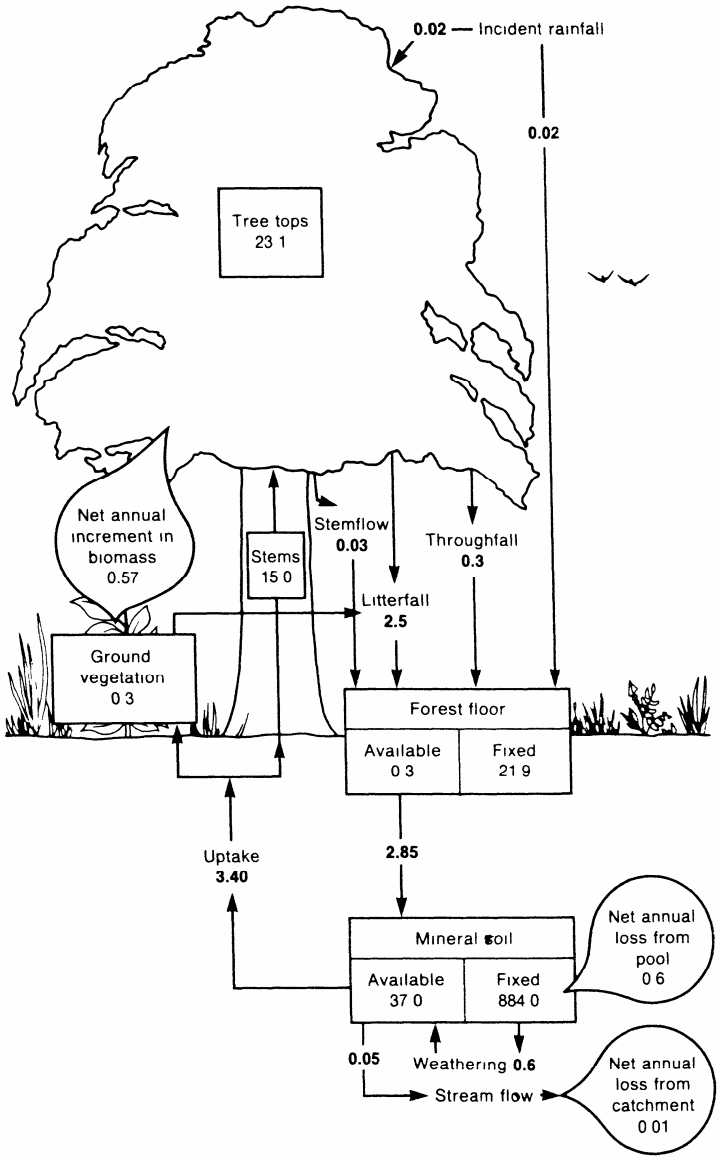

Figure 1.1 *Generalised model for the local biogeochemical cycling of phosphorus in maple—birch woodland in Nova Scotia: standing crops = pools (in boxes) are in kg ha^{-1}, transfer rates (on arrows) are in kg ha^{-1}year^{-1}. (Data from Freedman (1989).)*

The global biogeochemical **cycle of carbon** has some disagreement about sizes of pools and transfer rates, and the units used to express pool sizes (billion tonnes) are almost beyond grasp (all in contrast to phosphorus). One carbon model which appears to have gained a reasonable degree of acceptance is shown in figure 1.2. The interesting features here are:

1 The huge size of the pool of carbon in sediments, 20 million billion tonnes.

2 Fossil fuel combustion is removing carbon from the coal and oil pool much faster than it is being added to.

3 Despite the small size of the phytoplankton pool (5 billion tonnes), the flux of carbon out of this pool (40 billion tonnes year^{-1} into dead organic matter and consumption by zooplankton and fish) is larger than that (25 billion tonnes year^{-1}*)* from the plants on land (pool size 450 tonnes). This is because the turnover time (or life-cycle) of phytoplankton is so rapid.

4 Transfer rates into and out of the atmosphere (almost entirely carbon dioxide) are very high compared to the relatively small size of the pool. Residence time of carbon in the atmosphere is thus low.

The interest in biogeochemical cycles lies in the way pool sizes and transfer rates of a variety of elements and compounds, and nutrients and toxins have been influenced in ways which cause environmental problems. Environmental concerns arise when local or global biogeochemical cycles are opened or their pathways diverted or dominated by human activity. It is necessary, therefore, to have a mental picture of these cycles when considering these concerns.

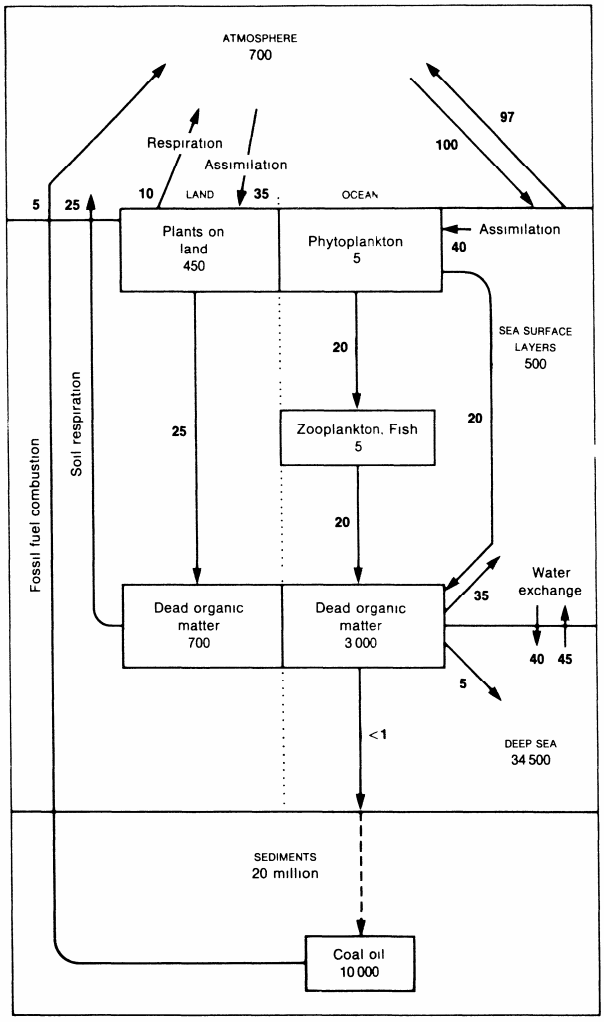

Figure 1.2 *Model of global carbon flow: pool sizes are in billion metric tonnes, transfer rates (on arrows) are in billion metric tonnes year^{-1}. (Data from Bolin B. (1970) in Scientific American* ***223****:124-32.)*

3.2 Ozone depletion

Ozone (0_3) is not an abundant chemical in the atmosphere, but it is highly significant because of several important properties:

1 It absorbs ultraviolet light (UV light).

2 It is involved in a complex series of chemical interactions with natural and pollutant chemicals in the atmosphere.

3 It has harmful effects on living organisms.

Ozone's capacity for absorbing UV light in the stratosphere is discussed here. Because the effects of ozone relate very much to its vertical distribution pattern in the atmosphere, it is essential that the terminology of the layers of the atmosphere is understood (see figure 1.3). The concentration of most atmospheric gases is highest at the earth's surface and declines in more or less a linear fashion with altitude. Ozone is aberrant, with an unusually high concentration in the stratosphere, where it acts as a filter for incoming UV radiation. Ozone is produced in this layer by the dissociation of oxygen, a reaction which occurs in the presence of UV light (wavelengths 180-240 nm):

$$O_2 + hv \rightarrow O + O$$

$$O + O_2 \rightarrow O_3$$

(hv is the symbol for a quantum of energy, here derived from UV light.)

It is thought that most of the ozone is produced in equatorial regions, where UV radiation penetrates furthest into the atmosphere, and is then transported around the globe by stratospheric air currents. The ozone is also converted back to oxygen by slightly longer wavelength UV light (200-320 nm). Absorption of UV light by these two reactions screens out a part of the light spectrum that is harmful to living organisms and warms the stratosphere. It is probably this action, producing the high ozone concentrations at about 23-30 km, which accounts for the high temperature of the stratosphere at this level. The balance between production and destruction of ozone normally keeps a relatively constant level of the gas in the stratosphere.

High intensities of UV light cause a variety of problems for biological systems. The wavelengths of UV light between 290 nm and 320 nm damage biological molecules, amino acids, proteins and nucleic acids, and consequently cells and tissues. The cells of the surfaces of living organisms exposed to UV light are at risk from damage, disruption of physiological processes, and scrambling of their genetic code. Exposure to high levels of UV light causes sunburn, it accelerates ageing of the skin, it suppresses the immune response, and long exposure to bright sunlight is implicated in increasing the incidence of skin cancer in humans and other animals. The incidences of skin cancer in Caucasoids are much higher in countries where the sky is clear for long periods and the intensity of sunlight is high, for example in Australia, New Zealand and South

Africa. The indigenous people of these countries have dark skins, which filter out UV light. Plant tissue is also susceptible to UV radiation. Biochemical composition of tissues and photosynthesis are affected.

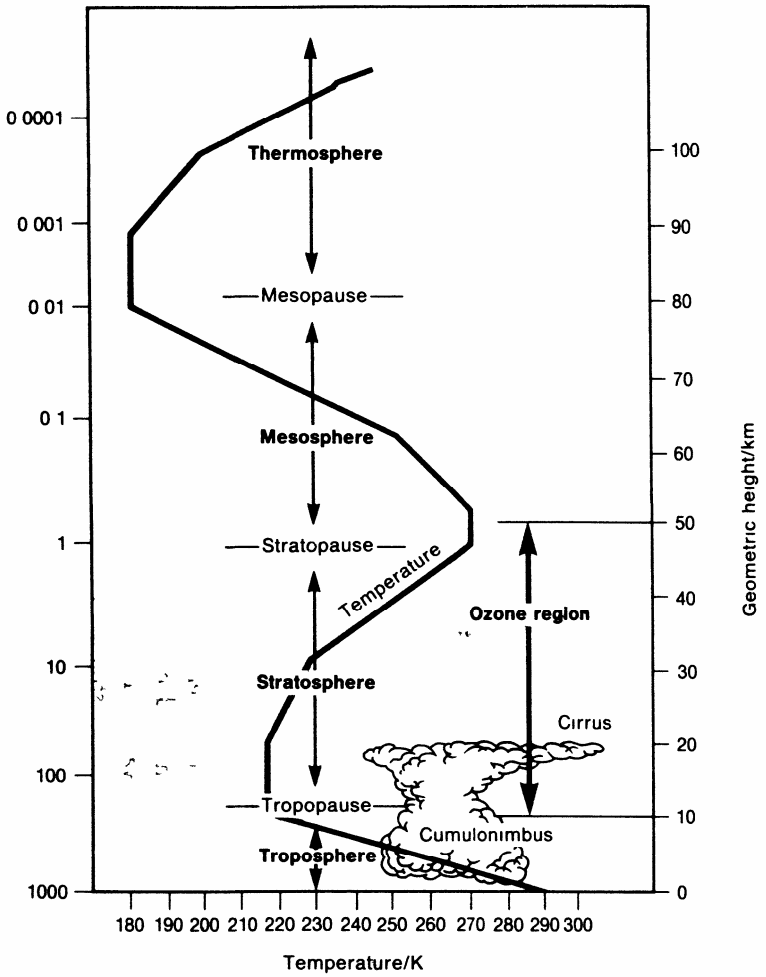

Figure 1.3. *The layers of the atmosphere and its temperature profile. The region of ozone is between altitudes of approximately 10km and 50km.*

The ozone layer of the stratosphere of Antarctica has been studied since 1957 by the British Antarctic Survey. The depth of the ozone layer at the poles is greater than at the equator. In 1982 the Survey noticed, for the first time, a depletion in the layer in October, the southern hemisphere spring. The data for October, from the time measurements were first taken, showed that a dramatic decline in ozone levels had commenced in about 1970. This coincided with an increase in the level of chlorofluorocarbons (CFCs) in the atmosphere (see figure 1.4). CFCs had been predicted, in the early 1970s, to be likely to release free chlorine atoms when they reached and then decomposed in the stratosphere. These chlorine atoms were known to be capable of destroying ozone molecules and, in the process, releasing the active chlorine atom again. This reaction is intensified by the presence of ice crystals and is believed to be the reason why ozone depletion occurs first at the poles. (A second reason is that ozone may be

broken down faster than it can be replaced, as maximum ozone production occurs in the tropics.)

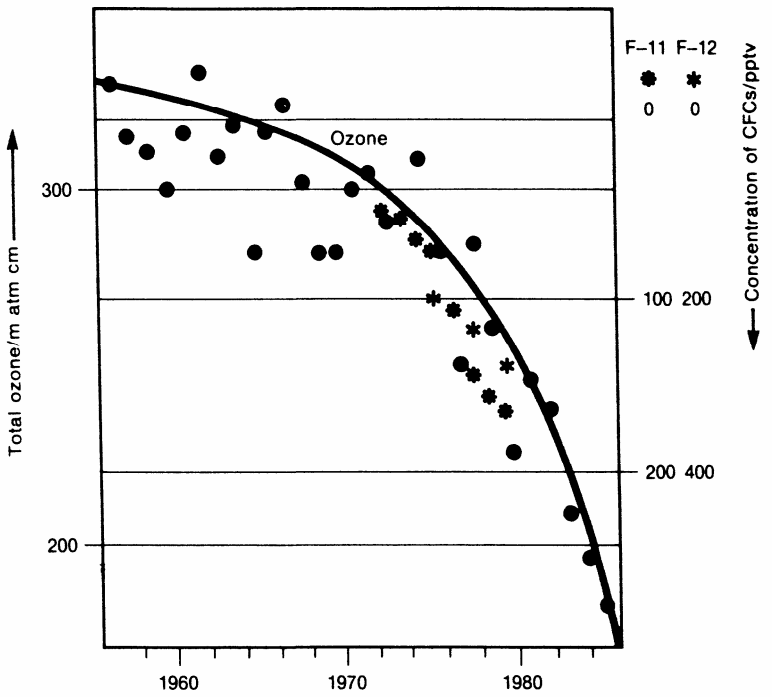

Figure 1.4 *Ozone concentration in the atmosphere over the Antarctic (Halley Bay) m October. The concentrations of two chlorofluorocarbons (CFCs) are also shown: note the axis for their concentrations is inverted. (Redrawn from Farman J. (1987) in New Scientist 12 November: 50-4.)*

CFCs are used as refrigerants and aerosol propellants. There is now little doubt that the serious depletion of atmospheric ozone is strongly influenced by CFC gases. Owing to the concern over atmospheric ozone depletion, considerable strides have been made in the substitution of CFCs with 'ozone-friendly' refrigerants and propellants. Other chemicals have been found to act in a similar way to CFCs; nitrogen oxide (NO) produced from dinitrogen oxide (N_2O) in the stratosphere also destroys ozone. A simple diagram illustrates the atmospheric gas flows in these reactions (see figure 1.5). This model also alerts us to the fact that many of the chemicals involved in ozone destruction are industrially produced and have a long retention time in the stratosphere. Reductions in production of these gases now will have little impact on their concentrations in the stratosphere for a long time. About one-third of one CFC ($CFCl_3$, known as F-11) present in 1987 will remain in the stratosphere in 65 years time, and for a second (CF_2Cl_2, F—12) the equivalent time will be 120 years. It would be necessary to cut CFC emissions to about 15% of their 1987 levels to prevent increases in atmospheric concentrations of these gases in the future.

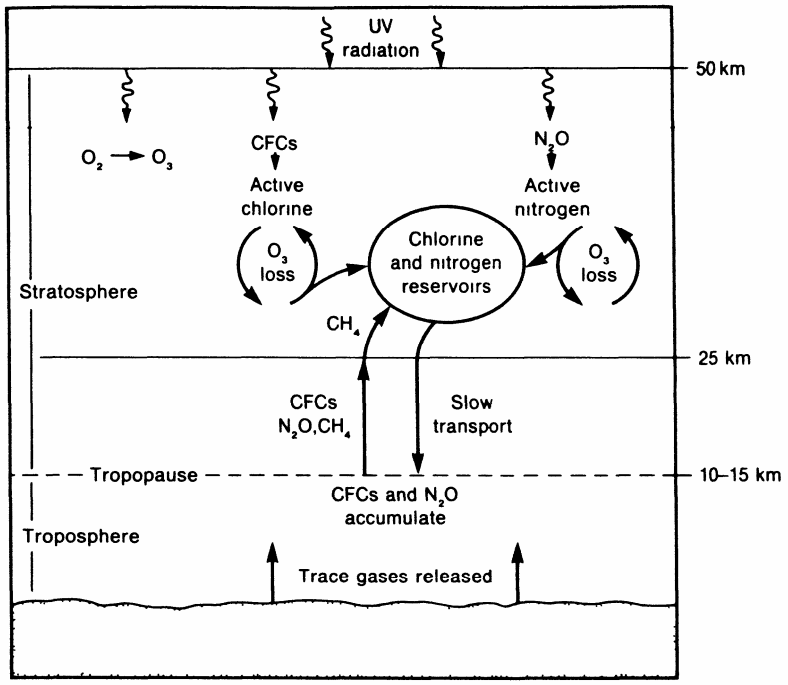

Figure 1.5 *The pathways leading to the breakdown of stratospheric ozone. The gases involved move slowly into the stratosphere where they are broken down by UV light into ozone-destroying catalysts. (Adapted from Warr K. (1990) in New Scientist 17 October: 36-40.)*

The reduction of ozone levels in the stratosphere over Antarctica has been described, popularly, as the **ozone hole,** owing to a virtual absence of ozone. Depressions of up to 50% of normal ozone concentrations, lasting 30-40 days in spring were noted in the late 1980s and appear to be becoming greater. Atmospheric circulation around the Arctic and other aspects of its meteorology are much more complex than in Antarctica. Because of this, conditions for ozone depletion are less likely to occur in the northern hemisphere, but an **ozone crater** (a less severe central depletion zone than a hole) was first reported in the Arctic in 1989.

The industrialised nations have limited the production and use of CFCs in response to this concern. On 16 September 1987, an initiative of the United Nations Environment Programme which began in 1973 was concluded when 21 states and those of the European Community (EC) signed the Montreal Protocol. This is a three-phase programme of objectives for reducing CFC production:

Phase 1. Nations were to cap CFC production in the middle of the year at 1986 levels.

Phase 2. Between mid-1993 and 1994 nations should cut CFC consumption by 20%.

Phase 3. By 1999 CFC use should be reduced by 50%.

There were exemptions for some Eastern Bloc countries, developing countries, Brazil and Argentina. Given the persistence of CFCs in the atmosphere,

many scientists working in this field think that this is an inadequate reduction. There is evidence to show that CFC levels will still be increasing in 1999, even if consumption is cut to 50% of 1986 levels. The protocol is reviewed periodically.

3.3 Acid rain

The term 'acid rain' was first used by Robert Angus Smith in 1872 when, as Chief Alkali Inspector of the UK, he described acidity of the polluted rain falling around Manchester. Distilled water has a pH of 7.0, but unpolluted rainfall, which contains dissolved carbon dioxide (carbonic acid), has a pH of 5.65. This can be modified by naturally occurring chemicals, for example hydrogen sulphide from hot springs, sulphur dioxide from volcanic eruptions and a variety of chemicals derived from soil particles. Any form of wet precipitation, including rainfall, snow and condensing fog, with a pH lower than 5.6 is referred to as acid precipitation or, more commonly, **acid rain.** Pollutants responsible for acidification of our environment are also deposited by gravity and by contact with surfaces. These dry deposited pollutants can have direct effects on the surfaces to which they adhere, but also contribute to acidification of waters when they interact with rainfall.

Examination of past precipitation captured as a historical record in ice sheets and glaciers has indicated that its pH prior to the Industrial Revolution was between 5.0 and 6.0. The average pHs of rainfall in parts of Europe and the USA are now below 5.0 or even 4.0. Exceptionally low values (e.g. pH 2.4 at Pitlochry, Scotland, in 1974) have been recorded in some rainstorms. The pollutants that are responsible for this acidification are oxides of nitrogen and sulphur, which ultimately produce nitric and sulphuric acids. In some areas (e.g. north-eastern USA) hydrochloric acid (HC1) is also significant. The increasing levels of acidity in rain are a serious problem because of their impact on soil nutrients and the health of forests, agricultural crops and freshwater habitats. The problems are more severe near and downwind of large centres of population and their attendant industries, for example in north-eastern North America, central Europe and Scandinavia.

3.4 Origins of the acids

Oxides of nitrogen and acid rain

The reactions which produce nitric acid (HNO_3) from oxides of nitrogen in the atmosphere are very complicated and are modified by temperature, light conditions and the presence of particulate matter and hydrocarbons in the air. Any

process which leads to an increase in nitric acid in the atmosphere will decrease the pH of atmospheric precipitation.

Nitrogen oxide (NO) is an important precursor in the atmospheric generation of nitric acid. It has been estimated that of the atmospheric oxides of nitrogen about 30% are derived from internal combustion engines, 45% from power-generating plants and 25% from domestic and general industrial sources. Nitrogen oxide interacts with ozone (O_3), oxygen (O_2) and energy-absorbing surfaces to produce an equilibrium mixture of nitrogen oxide, nitrogen dioxide (NO_2) and ozone. A further set of reactions converts nitrogen dioxide into nitric acid, which in turn can also be broken down in the atmosphere.

The most abundant oxide of nitrogen in the atmosphere is dinitrogen oxide (N_2O), most of which arrives in the atmosphere via microbial denitrification in anaerobic conditions. Nitrate ions (NO_3^-) are used by denitrifying soil microbes instead of oxygen for respiration and are reduced to produce nitrogen gas (N_2) and dinitrogen oxide. Applications of nitrate fertilisers to waterlogged or compacted soil encourage denitrification, thus wasting money through loss of nutrients. Dinitrogen oxide is relatively stable and is persistent in the atmosphere. If it enters the stratosphere it can decompose either into nitrogen and oxygen or react with atomic oxygen in the presence of bright sunlight to produce nitrogen oxide. Nitrogen oxide is involved in reactions which reduce ozone levels in the stratosphere.

Sulphur compounds and acid rain

Sulphur (S) can enter the atmosphere through a variety of routes, principally as sulphur dioxide (SO_2) from the burning of fossil fuels (coal, oils, natural gas), and refined diesel and petrol hydrocarbons. Approximately half the input of sulphur dioxide into the atmosphere is thought to be natural. Whereas the natural input is global, the rest is concentrated in industrialised parts of the world. The problem with sulphur dioxide is that it is oxidised to produce sulphuric acid and adds to the acidification of falling rain. The chemistry of transformation of the pollutant to the acid is complex. Sulphur dioxide gas interacts with water in cloud droplets to produce bisulphite (HSO_3) and sulphite (SO_32-) ions. These are oxidised in solution in cloud droplets by a variety of atmospheric chemicals to produce sulphuric acid (sulphate (SO_42-) and hydrogen (H^+) ions). It appears that the oxidant most important in controlling acid production is cloudwater hydrogen peroxide (H_2O_2). Some atmospheric sulphur dioxide is absorbed by vegetation and into the surface of oceans, but most is thought to be converted to sulphuric acid.

A second significant route by which sulphur enters the atmosphere is as dimethyl sulphide ((CH_3)S), a volatile organic chemical produced in large quantities by decomposition of plankton in the oceans. Dimethyl sulphide

accounts for about half of the gaseous sulphur (approximately 200 million tonnes) that circulates through the atmosphere each year. A mechanism for its conversion to sulphuric acid in the presence of other atmospheric pollutants has been proposed.

3.5 Acid rainfall

Acid rain falls when the acids in the atmosphere reach the ground through the action of **washout** (when the acids present below clouds are taken up by falling rain or snow) or **rainout** (when the cloudwater droplets or ice crystals containing the acids grow to sufficient size to fall). The gaseous precursors of acid rain are capable of being distributed on a global scale. It is found, however, that as the sources of the gases are centred on industrial countries the greatest effects of acid rain are experienced in areas downwind of these sources (see figure 1.6). South-westerly winds in Europe carry aerial pollutants from western Europe into central and northern Europe. It has been estimated that the UK is the source for about 16% of the acid rain falling in southern Norway. Although airstreams originating from the UK do reach Scandinavia, the air is only mildly polluted compared with the highly acidic rainfall that falls there which originates from airstreams flowing from Czechoslovakia, Hungary, Poland and Germany. It is interesting to compare the proportions of locally produced and imported pollutants in European countries (see table 1.1).

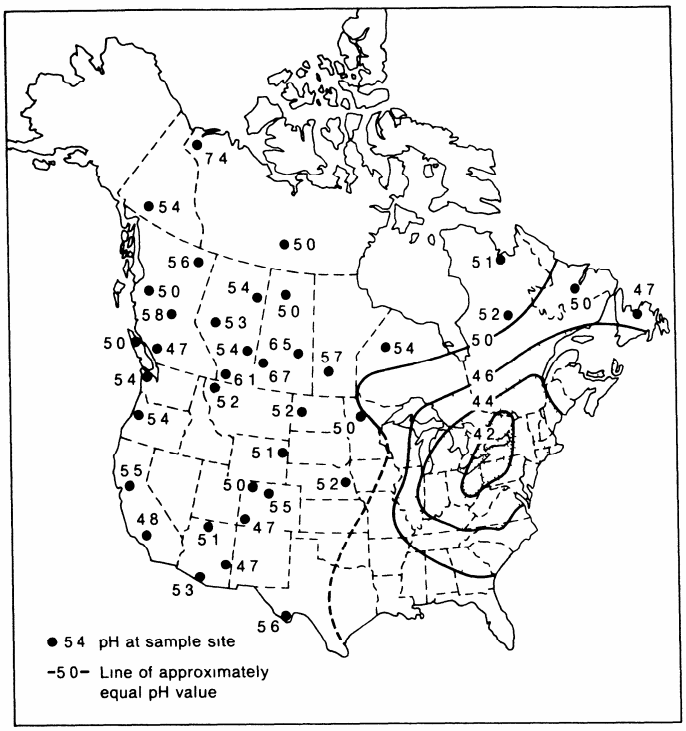

Figure 1.6 *The pH of rainfall in North America in 1982 Downwind of the industrialised regions, the pH is much lower (Redrawn from Miller J. M (1984) in Weatherwise 37: 222-51.)*

Countries such as Switzerland and Norway contribute little to their own sulphur deposition, lacking the advantage of being a western European state (e.g. UK and Spain) in a region of the world with prevailing westerly winds. The Scandinavians are in an invidious position: with low population density and relatively low sulphur emissions, they receive a high proportion of 'imported' sulphur from elsewhere.

Table 1.1. *Estimated sulphur sources as a percentage of the total deposition within selected European countries, October 1978 to September 1980*

	Foreign sources	Indigeno us sources	Undecided deposition	back ground deposition
Czechoslovakia	*56*	*37*	*7*	
Denmark	*54*	*36*	*10*	
Finland	*55*	*26*	*19*	
France	*34*	*52*	*14*	
East Germany	*32*	*65*	*3*	
West Germany	*45*	*48*	*7*	
Hungary	*54*	*42*	*4*	
Netherlands	*71*	*23*	*6*	
Norway	*63*	*8*	*29*	
Poland	*52*	*42*	*6*	
Spam	*18*	*63*	*19*	
Sweden	*58*	*18*	*24*	
Switzerland	*78*	*10*	*12*	
UK	*12*	*79*	*12*	

Source EMEP The co-operative programme for monitoring and evaluation of long range transmission of air pollution in Europe *'Economic Bulletin for Europe* United Nations Economic Commission for Europe (U\/ECE) **34** 29-40

3.6 History of acidification

Studies have been made of diatoms in sediments of lakes and, with a knowledge of the pH preferences of the species discovered, it has been possible to estimate pH levels in lake waters over long periods of time. The pH of the water in Lake Gardsjon, Sweden, had declined from about pH 7.0, 12 500 years ago to pH 6.0 in the mid-1950s as a result of natural processes after the last glacial retreat. From about the mid-1950s to 1979 the pH of the lake fell from 6.0 to 4.5. This pattern has been found elsewhere. In the last fifty years or so, pH values

have rapidly changed. However, it is not known why the impact of acid emissions (polluted outpourings initially produced at the beginning of the Industrial Revolution over 200 years ago) has taken so long to manifest itself in lake waters. It may have taken this period of time for the capacity of the environment to absorb the hydrogen ions to be saturated. The problems being seen in Scandinavian lakes and central European forests in the 1990s are the consequences of decades, if not centimes, of pollution.

The contributions of sulphuric and nitric acids to acid rain vary according to the locality (see table 1.2). There js a trend towards an increasing proportion of the acidity being derived from nitric acid as the burning of fossil fuels continues to increase.

Table 1.2. *Contributions (%) of nitric, sulphuric and hydrochloric acid to acid rain in different parts of the world*

	Acid species		
	Nitric	**Sulphuric**	**Hydrochloric**
Northern USA	32	62	6
Scandinavia	30	70	NA
Scotland	29	71	NA

NA Data not available

3.7 Impact of acid rain

The impact of acid rain on soils and water depend on the capacity of the minerals in the soil and the catchment of lakes and rivers to absorb hydrogen ions without significant changes in pH or in the behaviour of soil nutrients (i.e. the environment's **buffering capacity).** Soils derived from sedimentary rocks with high levels of calcium and magnesium have good buffering properties. Those formed on igneous or metamorphic rocks are strongly influenced by acid rain and exhibit a proportionately greater acidification for the same input of hydrogen ions (i.e. poor buffering capacity). This has been one of the main reasons why the effects of acid rain have been so evident in southern Scandinavia, in upland areas in the UK and in parts of Canada where the soils are derived from granite or are sandy.

Acid rain causes problems in soils in various ways. Low pH leads to leaching of some nutrients (e.g. Ca, Mg and K), increases the solubility of others (e.g. Al, Fe and Mn), mobilises toxic metals ions (e.g. Pb and Ni) and immobilises some important nutrients (e.g. Mo). Low pHs inhibit decomposition by bacteria and fungi. The low calcium levels found in acid soils exclude earthworms and molluscs, whose activity is important in decomposition processes. One of the most significant changes that occurs in soil is the release of aluminium ions into soil solution. Aluminium in solution has been shown to be toxic to plants, and to

reduce the uptake of calcium and probably other cations. Acid rain has been linked with growth problems in forests in Canada and Europe that appear to be due to deficiencies of potassium and magnesium and to changes in the balance between calcium and aluminium ions in soil solution.

In freshwater ecosystems the impact of excess hydrogen and toxic aluminium ions in water can be catastrophic. In southern Norway it was estimated that in 1983 lakes of a total surface area of 13 000 km^2 had no fish. In parallel to this there has been an increase in the proportion of Scandinavian lakes which have lost their populations of brown trout *(Salrno trutta)* (see figure 1.7). Several lochs in Scotland and upland rivers in Britain are also without fish as a result of acidification.

Fish are killed because they lose ions from their plasma and muscle tissue in acid water. Aluminium ions cause excessive mucus production by the gill surfaces, which become clogged, eventually causing respiratory distress and death. Species richness of aquatic

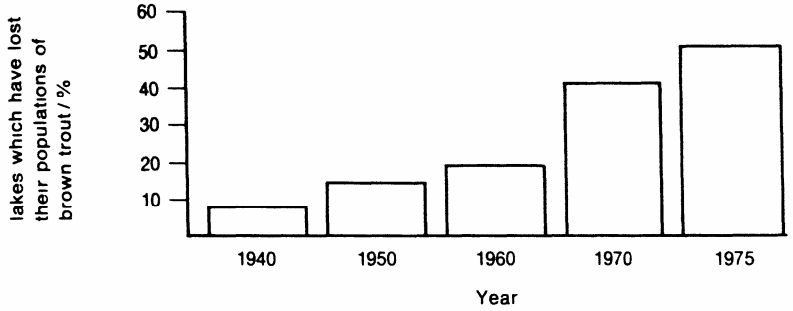

Figure 1.7 *Changes in the proportion of lakes in Scandinavia which have lost their brown trout (Salmo trutta). (Data from Wellbum A. (1988).)*

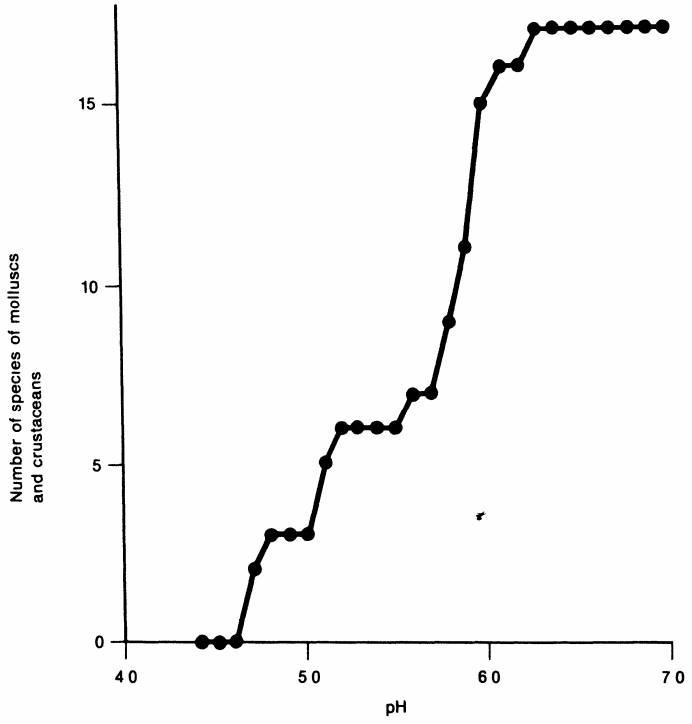

Figure 1.8 *The pH tolerance of 27 common species of molluscs and crustaceans found in near-neutral waters in Norway. (Adapted from Okland J. & Okland K.A. (1980) in Drablos D. & Tollan A. (eds.) Ecological impact of acid precipitation, SNSF Project, Oslo.)*

organisms declines with decreasing pH. This is well illustrated by the pH tolerance of common snails, mussels and crustaceans in some Norwegian lakes (see figure 1.8). Levels of pH well below 4.5 are not uncommon in acidified lakes and it is hardly surprising they are almost devoid of life. Lake bottoms become covered with growths of acid-tolerant plants, a few species of green algae and moss.

As far as humans are concerned, the effects of high hydrogen and aluminium ion concentrations in drinking water are not well known. High aluminium levels in water supplies have been associated by epidemiological studies with increased incidences of a rare bone-wasting disease (osteomalacia) and Alzheimers disease (premature senile dementia). The possible relationship between aluminium and Alzheimer's disease is discussed by A. Cornwell and V. Cornwell in their book *Drugs, alcohol and mental health* (Cambridge University Press, 1993) in this series. High nitrate levels in water are known to cause methaemoglobinaemia in infants. The nitrates are converted to nitrites in infant guts, which, in contrast to adults, are not able to reduce nitrites to nitrogen. The nitrite combines, irreversibly, with haemoglobin, which can then no longer transport oxygen. Babies turn blue (blue-baby syndrome), suffer from respiratory distress, and may die. A link has been proposed between high nitrate levels and the incidence of stomach cancer arising from the production of nitroso compounds in the body from the nitrates. The link has not been proven, but nitroso compounds are known to be carcinogenic.

The high nitrate levels in lakes and groundwaters are derived from nitrate leaching from agricultural land as well as acid rain. The fertilising effects of both sulphate and nitrate from acid rain has been shown to increase agricultural and forestry productivity until a point is reached where the increasing hydrogen ion concentrations become damaging.

3.8 Reduction of the impact of acid rain

Acid rain is a serious problem. It warrants effective control but this cannot be achieved by treating symptoms. The problem must be solved by removing its causes. Further additions of nitrogen oxides and sulphur dioxide to the atmosphere can be reduced in a variety of ways.

1 Improved engine designs

The amounts of nitrogen oxide produced by burning fossil fuels in power stations, furnaces and motor engines can be reduced by careful design of fuel delivery, combustion chambers, exhaust systems and the way in which the machinery is operated. In cars, for example, the considerable strides made in improving engine design (computerised fuel injection and the lean-bum engine with its high air-to-fuel ratio) have been linked with improvements in exhaust treatment (exhaust recirculation, and three-way catalytic conversion, where carbon monoxide, unburned hydrocarbon and nitrogen oxide gases are eliminated) to provide considerable reduction in nitrogen oxide emission from exhausts. The changes in design have not all been associated with improving engine performance!

2 Low sulphur and cleansed fuels

The greatest proportion of the sulphur dioxide entering the atmosphere is produced by coal and oil burning. The sulphur content of coal and oil varies considerably (about 0.5% to 5.0%) and utilisation of low-sulphur coal and oil can help reduce emissions. Oil and coal fuels can also be cleansed, at least partly, of their sulphur content, but using low-sulphur fuels and cleansing alone is unlikely to be sufficient to meet emission-reduction targets of 50% within ten years.

The fluidised-bed combustion system for burning fuels in power stations is effective in reducing sulphur dioxide and nitrogen oxide emissions. Small particles (or droplets) of fuels are held suspended in a jet of air and burned at relatively low temperatures (500-900 °C) in the presence of ground limestone or dolomite. The low temperatures greatly reduce the production of nitrogen oxide and up to 90% of the sulphur is removed as magnesium or calcium sulphate in the ash. Table 1.3 compares the level of pollutant gases in emissions and the thermal efficiencies of five different power station systems, showing the gains that can be made by using the fluidised-bed system.

The quantities of sulphur dioxide emitted from power station exhaust chimneys can be reduced still further by flue gas desulphurisation systems, usually referred to as scrubbers. A slurry of lime or limestone is directed against the emerging flue gases and can remove 90—99% of flue gas sulphur dioxide. The byproduct of the process, gypsum, can be used in the manufacture of cement products.

Table 1.3. *Thermal efficiency and emission qualities of power station combustion systems*

		Gas emissions		
	% maximum	Carbon	Sulphur	Nitrogen
Combusti	thermal	monoxide	dioxide	oxides
Oil-fired	35-37	Trace	High	considerable
Natural gas-fired	35-37	Trace	Low	very high
Coal-fired	35-40	Low	High	considerable
Gas turbine	18-28	High	very high	very high
Fluidised-bed	50-70	Trace	Low	low

3 Liming

The symptoms of acidification of lakes and their catchment areas, and perhaps the decades of acidification past, can be treated by the application of lime. This will neutralise acidity, increase calcium levels in soil and water and precipitate aluminium from solution. This treatment has been used in Norway, Sweden, Canada, USA and the UK. It has been successful with some lakes but not all. Liming can cause significant changes to the terrestrial vegetation and to the living organisms in streams and lakes, which may be equally as unacceptable as the water's acidity.

3.9 Greenhouse effect

The temperature of the Earth's atmosphere is governed by many factors, but is essentially a product of the interaction of incoming solar radiation with a variety of compounds in the atmosphere. The temperature of the sun's surface is about 6000 °C and it radiates most of its energy in the visible waveband (0.4-0.7μm). This penetrates the atmosphere and reaches the Earth's surface, along with some UV light (below 0.4μm) and short wavelength infrared light (just above 0.7 μm). This warms the Earth's surface which then, because it is much cooler, radiates energy in the long infrared wavelengths (4-100 μm). About 70% of this energy escapes into space, but some is absorbed by compounds in the atmosphere. Water vapour absorbs wavelengths from 4 μm to 7 μm and carbon dioxide absorbs from 7 μm to 13 μm. This absorption of heat warms the troposphere (the atmosphere's lowest layer) and heat is radiated back and warms the Earth's surface. This is the **greenhouse effect.** Water vapour and carbon dioxide, and some other gases which have similar properties in this respect, are known as **greenhouse gases.** If

the sun's heat supply to the Earth remains constant (which it does, more or less) and the concentration of greenhouse gases remains constant, then the heat balance of the atmosphere and the surface would be constant. One of our most serious global concerns is that the concentrations of greenhouse gases are not constant. They are being increased substantially by human activities (or anthropogenic influences), and there is undoubtedly a parallel rise in the temperature of the atmosphere.

3.10 Carbon dioxide as a greenhouse gas

Carbon dioxide levels in the atmosphere have been increasing for a long time. Data produced at the Mauna Loa Observatory, Hawaii, have shown an increase since records commenced in 1958. Data on levels of gases captured in ice cores suggest that carbon dioxide levels have fluctuated widely since the last glacial retreat, but they appear to be higher now than at any time since the last glaciation. It is clear that the present upward trend has gone on for 200 years at least (see figure 1.9).

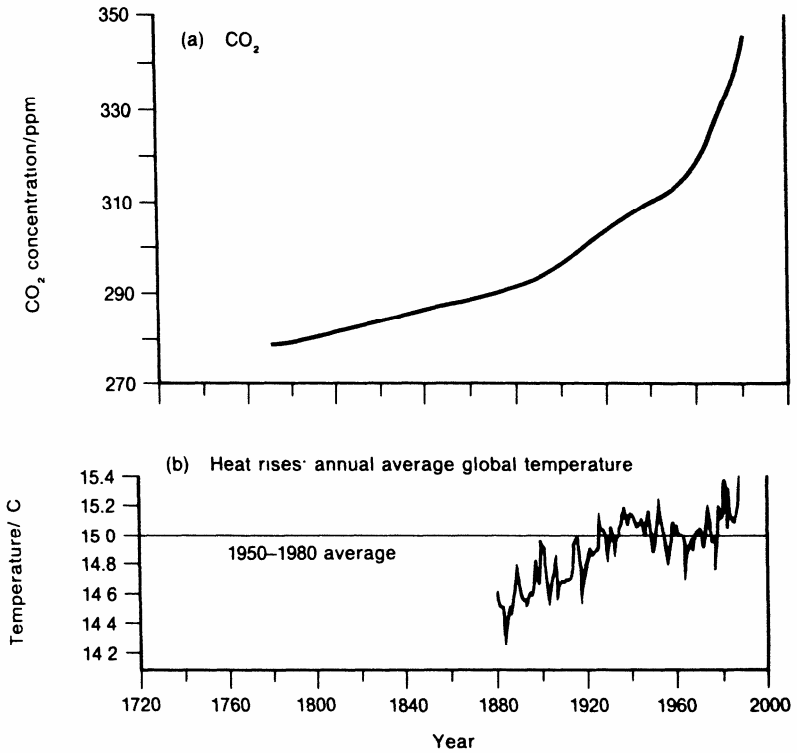

Figure ***1.9*** *Changes in the atmosphere (a) global carbon dioxide concentrations since the Industrial Revolution and (b) temperature since 1880. (Data from Neftel A. et ai (1985) in Nature 315:45-7; and Gribbin J. (1988) in New Scientist* ***120.)***

Research has also shown a close correlation between atmospheric carbon dioxide levels and global temperature. The carbon dioxide increase in the atmosphere represents a balance between the amount given off by respiration,

burning of fossil fuels and forest conversion, on the one hand, and photosynthetic uptake and solution in the seas, on the other. The equation is not in balance now because the rate of carbon dioxide production from fossil fuels and forest conversion exceeds its fixation rate. It is estimated (early 1990s) that deforestation releases about 1-3 billion tonnes and the burning of fossil fuels 6 billion tonnes of carbon dioxide each year. Levels of carbon dioxide, about 350 ppm in the early 1990s, are expected to be in excess of 400 ppm by the turn of the century. The United States Environmental Protection Agency has estimated that levels will reach 600 ppm in the next century (between the years 2060 and 2080), which will produce a rise in global air temperature of 1.5-4.5 °C. This appears within the band of temperature rise expected by most authorities, but there are some who expect higher increases and others who expect negligible ones.

3.11 Other greenhouse gases

Carbon dioxide is not the only greenhouse gas; methane, dinitrogen oxide, ozone and chlorofluorocarbons (CFCs) act in a similar way. These are more effective greenhouse gases than carbon dioxide: a molecule of methane is equivalent to 20 molecules of carbon dioxide; and a dinitrogen oxide molecule is equivalent to 200 in this respect. All of these gases are being released to the atmosphere in increasing quantities as a result of the anthropogenic influences.

Methane is a common product of the breakdown of organic matter, including wastes, in anaerobic conditions. There is evidence that it is even produced during the burning of biomass as a result of incomplete oxidation. Methane is released naturally by decomposition in anaerobic estuarine muds, peat bogs and other wetlands but is also produced in increasing volumes from rice paddies, the rumen of cattle, rubbish tips and the burning of forests. Methane in bubbles in ice captured in 1771 is recorded at a level of 0.78 ppm, but by the 1980s this had risen to 1.7 ppm and is increasing at a rate of 1.2% per year.

Dinitrogen oxide and ozone have been mentioned earlier in this chapter. Dinitrogen oxide levels are 0.3 ppm (1991) but expected to rise to 0.35 ppm by the year 2050. Dinitrogen oxide is derived mainly from denitrifying bacteria in the soil which produce dinitrogen oxide from nitrates in the soil under anaerobic conditions. Its increasing concentration is almost certainly due to the escalating use of nitrate fertilisers. Ozone and CFC levels in the atmosphere are also increasing. As well as causing problems by its absence from the stratosphere in polar regions, ozone also enhances global warming through its increasing concentrations in the troposphere.

3.12 Consequences of global warming

The impact of the global warming that has occurred so far is not well known. It has been shown that the density of stomata in plant species has increased by about 40% in the last 200 years in response, it is thought, to the carbon dioxide levels. Increases in growth rates of subalpine conifers in western North America have been recorded and attributed to global warming, as has the decline in red spruce *(Picea rubens)* populations in the USA, but the evidence is not unequivocal. Predictions of future repercussions are not certain, despite global atmospheric models becoming increasingly refined. A particular focus in the debate is the amount of cloud cover predicted by the models. Cloud cover, it is thought, has an impact on incoming solar radiation (cooling) rather greater than its radiation-capturing effect (warming). The complex predictions from the models are difficult to assess, as can be gathered from reading the literature (e.g. Wyman (1991)). There is a consensus, however, that temperature will continue to rise, that parts of the world will become drier and others wetter (see figure 1.10) and that the warming will be greater at the poles than at the equator. The change in moisture regimes around the world would lead to significant changes in vegetation and crop growth. The major concern is that areas where rainfall is marginal for agriculture now may become even less productive. It has been suggested that for the UK, by the year 2030, there will be lower rainfall in summer and more in winter in the south east, and higher rainfall in summer and winter in the north and west. Low summer rainfall and increased evapotranspiration may lead to droughts in the south east. The elevated temperatures may make the climate warm enough to grow soya beans and navy beans and to plant sunflowers and maize further north. The range of plants like these is likely to move 300km north for each degree the temperature rises.

A major effect of global warming will be the melting of polar ice caps and the raising of sea levels. In the last 100 years temperatures have risen about 1 °C and sea levels about 10 cm. Projections of a further increase in sea levels vary between 0.3m and 3.5m by the year 2100. This will flood low-lying coastal areas, cause erosion, lead to saltwater intrusion and increase storm damage. Wetland areas will be altered and, as efforts will be made to protect low-lying productive land with polders, it is possible that salt marshes and swamps will disappear by submersion and not be replaced.

3.13 Solutions to problems caused by greenhouse gases

Global warming, as its name implies, is a global and, therefore, international problem which will either be addressed internationally, presumably led by financially prosperous countries through the United Nations, or in practical terms it will be ignored. The solutions are obvious: we have to stop cutting down

forests; reduce our burning of fossil fuels; reduce our utilisation of nitrate fertilisers; stop using CFCs and producing other greenhouse gases; and be more careful with our resources. It has been suggested that the resolution of this problem could be achieved by substituting non-renewable fossil fuels with sustainably managed wood fuels.

The demands for resources and increasing food production, and the wastes produced by these demands, so dominate global biogeochemical cycles and their rate of turnover that their undesirable consequences are being felt on a global scale. Surely it is not possible for over one-third of global nitrogen to be fixed industrially without causing major disruptions to ecosystems that have taken millennia to evolve? Ultimately it is the growing demands placed on resources by an increasing world population that is the source of the problem. This requires the carrying capacity of the globe to be continually raised. It might be a much better idea to seek population stability, or even decline, so that resource demands placed on our environment were sustainable and environmentally friendly in all respects.

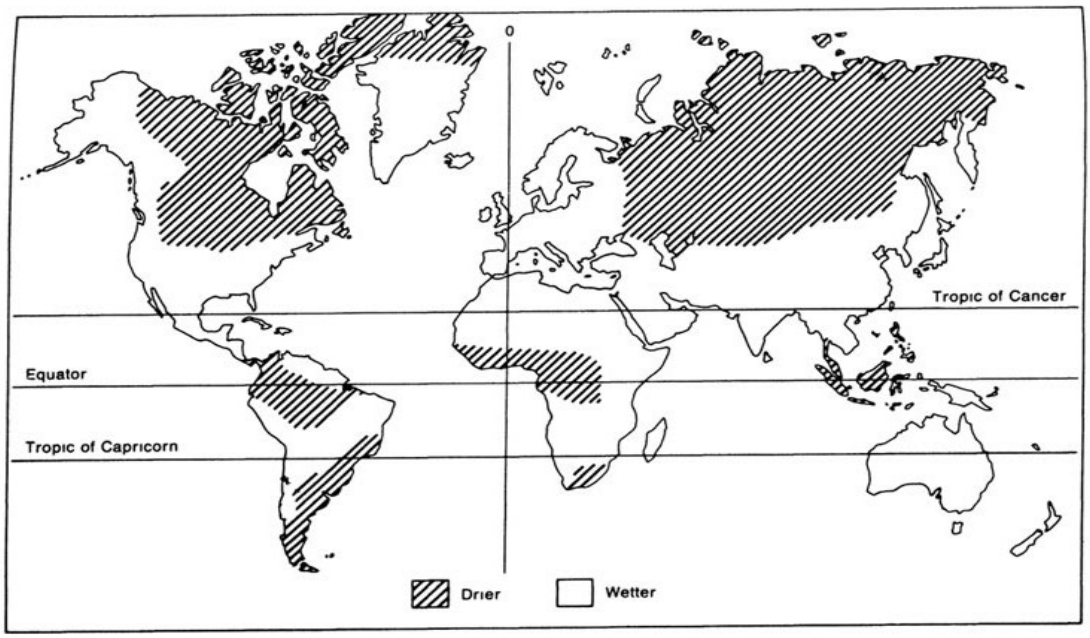

Figure 1.10 *A warmer Earth: one prediction for wetter and drier soil moisture patterns in the growing seasons. (Redrawn from Kellogg W.W. & Schware R. (1981) Climatic change and society. Westview press)*

3.14 The way forward

Hopes exist for solving global problems. The United Nations has established an Environment Programme (UNEP) to focus world attention on its problems and to make recommendations for their solution. UNEP evolved from the United

Nations Conference on the Human Environment in 1972. It has numerous offshoots and subcommittees, for example:

- Global Environment Monitoring Systems (GEMS)
- INFOTERRA - a scheme for Information Exchange on National
- Environmental Information
- Co-ordinating Committee on the Ozone Layer (CCOL)
- The Vienna Ozone Convention

It is hoped that the impacts of global environmental issues will, **as a** result of this international focus, be fully appreciated and that solutions will be found and implemented to resolve them. Sweden has set an example by placing a carbon dioxide tax on fuels, specifically to cut down greenhouse gas emissions.

An apt conclusion to this chapter is the following extract (about global warming):

Education holds our hope for the future. Environmental education should be the backbone of a new global morality. Every student on the Earth should learn to recognise the finite limits of our planet, that we have the ability to alter its climate and destroy its life-support system. We must come to realise that our future can be made brighter only by limiting our family size and by carefully planned, conservative use of natural resources.

4. DICTIONARY

abiotic - Pertaining to factors or things that are separate from and independent of living things; nonliving.
absolute poverty - The lack of sufficient income in cash or exchange items for meeting the most basic human needs for food, clothing, and shelter.
acid - Any compound that releases hydrogen ions when dissolved in water. Also, a water solution that contains a surplus of hydrogen ions.
acid deposition - Any form of acid precipitation and also fallout of dry acid particles. (See acid precipitation.)
acid precipitation - Includes acid rain, acid fog, acid snow, and any other form of precipitation that is more acidic than normal, i.e., less than pH 5.6. Excess acidity is derived from certain air pollutants, namely sulfur dioxide and oxides of nitrogen.
activated sludge - Sludge made up of clumps of living organisms feeding on detritus that settles out and is recycled in the process of secondary wastewater treatment.
activated sludge system - A system for removing organic wastes from water. The system uses microorganisms and active aeration to decompose such wastes. The system is used most as a means of secondary sewage treatment following the primary settling of materials.
active safety features - Those safety features of nuclear reactors that rely on operator-controlled reactions, external power sources, and other features that are capable of failing. (See passive safety features.)
adaptation - An ecological or evolutionary change in structure or function that produces better adjustment of an organism to its environment and hence enhances its ability to survive and reproduce.
adsorption - The process whereby chemicals (ions or molecules) stick to the surface of other materials.
aeration - Soil: The exchange within the soil of oxygen and carbon dioxide, necessary for the respiration of roots. Water: The bubbling of air or oxygen through water to increase the dissolved oxygen.
age structure - Within a population, proportions of people who are old, middle-aged, young adults, and children.
air pollution disaster - Short-term situation in industrial cities in which intense industrial smog brings about a significant increase in human mortality.
air toxics - A category of air pollutants including radioactive materials and other toxic chemicals that are present at low concentrations but are of concern because they often are carcinogenic.
alga, pl. algae - Any of numerous kinds of photosynthetic plants that live and reproduce entirely immersed in water. Many species, the planktonic forms, exist

as single or small groups of cells that float freely in the water. Other species, the 'seaweeds,' may be large and attached.
algal bloom - A relatively sudden development of a heavy growth of algae, especially planktonic forms. Algal blooms generally result from additions of nutrients, whose scarcity is normally limiting.
alleles - The two or more variations of a gene for any particular characteristic, e.g., blue and brown are alleles of the gene for eye color.
alternative farming - Farming methods designed to minimize the use of agricultural chemicals.
ambient standards - Air quality standards (set by the EPA) stating that outside average air should always maintain a level of purity. That is, certain levels of pollution should not be exceeded in order to maintain environmental and human health.
anaerobic - Oxygen-free.
anaerobic digestion - The breakdown of organic material by microorganisms in the absence of oxygen. The process results in the release of methane gas as a waste product.
anaerobic respiration - Respiration carried on by certain bacteria in the absence of oxygen. Methane, which can be used as fuel gas (it is the same as natural gas), may be a by-product of the process.
anthropogenic - Referring to pollutants and other forms of impacts on natural environments that can be traced to human activities.
appropriate technology - Technology that seeks to increase the efficiency and productivity of hand labor without displacing workers. That is, it seeks to enable people to improve their well-being without disrupting the existing social and economic system.
aquaculture - A propagation and/or rearing of any aquatic (water) organism in a more or less artificial system.
aquifer - An underground layer of porous rock, sand, or other material that allows the movement of water between layers of nonporous rock or clay. Aquifers are frequently tapped for wells.
artificial selection - Plant and animal breeders' practice of selecting individuals with the greatest expression of desired traits to be the parents of the next generation.
asbestos fibers - Crystals of asbestos, a natural mineral, that have the form of minute strands.
atom - The fundamental unit of all elements.
autotroph - Any organism that can synthesize all its organic substances from inorganic nutrients, using light or certain inorganic chemicals as a source of energy. Green plants are the principal autotrophs.
background radiation - Radioactive radiation that comes from natural sources apart from any human activity. We are all exposed to such radiation.

bacterium, pl. bacteria - Any of numerous kinds of microscopic organisms that exist as simple, single cells that multiply by simple division. Along with fungi, they constitute the decomposer component of ecosystems. A few species cause disease.
balanced herbivory - A diversified plant community held in balance by various herbivores specific to each plant species.
bar screen - A set of iron bars about an inch apart used to screen debris out of wastewater.
aase - Any compound that releases hydroxyl ions (OHs) when dissolved in water. A solution that contains a surplus of hydroxyl ions.
bedload - The load of coarse sediment, mostly coarse silt and sand, that is gradually moved along the bottom of a riverbed by flowing water rather than being carried in suspension.
benefit-cost analysis - An analysis and/or comparison of the value benefits in contrast to the costs of any particular action or project. (See cost-benefit ratio.)
benthic plants - Plants that grow under water attached to or rooted in the bottom. For photosynthesis, they depend on light penetrating the water.
best management practice - Farm management practices that serve best to reduce soil and nutrient runoff and subsequent pollution.
bioaccumulation - The accumulation of higher and higher concentrations of potentially toxic chemicals in organisms. It occurs in the case of substances that are ingested but cannot be excreted or broken down (nonbiodegradable substances).
biochemical oxygen demand (BOD) - The amount of oxygen that will be absorbed or 'demanded' as wastes are being digested or oxidized in both biological and chemical processes. Potential impacts of wastes are commonly measured in terms of the BOD.
biocide - Applies to any pesticide or other chemical that is toxic to many, if not all, kinds of living organisms.
bioconversion - The use of biomass as fuel. Burning materials such as wood, paper, and plant wastes directly to produce energy, or converting such materials into fuels such as alcohol and methane.
biodegradable - Able to be consumed and broken down to natural substances such as carbon dioxide and water by biological organisms, particularly decomposers. Opposite: nonbiodegradable.
biodiversity - The diversity of living things found in the natural world. The concept usually refers to the different species but also includes ecosystems and the genetic diversity within a given species.
biogas - The mixture of gases -- about two-thirds methane, one-third carbon dioxide, and small portions of foul-smelling compounds -- resulting from the anaerobic (without air) digestion of organic matter. The methane content enables biogas to be used as a fuel gas.

biological control - Control of a pest population by introduction of predatory, parasitic, or disease-causing organisms.
biological treatment - See secondary treatment.
biological wealth - The combination of commercial, scientific, and aesthetic values imparted to a region by its biota.
biomagnification - Bioaccumulation occurring through several levels of a food chain.
biomass - Mass of biological material. Usually the total mass of a particular group or category; for example, biomass of producers.
biomass energy, biomass fuels - Energy or fuels such as alcohol and methane produced from current photosynthetic production of biological materials. (See bioconversion.)
biomass pyramid - Refers to the structure that is obtained when the respective biomasses of producers, herbivores, and carnivores in an ecosystem are compared. Producers have the largest biomass, followed by herbivores and then carnivores.
biome - A group of ecosystems that are related by having a similar type of vegetation governed by similar climatic conditions. Examples include prairies, deciduous forests, arctic tundra, deserts, and tropical rain forests.
bioremediation - Refers to the use of microorganisms for the decontamination of soil or groundwater. Usually involves injecting organisms and/or oxygen into contaminated zones.
biosolids - The sludges derived as a result of removing pollutants from sewage wastewater.
Biosphere - The overall ecosystem of Earth. It is the sum total of all the biomes and smaller ecosystems, which ultimately are all interconnected and interdependent through global processes such as water and atmospheric cycles.
biota - Refers to any and all living organisms and the ecosystems in which they exist.
biotic - Living or derived from living things.
biotic community - All the living organisms (plants, animals, and micro-organisms) that live in a particular area.
biotic potential - Reproductive capacity. The potential of a species for increasing its population and/or distribution. The biotic potential of every species is such that, given optimum conditions, its population will increase. (Contrast environmental resistance.)
biotic structure - The organization of living organisms in an ecosystem into groups such as producers, consumers, detritus feeders, and decomposers.
birth control - Any means, natural or artificial, that may be used to reduce the number of live births.
BOD - See biochemical oxygen demand.

borrowed time - Time preceding a predictable and inevitable collapse or failure of a system during which nothing is done to avert the end result despite awareness of it.
bottle law (bottle bill) - A law that provides for the recycling or reuse of beverage containers, usually by requiring a returnable deposit at the purchase of the item.
breeder reactor - A nuclear reactor that in the course of producing energy also converts nonfissionable uranium-238 into fissionable plutonium-239, which can be used as fuel. Hence, a reactor that produces as much nuclear fuel as it consumes or more.
broad-spectrum pesticides - Chemical pesticides that kill a wide range of pests. They also kill a wide range of nonpest and beneficial species; therefore, they may lead to environmental upsets and resurgences. The opposite of narrow-spectrum pesticides and biorational pesticides.
BTU (British Thermal Unit) - A fundamental unit of energy in the English system. The amount of heat required to raise the temperature of 1 pound of water 1 degree Fahrenheit.
buffer - A substance that will maintain the pH of a solution by reacting with the excess acid. Limestone is a natural buffer that helps to maintain water and soil at a pH near neutral.
buffering capacity - Refers to the amount of acid that may be neutralized by a given amount of buffer.
calorie - A fundamental unit of energy. The amount of heat required to raise the temperature of 1 gram of water 1 degree Celsius. All forms of energy can be converted to heat and measured in calories. Calories used in connection with food are kilocalories, or 'big' calories, the amount of heat required to raise the temperature of 1 liter of water 1 degree Celsius.
capillary water - Water that clings in small pores, cracks, and spaces against the pull of gravity, like water held in a sponge.
carbon monoxide - A highly poisonous gas, the molecules of which consist of a carbon atom with one oxygen attached. Not to be confused with nonpoisonous carbon dioxide, a natural gas in the atmosphere.
carbon tax - A tax levied on all fossil fuels in proportion to the amount of carbon dioxide that is released as they burn.
carcinogenic - Having the property of causing cancer, at least in animals and by implication in humans.
carnivore - An animal that feeds more or less exclusively on other animals.
carrying capacity - The maximum population of a given species that an ecosystem can support without being degraded or destroyed in the long run. The carrying capacity may be exceeded, but not without lessening the system's ability to support life in the long run.
castings - The humus-rich pellets resulting from earthworm activity.

catalyst - A substance that promotes a given chemical reaction without itself being consumed or changed by the reaction. Enzymes are catalysts for biological reactions. Also catalysts are used in some pollution control devices, e.g., the catalytic converter.
catalytic converter - The device used by U.S. automobile manufacturers to reduce the amount of carbon monoxide and hydrocarbons in the exhaust. The converter contains a catalyst that oxidizes these compounds to carbon dioxide and water as the exhaust passes through.
cell - The basic unit of life; the smallest unit that still maintains all the attributes of life. Many microscopic organisms consist of a single cell. Large organisms consist of trillions of specialized cells functioning together.
cell respiration - The chemical process that occurs in all living cells wherein organic compounds are broken down to release energy required for life processes. Higher plants and animals require oxygen for the process as well and release carbon dioxide and water as waste products, but certain microorganisms do not require oxygen. (See anaerobic respiration.)
cellulose - The organic macromolecule that is the prime constituent of plant cell walls and hence the major molecule in wood, wood products, and cotton. It is composed of glucose molecules, but because it cannot be digested by humans its dietary value is only as fiber, bulk, or roughage.
center pivot irrigation - An irrigation system consisting of a spray arm several hundred meters long supported by wheels pivoting around a central well from which water is pumped.
CFCs - See chlorofluorocarbons.
chain reaction - Nuclear reaction wherein each atom that fissions (splits) causes one or more additional atoms to fission.
channelization/channelized - The straightening and deepening of stream or river channels to speed water flow and reduce flooding. A waterway so treated is said to be channelized.
chemical barrier - In reference to genetic pest control, a chemical aspect of the plant that makes it resist pest attack.
chemical energy - The potential energy that is contained in certain chemicals; most importantly, the energy contained in organic compounds such as food and fuels, which may be released through respiration or burning.
chemical technology - Applied to the control of agricultural pests, refers to the use of pesticides and herbicides to control or eradicate the pests.
chemosynthesis - The ability of some microorganisms to utilize the chemical energy contained in certain inorganic chemicals such as hydrogen sulfide for the production of organic material. Such organisms are producers.
chlorinated hydrocarbons - Synthetic organic molecules in which one or more hydrogen atoms have been replaced by chlorine atoms. They are extremely hazardous compounds because they tend to be nonbiodegradable and therefore to

bioaccumulate; many have been shown to be carcinogenic. Also called organochlorides.
chlorination - The process of adding chlorine to drinking water or sewage water in order to kill microorganisms that may cause disease.
chlorofluorocarbons (CFCs) - Synthetic organic molecules that contain one or more of both chlorine and fluorine atoms, and are implicated in ozone destruction.
chlorophyll - The green pigment in plants responsible for absorbing the light energy required for photosynthesis.
Clean Air Act of 1970 - Amended in 1977 and 1990, this is the foundation of U.S. air pollution control efforts.
Clean Water Act of 1972 - The cornerstone federal legislation addressing water pollution.
clearcutting - Cutting every tree, leaving the area completely clear.
climate - A general description of the average temperature and rainfall conditions of a region over the course of a year.
climax ecosystem - The last stage in ecological succession. An ecosystem in which populations of all organisms are in balance with each other and with existing abiotic factors.
clone - A group of genetically identical individuals derived from the asexual propagation of a single individual.
clustered development - The development pattern in which homes and other facilities are arranged in dense clusters on a relatively small portion of the land considered for development, allowing the rest of the land to remain open.
co-composting - A technique of composting sewage sludge and shredded paper together.
cogeneration - The joint production of useful heat and electricity. For example, furnaces may be replaced with gas turbogenerators that produce electricity while the hot exhaust still serves as a heat source. An important avenue of conservation, it effectively avoids the waste of heat that normally occurs at centralized power plants.
command-and-control strategy - The basic strategy behind most air and water pollution public policy. It involves setting limits on pollutant levels and specifying control technologies that must be used to accomplish those limits.
commons, common pool resources - Resources (usually natural ones) owned by many people in common, or, as in the case of the air or the open oceans, owned by no one but open to exploitation.
compaction - Packing down. Soil: Packing and pressing out air spaces present in the soil. Reduces soil aeration and infiltration and thus reduces the capacity of the soil to support plants. Trash: Packing down trash to reduce the space that it requires.

compliance schedule - A timetable for reducing pollutants by certain amounts by certain dates. Such schedules are arrived at through negotiations between companies and regulatory agencies.
composting/compost - The process of letting organic wastes decompose in the presence of air. A nutrient-rich humus, or compost, is the resulting product.
composting toilet - A toilet that does not flush wastes away with water but deposits them in a chamber where they will compost. (See composting.)
compound - Any substance (gas, liquid, or solid) that is made up of two or more different kinds of atoms bonded together. (Contrast element.)
Comprehensive Environmental Response, Compensation, and Liability Act of 1980 - See Superfund.
condensation - The collecting of molecules from the vapor state to form the liquid state, as for example, water vapor condenses on a cold surface and forms droplets. Opposite: evaporation.
confusion technique - Pest control method in which a quantity of sex attractant is applied to an area so that males become confused and are unable to locate females. The actual quantities of pheromones applied are very small because of their extreme potency.
conservation - The management of a resource in such a way as to assure that it will continue to provide maximum benefit to humans over the long run. Conservation may include various degrees of use or protection, depending on what is necessary to maintain the resource over the long run. Energy: Saving energy. It entails not only cutting back on use of heating, air conditioning, lighting, transportation, and so on but also increasing the efficiency of energy use. That is, developing and instigating means of doing the same jobs, e.g., transporting people, with less energy.
consumers - In an ecosystem, those organisms that derive their energy from feeding on other organisms or their products.
consumptive water use - Use of water for such things as irrigation, where the water does not remain available for potential purification and reuse.
containment building - Reinforced concrete building housing the nuclear reactor. Designed to contain an explosion should one occur.
contour farming - The practice of cultivating land along the contours across rather than up and down slopes. In combination with strip cropping it reduces water erosion.
control group - The group in an experiment that is the same as and is treated like the experimental group in every way except for the particular factor being tested. Only by comparison with a control group can one gain specific information concerning the effect of any test factor.
controlled experiment - An experiment with adequate control groups. (See control group.)

control rods - Part of the core of a nuclear reactor; the rods of neutron-absorbing material that are inserted or removed as necessary to control the rate of nuclear fission.
Convention on Biological Diversity - The Biodiversity Treaty signed by 158 nations at the Earth Summit in Rio de Janeiro in 1992 calling for various actions and cooperative steps between nations to protect the world's biodiversity.
cooling tower - A massive tower designed to dissipate waste heat from a power plant (or other industrial process) into the atmosphere.
cornucopianism - Dominant world view that embodies the assumption that all parts of the environment are natural resources to be exploited for the advantage of humans.
cosmetic damage - Damage to the surface of fruits and vegetables that affects appearance but does not otherwise affect taste, nutritional quality, or storability.
cosmetic spraying - Spraying of pesticides to control pests that damage only the surface appearance.
cost-benefit analysis - See benefit-cost analysis.
cost-benefit ratio/benefit-cost ratio - The value of the benefits to be gained from a project divided by the costs of the project. If the ratio is greater than 1, the project is economically justified; if the ratio is less than 1, the project is not economically justified.
cost-effective - Pertaining to a project or procedure that produces economic returns or benefits that are significantly greater than the costs.
covalent bond - A chemical bond between two atoms, formed by sharing a pair of electrons between the two atoms. Atoms of all organic compounds are joined by covalent bonds.
credit associations - Associated with microlending. Groups of poor people with no collateral to assure loans forming an association to assure each other's loans.
criteria pollutants - Certain pollutants the level of which is used as a gauge for the determination of air (or water) quality.
critical level - The level of one or more pollutants above which severe damage begins to occur and below which few if any ill effects are noted.
critical number - The minimum number of individuals of a given species that is required to maintain a healthy, viable population of the species. If a population falls below its critical number its extinction will almost certainly occur.
crop rotation - The practice of alternating the crops grown on a piece of land. For example, corn one year, hay for two years, then back to corn. (Contrast monocropping.)
crude birth rate - Number of births per 1000 individuals per year.
crude death rate - Number of deaths per 1000 individuals per year.
crystallization - The joining together of molecules or ions from a liquid (or sometimes gaseous) state to form a solid state.

cultivar - A cultivated variety of a plant species. All individuals of the cultivar are genetically highly uniform.
cultural control - A change in the practice of growing, harvesting, storing, handling, or disposing of wastes that reduces the susceptibility or exposure to pests. For example, spraying the house with insecticides to kill flies is a chemical control; putting screens on the windows to keep flies out is a cultural control.
cultural eutrophication - The process of natural eutrophication accelerated by human activities. (See eutrophication.)
DDT (dichlorodiphenyltrichloroethane) - The first and most widely used of the synthetic organic pesticides belonging to the chlorinated hydrocarbon class.
debt crisis - Refers to the fact that many less-developed nations are so heavily in debt that they may not be able to meet their financial obligations, e.g., interest payments. Their failure to meet such obligations could have severe economic impacts on the entire world.
declining tax base - The loss of tax revenues that occurs when affluent taxpayers and businesses leave an area and property values subsequently decline. Also referred to as eroding tax base.
decommissioning - Refers to the inevitable need to take nuclear power plants out of service after 25-35 years because the effects of radiation will gradually make them inoperable.
decomposers - Organisms whose feeding action results in decay or rotting of organic material. The primary decomposers are fungi and bacteria.
deep-well injection - A technique used for the disposal of liquid chemical wastes that involves putting them into deep dry wells where they permeate dry strata.
demographic transition - The transition from a condition of high birth rate and high death rate through a period of declining death rate but continuing high birth rate finally to low birth rate and low death rate. This transition may result from economic development.
demography/demographer - The studies of population trends (growth, movement, development, and so on). People who perform such studies and make projections from them.
denitrification - The process of converting nitrogen compounds present in soil or water back to nitrogen gas in the atmosphere. It is a natural process conducted by certain bacteria (see text discussion of the nitrogen cycle), and it is now utilized in the treatment of sewage effluents.
density-dependent - Refers to population balancing, factors such as parasitism that increase and decrease in intensity corresponding to population density.
deoxyribonucleic acid - See DNA.
Department of Transportation Regulations (DOT Regs) - Regulations intended to reduce the risk of spills, fires, and poisonous fumes by specifying the kinds of containers and methods of packing to be used in transporting hazardous materials.

desalinization - Processes that purify seawater into high-quality drinking water via distillation or microfiltration.
desertification - Declining land productivity caused by mismanagement. Overgrazing and overcultivation allowing erosion and salinization are the major causes.
desertified. - Land for which productivity has been significantly reduced (25% or more) because of human mismanagement. Erosion is the most common cause.
desert pavement - A covering of stones and coarse sand protecting desert soils from further wind erosion. The covering results from the differential erosion of finer material.
detritus - The dead organic matter, such as fallen leaves, twigs, and other plant and animal wastes, that exists in any ecosystem.
detritus feeders - Organisms such as termites, fungi, and bacteria that obtain their nutrients and energy mainly by feeding on dead organic matter.
deuterium (2H) - A stable, naturally occurring isotope of hydrogen. It contains one neutron in addition to the single proton normally in the nucleus.
developed countries - Industrialized countries -- United States, Canada, Western European nations, Japan, Australia, and New Zealand -- in which the gross domestic product exceeds $7000 per capita.
developing countries - All free-market countries in which the gross domestic product is less than $7000 per capita. Includes nations of Latin America, Africa, and Asia excepting Japan.
development rights - Legal documents that grant permission to develop a given piece of property. They must be owned by the developer before development can occur. They can be bought and sold apart from the property itself.
differential reproduction - Refers to the fact that within a population certain individuals reproduce much more than others.
diffuse sources - Widespread sources of pollution such as agricultural and urban runoff. Also called nonpoint sources. (Contrast point sources.)
dioxin - A synthetic organic chemical of the chlorinated hydrocarbon class. It is one of the most toxic compounds known to humans, having many harmful effects, including induction of cancer and birth defects, even in extremely minute concentrations. It has become a widespread environmental pollutant because of the use of certain herbicides that contain dioxin as a contaminant.
direct solar energy - See solar energy.
discharge permit - (Technically called NPDES permit.) A permit that allows a company to legally discharge certain amounts or levels of pollutants into air or water.
disinfection - The killing (as opposed to removal) of microorganisms in water or other media where they might otherwise pose a health threat. For example, chlorine is commonly used to disinfect water supplies.

dissolved oxygen (DO) - Oxygen gas molecules (O2) dissolved in water. Fish and other aquatic organisms depend on dissolved oxygen for respiration. Therefore, concentration of dissolved oxygen is a measure of water quality.
distillation - A process of purifying water or other liquids by boiling the liquid and recondensing the vapor. Contaminants remain behind in the boiler.
district heating - The heating of an entire community or city area through circulating heat (e.g., steam) from a central source; particularly, utilizing waste heat from a power plant or from incineration of refuse.
diversion - Taking some or all of the flow of a natural waterway and carrying it to other places for uses such as municipal water supplies or irrigation.
DNA (deoxyribonucleic acid) - The natural organic macromolecule that carries the genetic or hereditary information for virtually all organisms.
DO - See dissolved oxygen.
domestic solid wastes - Wastes that come from homes, offices, schools, and stores, as opposed to wastes that are generated from agricultural or industrial processes.
dose - A consideration of the concentration of a hazardous material times the length of exposure to it. For any given material or radiation, effects correspond to the product of these two factors.
doubling time - The time it will take a population to double in size, assuming the continuation of current rate of growth.
drift-netting - The practice of harvesting marine fish and squid by laying down miles of gill nets across the open seas. The nets collapse around larger organisms and kill many whales, dolphins, seals, marine birds, and turtles.
drip irrigation - Supplying irrigation water through tubes that literally drip water onto the soil at the base of each plant.
dasement - In reference to land protection, an arrangement whereby a landowner gives up development rights into the future but retains ownership.
ecological pest management - Control of pest populations through understanding the various ecological factors that provide natural control and so far as possible utilizing these factors as opposed to using synthetic chemicals.
ecological regard - Taking into consideration the environmental impact, direct and indirect, of one's actions and lifestyle. Adjusting actions and lifestyle to minimize their impact as much as possible.
ecological restoration - See restoration ecology.
ecological risk - Any factor that may cause undetermined damage or upset to the existing natural ecological system.
ecological succession - Process of gradual and orderly progression from one ecological community to another.
dcologists - Scientists who study ecology, i.e., the ways in which organisms interact with each other and with their environment.

ecology - The study of any and all aspects of how organisms interact with each other and with their environment.
economic exclusion - The cutting of access of certain ethnic or economic groups to jobs, quality education, and other opportunities and thus preventing them from entering the economic mainstream of society -- a condition that prevails in poor areas of cities.
economic threshold - The level of pest damage that, to be reduced further, would require an application of pesticides that is more costly than the economic damage caused by the pests.
Ecosystem - A grouping of plants, animals, and other organisms interacting with each other and with their environment in such a way as to perpetuate the grouping more or less indefinitely. Ecosystems have characteristic forms such as deserts, grasslands, tundra, deciduous forests, and tropical rain forests.
dcotone - A transitional region between two ecosystems that contains some of the species and characteristics of the two adjacent ecosystems and also certain species characteristic of the transitional region.
ecotourism - The enterprises involved in promoting tourism of unusual or interesting ecological sites.
electrolysis - The use of electrical energy to split water molecules into their constituent hydrogen and oxygen atoms. Hydrogen gas and oxygen gas result.
electrons - Fundamental atomic particles that have a negative electrical charge but virtually no mass. They surround the nuclei of atoms and thus balance the positive charge of protons in the nucleus. A flow of electrons in a wire is synonymous with an electrical current.
element - A substance that is made up of one and only one distinct kind of atom. (Contrast compound>)
embrittlement - Becoming brittle. Pertains especially to the reactor vessel of nuclear power plants gradually becoming prone to breakage or snapping as a result of continuous bombardment by radiation. It is the prime factor forcing the decommissioning of nuclear power plants.
emergency response teams - Teams of people, generally associated with police or fire departments, specially trained to handle accidents involving hazardous materials.
emergent vegetation - Aquatic plants whose lower parts are under water but whose upper parts emerge from the water.
emission allowance/standards - See discharge permit.
endangered species - A species the total population of which is declining to relatively low levels, a trend that if continued will result in extinction.
endangered Species Act - The federal legislation that mandates protection of species and their habitats that are determined to be in danger of extinction.

energy - The ability to do work. Common forms of energy are light, heat, electricity, motion, and chemical bond energy inherent in compounds such as sugar, gasoline, and other fuels.
enrichment - With reference to nuclear power, signifies the separation and concentration of uranium-235 so that, in suitable quantities, it will sustain a chain reaction.
entomologist - A scientist who studies insects, their life cycles, physiology, behavior, and so on.
entropy - Refers to the degree of disorder: increasing entropy means increasing disorder.
Environment - The combination of all things and factors external to the individual or population of organisms in question.
environmental impact - Effects on the natural environment caused by human actions. Includes indirect effects through pollution, for example, as well as direct effects such as cutting down trees.
environmental impact statement - A study of the probable environmental impacts of a development project. The National Environmental Policy Act of 1968 (NEPA) requires such studies prior to proceeding with any project receiving federal funding.
environmental movement - Refers to the upwelling of public awareness and citizen action regarding environmental issues that began during the 1960s.
environmental regard - A factor that may moderate negative environmental impacts, such as suitable attention to conservation or recycling.
environmental resistance - The totality of factors such as adverse weather conditions, shortage of food or water, predators, and diseases that tend to cut back populations and keep them from growing or spreading. (Contrast biotic potential.)
environmental science - The branch of science concerned with environmental issues.
environmentalism - Embodies the assumption that what we generally view as natural resources are products of the natural environment and can be maintained only insofar as the natural environment is maintained.
environmentalist - Has come to include any person who believes that sustainability of civilization hinges on preserving natural aspects of the biosphere, namely, freedom from pollution and maintenance of biodiversity.
EPA - U.S. Environmental Protection Agency. The federal agency responsible for control of all forms of pollution and other kinds of environmental degradation.
epidemiological study - Determination of causes of disease (e.g., lung cancer) through the study and comparison of large populations of people living in different locations or following different lifestyles and/or habits (e.g., smoking versus nonsmoking).
epiphytes - Air plants that are not parasitic but 'perch' on tree branches, where they can get adequate light.

erosion - The process of soil particles being carried away by wind or water. Erosion moves the smaller soil particles first and hence degrades the soil to a coarser, sandier, stonier texture.
estimated reserves - See reserves.
estuary - A bay open to the ocean at one end and receiving fresh water from a river at the other. Hence, mixing of fresh and salt water occurs (brackish).
ETS (environmental tobacco smoke) - 'Second-hand' tobacco smoke to which nonsmokers are exposed when in the presence of smokers.
euphotic zone - The layer or depth of water through which there is adequate light penetration to support photosynthesis.
eutrophic - Refers to a body of water characterized by nutrient-rich water supporting abundant growth of algae and/or other aquatic plants at the surface. Deep water has little or no dissolved oxygen.
eutrophication - The process of becoming eutrophic.
evaporation - Molecules leaving the liquid state and entering the vapor or gaseous state as, for example, water evaporates to form water vapor. Opposite: condensation.
evapotranspiration - The combination of evaporation and transpiration.
evolution - The theory that all species now on Earth descended from ancestral species through a process of gradual change brought about by natural selection.
evolutionary succession - The succession of different species that have inhabited Earth at different geological periods, as revealed through the fossil record. The process whereby new species come in through the process of speciation while other species pass into extinction.
experimental group - The group in an experiment that receives the experimental treatment in contrast to the control group, used for comparison, which does not receive the treatment. Synonym: test group.
exotic species - A species introduced to a geographical area where it is not native.
exponential increase - The growth produced when the base population increases by a given percentage (as opposed to a given amount) each year. It is characterized by doubling again and again, each doubling occurring in the same period of time. It produces a J-shaped curve.
externality - Any effect of a business process not included in the usual calculations of profit and loss. Pollution of air or water is an example of a negative externality -- one that imposes a cost on society that is not paid for by the business itself.
extinction - The death of all individuals of a particular species. When this occurs, all the genes of that particular line are lost forever.
extractive reserves - As now established in Brazil, forest lands that are protected for native peoples and others who harvest natural products of the forests, such as latex and Brazil nuts.

exurban migration - Refers to the pronounced trend since World War II of relocating homes and businesses from the central city and older suburbs to more-outlying suburbs.
exurbs - New developments beyond the traditional suburbs but from which most residents still commute to the associated city for work.
famine - A severe shortage of food accompanied by a significant increase in the local or regional death rate.
FAO - Food and Agriculture Organization of the United Nations.
farm cooperatives - An association of consumers who jointly own and manage a farm for the production of produce specifically for their own consumption.
fecal coliform test - A test for the presence of Escherichia coli, the bacterium that normally inhabits the gut of humans and other mammals. A positive test indicates sewage contamination and the potential presence of disease-causing microorganisms carried by sewage.
fermentation - A form of respiration carried on by yeast cells in the absence of oxygen. It involves a partial breakdown of glucose (sugar) that yields energy for the yeast and the release of alcohol as a by-product.
fertility rate - See total fertility rate.
fertilizer - Material applied to plants or soil to supply plant nutrients, most commonly nitrogen, phosphorus, and potassium but may include others. Organic fertilizer is natural organic material such as manure, which releases nutrients as it breaks down. Inorganic fertilizer, also called chemical fertilizer, is a mixture of one or more necessary nutrients in inorganic chemical form.
field capacity - A measure of the maximum volume of water that a soil can hold by capillary action, i.e., against the pull of gravity.
field scouts - Persons trained to survey crop fields and determine whether applications of pesticides or other pest management procedures are actually necessary to avert significant economic loss.
FIFRA - Federal Insecticide, Fungicide, and Rodenticide Act; the key U.S. legislation to control pesticides.
filtration - The passing of water (or other fluid) through a filter to remove certain impurities.
fire climax ecosystems - Ecosystems that depend on the recurrence of fire to maintain the existing balance.
first basic principle of ecosystem sustainability - Resources are supplied and wastes are disposed of by recycling all elements.
first-generation pesticides - Toxic inorganic chemicals that were first used to control insects, plant diseases, and other pests. Included mostly compounds of arsenic and cyanide and various heavy metals such as mercury and copper.
First Law of Thermodynamics - The fact, based on irrefutable observations, that energy is never created or destroyed, but may be converted from one form to

another, e.g., electricity to light. Also called the Law of Conservation of Energy. (See also Second Law of Thermodynamics.)

fishery - Fish species being exploited, or a limited marine area containing commercially valuable fish.

fission - The splitting of a large atom into two atoms of lighter elements. When large atoms such as uranium or plutonium fission, tremendous amounts of energy are released.

fission products - Any and all atoms and subatomic particles resulting from splitting atoms in nuclear reactors. All or most such products are highly radioactive.

flat-plate collector - A solar collector that consists of a stationary, flat, black surface oriented perpendicular to the average sun angle. Heat absorbed by the surface is removed and transported by air or water (or other liquid) flowing over or through the surface.

flood irrigation - Technique of irrigation in which water is diverted from rivers through canals and flooded through furrows in fields.

food aid - Food of various forms that is donated or sold below cost to needy people for humanitarian reasons.

food chain - The transfer of energy and material through a series of organisms as each one is fed upon by the next.

food security - For families, the ability to meet the food needs of everyone in the family, providing freedom from hunger and malnutrition.

food web - The combination of all the feeding relationships that exist in an ecosystem.

fossil fuels - Energy sources, mainly crude oil, coal, and natural gas, that are derived from prehistoric photosynthetic production of organic matter on Earth.

fourth principle of ecosystem sustainability - Bio-diversity must be maintained.

freshwater - Water that has a salt content of less than 0.05% (500 parts per million).

fuel assembly - The assembly of many rods containing the nuclear fuel, usually uranium, positioned close together. The chain reaction generated in the fuel assembly is controlled by rods of neutron-absorbing material between the fuel rods.

fuel elements - The pellets of uranium or other fissionable material that are placed in tubes, which, with the control rods, form the core of the nuclear reactor.

fuel rods - See fuel elements.

fungus, pl. fungi - Any of numerous species of molds, mushrooms, brackets, and other forms of nonphotosynthetic plants. They derive energy and nutrients by consuming other organic material. Along with bacteria they form the decomposer component of ecosystems.

fusion - The joining together of two atoms to form a single atom of a heavier element. When light atoms such as hydrogen are fused, tremendous amounts of energy are released.
gasohol - A blend of 90% gasoline and 10% alcohol, which can be substituted for straight gasoline. It serves to stretch gasoline supplies.
gene pool - The sum total of all the genes that exist among all the individuals of a species.
genes - Segment of DNA that codes for one protein, which in turn determines a particular physical, physiological, or behavioral trait.
genetic bank - The concept that natural ecosystems with all their species serve as a tremendous repository of genes that is frequently drawn upon to improve domestic plants and animals and to develop new medicines, among other uses.
genetic control - Selective breeding of the desired plant or animal to make it resistant to attack by pests. Also, attempting to introduce harmful genes -- for example, those that cause sterility - into the pest populations.
genetic engineering - The artificial transfer of specific genes from one organism to another.
genetic makeup - Refers to all the genes that an individual possesses and that determine all of the individual's inherited characteristics.
genetics - The study of heredity and the processes by which inherited characteristics are passed from one generation to the next.
genetic variation - An expression of the range of genetic (DNA) differences that occur among individuals of the same species.
gentrification - The trend seen in modern society of people moving into more or less isolated communities with others of similar economic, ethnic, and social backgrounds.
geothermal - Refers to the naturally hot interior of Earth. The heat is maintained by naturally occurring nuclear reactions in Earth's interior.
geothermal energy - Useful energy derived from the naturally hot interior of Earth.
global warming - The term given to the possibility that Earth's atmosphere is gradually warming because of the greenhouse effect of carbon dioxide and other gases. Global warming is thought by many to be the most serious global environmental issue facing our society. (See also greenhouse effect and greenhouse gases.)
glucose - A simple sugar, the major product of photosynthesis. Serves as the basic building block for cellulose and starches and as the major 'fuel' for the release of energy through cell respiration in both plants and animals.
gravitational water - Water that is not held by capillary action in soil but percolates downward by the force of gravity.

graying - The increasing average age in populations in developed and many developing countries that is occurring because of decreasing birth rates and increasing longevity.
gray water - Wastewater, as from sinks and tubs, that does not contain human excrement. Such water can be reused without purification for some purposes.
greenhouse effect - An increase in the atmospheric temperature caused by increasing amounts of carbon dioxide and certain other gases that absorb and trap heat radiation, which normally escapes from Earth.
greenhouse gases - Gases in the atmosphere that absorb infrared energy and contribute to the air temperature. These gases are like a heat blanket and are important in insulating Earth's surface. They include carbon dioxide, water vapor, methane, nitrous oxide, and chlorofluorocarbons and other halocarbons.
green manure - A legume crop such as clover that is specifically grown to enrich the nitrogen and organic content of soil.
green revolution - Refers to the development and introduction of new varieties of wheat and rice (mainly) that increased yields per acre dramatically in some countries.
grit chamber - Part of preliminary treatment in wastewater-treatment plants; a swimming pool-like tank in which the velocity of the water is slowed enough to let sand and other gritty material settle.
grit-settling tank - See grit chamber.
gross domestic (national) product per capita - The total value of all goods and services exchanged in a year in a country, divided by its population. A common indicator for the average level of development and standard of living for a country.
groundwater - Water that has accumulated in the ground, completely filling and saturating all pores and spaces in rock and/or soil. Groundwater is free to move more or less readily. It is the reservoir for springs and wells and is replenished by infiltration of surface water.
groundwater remediation - The repurification of contaminated groundwater by any of a number of techniques.
growth momentum - Refers to the fact that the human population will continue to grow for some time even after the fertility rate is reduced to 2.0 because there is currently such an excessive number of children moving into the reproductive age brackets.
gully erosion - Gullies, large or small, resulting from water erosion.
habitat - The specific environment (woods, desert, swamp) in which an organism lives.
habitat alteration - Any change in a natural habitat that may occur because of changing drainage, pollution, or direct impacts.

half-life - The length of time it takes for half of an unstable isotope to decay. The length of time is the same regardless of the starting amount. Also refers to the amount of time it takes compounds to break down in the environment.
halogenated hydrocarbon - Synthetic organic compound containing one or more atoms of the halogen group, which includes chlorine, fluorine, and bromine.
hard water - Water that contains relatively large amounts of calcium and/or certain other minerals that cause soap to precipitate. (Contrast soft water.)
hazard - Anything that can cause (1) injury, disease, or death to humans; (2) damage to property; or (3) degradation of the environment.
hazard assessment - The process of examining evidence linking a particular hazard to its harmful effects.
hazardous materials (HAZMAT) - Any material having one or more of the following attributes: ignitability, corrosivity, reactivity, toxicity.
heavy metals - Any of the high atomic weight metals such as lead, mercury, cadmium, and zinc. All may be serious pollutants in water or soil because they are toxic in relatively low concentrations and they tend to bioaccumulate.
herbicide - A chemical used to kill or inhibit the growth of undesired plants.
herbivore/herbivorous - An organism such as rabbit or deer that feeds primarily on green plants or plant products such as seeds or nuts. Such an organism is said to be herbivorous. Synonym: primary consumer.
herbivory - The feeding on plants that occurs in an ecosystem. The total feeding of all plant-eating organisms.
heterotroph/heterotrophic - Any organism that consumes organic matter as a source of energy. Such an organism is said to be heterotrophic.
Highway Trust Fund - The monies collected from the gasoline tax designated for construction of new highways.
hormones - Natural chemical substances that control development, physiology, and/or behavior of an organism. Hormones are produced internally and affect only that individual. Hormones are coming into use in pest control. (See also pheromones.)
host - In feeding relationships, particularly parasitism, refers to the organism that is being fed upon, i.e., supporting the feeder.
host-parasite relationship - The combination of a parasite and the organism upon which it feeds.
host-specific - Referring to insects, fungal diseases, and other parasites that are unable to attack species other than their particular host.
human system - The entire system that humans have created for their own support, consisting of agriculture, industry, transportation and communications networks, etc.
humidity - The amount of water vapor in the air. (See also relative humidity.)
humus - A dark brown or black, soft, spongy residue of organic matter that remains after the bulk of dead leaves, wood, or other organic matter has

decomposed. Humus does oxidize, but relatively slowly. It is extremely valuable in enhancing physical and chemical properties of soil.

hunger - A general term referring to the lack of basic food required for meeting nutritional and energy needs, such that the individual is unable to lead a normal, healthy life.

hunter-gatherers - Humans surviving by hunting wild game and gathering seeds, nuts, berries, and other edible things from the natural environment.

hybrid - A plant or animal resulting from a cross between two closely related species that do not normally cross.

hybridization - Cross-mating between two more or less closely related species.

hydrocarbon emissions - Exhaust of various hydrogencarbon compounds due to incomplete combustion of fuel. They are a major contribution to photochemical smog.

hydrocarbons - Chemistry: Natural or synthetic organic substances that are composed mainly of carbon and hydrogen. Crude oil, fuels from crude oil, coal, animal fats, and vegetable oils are examples. Pollution: A wide variety of relatively small carbon-hydrogen molecules resulting from incomplete burning of fuel and emitted into the atmosphere. (See volatile organic compounds.)

hydroelectric dam - A dam and associated reservoir used to produce electrical power by letting the high-pressure water behind the dam flow through and drive a turbogenerator.

hydroelectric power - Electrical power that is produced from hydroelectric dams or, in some cases, natural waterfalls.

hydrogen bonding - A weak attractive force that occurs between a hydrogen atom of one molecule and, usually, an oxygen atom of another molecule. It is responsible for holding water molecules together to produce the liquid and solid states.

hydrogen ions - Hydrogen atoms that have lost their electrons. Chemical symbol, Hr.

hydrological cycle - (See water cycle.)

hydroponics - The culture of plants without soil. The method uses water with the required nutrients in solution.

hydroxyl radical - The hydroxyl group (OHs) missing the electron. It is a natural cleansing agent of the atmosphere. It is highly reactive and readily oxidizes many pollutants on contact and thus contributes to their removal.

hypothesis - An educated guess concerning the cause of an observed phenomenon that is then subjected to experimental tests to prove its accuracy or inaccuracy.

indicator organism - An organism, the presence or absence of which indicates certain conditions. For example, the presence of Escherichia coli indicates that water is contaminated with fecal wastes and pathogens may be present; the absence indicates that the water is free of pathogens.

indirect products - Air pollutants that are not contained in emissions but are formed when compounds in emissions undergo various reactions in the atmosphere.
indirect solar energy - (See solar energy.)
industrialized agriculture - Using fertilizer, irrigation, pesticides, and energy from fossil fuels to produce large quantities of crops and livestock with minimal labor for domestic and foreign sale.
industrial smog - The grayish mixture of moisture, soot, and sulfurous compounds that occurs in local areas where industries are concentrated and coal is the primary energy source.
infant mortality - The number of babies that die before age 1, per 1000 babies born.
infiltration - The process in which water soaks into soil as opposed to running off the surface.
infiltration-runoff ratio - The ratio of the amount of water soaking into the soil to that running off the surface. The ratio is obtained by dividing the first amount by the second.
infrared radiation - Radiation of somewhat longer wavelengths than red light; the longest wavelengths of the visible spectrum. Such radiation manifests itself as heat.
infrastructure - The sewer and water systems, roadways, bridges, and other facilities that underlie the functioning of a city and that are owned, operated, and maintained by the city.
inherently safe reactor - In theory, a nuclear reactor that is designed in such a way that any accident would be automatically corrected and no radioactivity released.
inorganic compounds/molecules - Classical definition: All things such as air, water, minerals, and metals that are neither living organisms nor products uniquely produced by living things. Chemical definition: All chemical compounds or molecules that do not contain carbon atoms as an integral part of their molecular structure. (Contrast organic compounds.)
inorganic fertilizer - See fertilizer.
inorganic molecules - See inorganic compounds/molecules.
insecticide. - Any chemical used to kill insects.
instrumental value - Based on the belief that living organisms or species are worthwhile if their existence or use benefits people; the degree to which they benefit humans. (Contrast intrinsic value.)
insurance spraying - Spraying of pesticides that is done when it is not really needed, in the belief that it will insure against loss due to pests.
integral urban house - A house in an urban setting that utilizes ecological principles, including water and materials conservation and recycling, solar energy, and intensive cultivation of food plants insofar as possible.

integrated pest management (IPM) - Two or more methods of pest control carefully integrated into an overall program designed to avoid economic loss from pests. The objective is to minimize the use of environmentally hazardous, synthetic chemicals. Such chemicals may be used in IPM, but only as a last resort to prevent significant economic losses.
integrated waste management - The approach to municipal solid waste that provides for several options for dealing with wastes, including recycling, composting, waste reduction, and landfilling and incineration where unavoidable.
intrinsic value - Based on the belief that living organisms or species are worthwhile in their own right; they do not have to be useful to have value. (Contrast instrumental value.)
inversion - See temperature inversion.
ion - An atom or group of atoms that has lost or gained one or more electrons and consequently has acquired a positive or negative charge. Ions are designated by r or s superscripts following the chemical symbol.
ion-exchange capacity - See nutrient-holding capacity.
ionic bond - The bond formed by the attraction between a positive and a negative ion.
IPM - See integrated pest management.
irrigation - Any method of artificially adding water to crops.
isotope - A form of an element in which the atoms have more (or less) than the usual number of neutrons. Isotopes of a given element have identical chemical properties, but they differ in mass (weight) as a result of the additional (or lesser) neutrons. Many isotopes are unstable and radioactive. (See radioactive decay, radioactive emissions, and radioactive materials.)
juvenile hormone - The insect hormone that, at sufficient levels, preserves the larval state. Pupation requires diminished levels; hence artificial applications of the hormone may block development.
keystone species - A species whose role is essential for the survival of many other species in an ecosystem.
kinetic energy - The energy inherent in motion or movement, including molecular movement (heat) and movement of waves, hence radiation including light.
landfill - A site where wastes (municipal, industrial, or chemical) are disposed of by burying them in the ground or placing them on the ground and covering them with earth. Also used as a verb meaning to dispose of a material in such a way.
land subsidence - The phenomenon whereby land gradually sinks. It may result from removing groundwater or oil, which is frequently instrumental in supporting the overlying rock and soil.
land trust - Land that is purchased and held by various organizations specifically for the purpose of protecting its natural environment and biota that inhabit it.

larva, pl. larvae - A free-living immature form that occurs in the life cycle of many organisms and that is structurally distinct from the adult. For example, caterpillars are the larval stage of moths and butterflies.
Law of Conservation of Energy - See First Law of Thermodynamics.
Law of Conservation of Matter - Law stating that in chemical reactions, atoms are neither created, changed, nor destroyed; they are only rearranged.
Law of Limiting Factors - Also known as Liebig's Law of Minimums. A system may be limited by the absence or minimum amount (in terms of that needed) of any required factor. (See limiting factor.)
leachate - The mixture of water and materials that are leaching.
leaching - The process in which materials in or on the soil gradually dissolve and are carried by water seeping through the soil. It may result in the removal of valuable nutrients from the soil, or it may carry buried wastes into groundwater, thereby contaminating it.
legumes - The group of land plants that is virtually alone in its ability to fix nitrogen; includes such common plants as peas, beans, clovers, alfalfa, and locust trees but no major cereal grains. (See nitrogen fixation.)
lethal mutation - A genetic alteration that results in such severe abnormalities that the organism cannot survive.
Liebig's Law of Minimums - See Law of Limiting Factors.
limiting factor - A factor primarily responsible for determining the growth and/or reproduction of an organism or a population. The limiting factor may be a physical factor such as temperature or light, a chemical factor such as a particular nutrient, or a biological factor such as a competing species. The limiting factor may differ at different times and places.
limits of tolerance - The extremes of any factor, e.g., temperature, that an organism or a population can tolerate and still survive and reproduce.
lipids - A class of natural organic molecules that includes animal fats, vegetable oils, and phospholipids, the last being an integral part of cellular membranes.
litter - In an ecosystem, the natural cover of dead leaves, twigs, and other dead plant material. This natural litter is subject to rapid decomposition and recycling in the ecosystem, whereas human litter, such as bottles, cans, and plastics, is not.
loam - A solid consisting of a mixture of about 40% sand, 40% silt, and 20% clay.
longevity - The average life span of individuals of a given population.
LULU - An acronym standing for 'locally unwanted land use.' Expresses the difficulty in siting a facility that is necessary but which no one wants in the immediate locality.
macromolecules - Very large, organic molecules such as proteins and nucleic acids that constitute the structural and functional parts of cells.
MACT (maximum achievable control technology) - The best technologies available for reducing the output of especially toxic industrial pollutants.

malnutrition - The lack of essential nutrients such as vitamins, minerals, and amino acids. Malnutrition ranges from mild to severe and life-threatening.
mariculture - The propagation and/or rearing of any marine (saltwater) organism in more or less artificial systems.
marine environment - An ocean environment that supports a distinctive array of seaweeds, plankton, fish, shellfish, and other marine organisms depending on temperature, water depth, nature of the bottom, and concentrations of nutrients and sediments.
mass number - The number that accompanies the chemical name or symbol of an element or isotope. It represents the number of neutrons and protons in the nucleus of the atom.
materials recycling facility (MRF) - A processing plant where regionalized recycling is facilitated. Recyclable municipal solid waste, usually presorted, is prepared in bulk for the recycling market.
matter - Anything that occupies space and has mass. Refers to any gas, liquid, or solid. (Contrast energy.)
maximum sustainable yield - The maximum amount of a renewable resource that can be taken year after year without depleting the resource. It is the maximum rate of use or harvest that will be balanced by the regenerative capacity of the system -- for example, the maximum rate of tree cutting that can be balanced by tree regrowth.
meltdown - The event of a nuclear reactor getting out of control or losing its cooling water so that it melts from its own production of heat. The melted reactor would continue to produce heat and could melt its way out of the reactor vessel and eventually down into groundwater, where it would cause a violent eruption of steam that could spread radioactive materials over a wide area.
metabolism - The sum of all the chemical reactions that occur in an organism.
methane - A gas, CH_4. It is the primary constituent of natural gas. It is also produced as a product of fermentation by microbes. Methane from ruminant animals is thought to be responsible for the rise in atmospheric methane, of concern because methane is one of the greenhouse gases.
Microbe - A term used to refer to any microscopic organism, primarily bacteria, viruses, and protozoans.
microclimate - The actual conditions experienced by an organism in its particular location. Owing to numerous factors such as shading, drainage, and sheltering, the microclimate may be quite distinct from the overall climate.
microfiltration - A process for purifying water in which water is forced under very high pressure through a membrane that is fine enough to filter out ions and molecules in solution; used by small desalination plants to filter salt from seawater. Also called reverse osmosis.

microlending - The process of providing very small loans (usually $50 - $100) to poor people to facilitate their starting a small enterprise to become economically self-sufficient.
microorganism - Any microscopic organism, particularly bacteria, viruses, and protozoans.
midnight dumping - The wanton illicit dumping of materials, particularly hazardous wastes, frequently under the cover of darkness.
Minamata disease - A 'disease' named for a fishing village in Japan where an 'epidemic' was first observed. Symptoms, which included spastic movements, mental retardation, coma, death, and crippling birth defects in the next generation, were found to be the result of mercury poisoning.
mineral - Any hard, brittle, stonelike material that occurs naturally in Earth's crust. All consist of various combinations of positive and negative ions held together by ionic bonds. Pure minerals, or crystals, are one specific combination of elements. Common rocks are composed of mixtures of two or more minerals.
mineralization - The process of gradual oxidation of the organic matter (humus) present in soil that leaves just the gritty mineral component of the soil.
mixture - Means there is no chemical bonding between the molecules of the element involved. For example, air contains (is a mixture of) oxygen, nitrogen, and carbon dioxide.
mobilization - In soil science, the bringing into solution of normally insoluble minerals. Presents a particular problem when the elements of such minerals have toxic effects.
moderator - In a nuclear reactor, the moderator is any material that slows down neutrons from fission reactions so that they are traveling at the right speed to trigger another fission. Water and graphite represent two types of moderators.
molecule - A specific union of two or more atoms. The smallest unit of a compound that still has the characteristics of that compound.
monocropping - The practice of growing the same crop year after year on the same land. (Contrast crop rotation and polyculture.)
monoculture - The practice of growing a single crop over very wide areas, for example, thousands of square kilometers of wheat, and only wheat, grown in the Midwest.
Montreal Protocol - An agreement made in 1987 by a large group of nations to cut back the production of chlorofluorocarbons by 50% by the year 2000 in order to protect the ozone shield. A 1990 amendment calls for the complete phase-out of these chemicals by 2000 in developed nations and by 2010 in less-developed nations.
MRF - See materials recycling facility.
municipal solid waste - The entirety of refuse or trash generated by a residential and business community. The refuse that a municipality is responsible for collecting and disposing of, distinct from agricultural and industrial wastes.

mutagenic - Causing mutations.
mutation - A random change in one or more genes of an organism. Mutations may occur spontaneously in nature, but their number and degree are vastly increased by exposure to radiation and/or certain chemicals. Mutations generally result in a physical deformity and/or metabolic malfunction.
mutualism - Refers to a close relationship between two organisms in which both organisms benefit from the relationship.
Mycelia - The threadlike feeding filaments of fungi.
mycorrhizae, sing. Mycorrhiza - The mycelia of certain fungi that grow symbiotically with the roots of some plants and provide for additional nutrient uptake.
NASA - National Aeronautics and Space Administration.
national forests - Administered by the National Forest Service, these are public forests and woodlands that are managed for multiple uses, such as logging, mineral exploitation, livestock grazing, and recreation.
national parks - Administered by the National Park Service, national parks are lands and coastal areas of great scenic, ecological, or historical importance. They are managed with the dual goals of protection and providing public access.
national priorities list (NPL) - A list of the chemical waste sites presenting the most immediate and severe threats. Such sites are scheduled for cleanup ahead of other sites.
Natural - Describes a substance or factor that occurs or is produced as a normal part of nature apart from any activity or intervention of humans. Opposite of artificial, synthetic, human-made, or caused by humans.
natural chemical control - The use of one or more natural chemicals such as hormones or pheromones to control a pest.
natural control methods - Any of many techniques of controlling a pest population without resorting to the use of synthetic organic or inorganic chemicals. (See biological control, cultural control, genetic control, hormones, and pheromones.)
natural enemies - All the predators and/or parasites that may feed on a given organism. Organisms used to control a specific pest through predation or parasitism.
natural increase - The number of births minus the number of deaths in a given population. It does not consider immigration and emigration.
natural laws - Derivations from our observations that matter, energy, and certain other phenomena apparently always act (or react) according to certain 'rules.'
natural organic compounds - See organic compounds/molecules.
natural rate of change - The percent of growth (or decline) of a given population during a year. It is found by subtracting the crude death rate from the crude birth rate and changing the result to a percent. It does not include immigration or emigration.

natural resources - As applied to natural ecosystems and species, this term indicates that they are expected to be of economic value and may be exploited. Likewise the term applies to particular segments of ecosystems such as air, water, soil, and minerals.
natural selection - The process whereby the natural factors of environmental resistance tend to eliminate those members of a population that are least well-adapted to cope and thus, in effect, select those best adapted for survival and reproduction.
natural services - Functions performed free of charge by natural ecosystems such as control of runoff and erosion, absorption of nutrients, and assimilation of air pollutants.
natural succession - See ecological succession.
net energy yield - The amount of energy produced minus the amount that is expended in production and transmission to consumers.
Neutron - A fundamental atomic particle found in the nuclei of atoms (except hydrogen) and having one unit of atomic mass but no electrical charge.
niche (ecological) - The total of all the relationships that bear on how an organism copes with both biotic and abiotic factors it faces.
NIMBY - Acronym for 'not in my back yard.' NIMBY refers to a common attitude regarding undesirable facilities such as incinerators, nuclear facilities, and hazardous waste treatment plants, whereby people do everything possible to prevent the location of such facilities nearby.
NIMTOO - An acronym for 'not in my term of office.'
nitric acid (HNO_3) - One of the acids in acid rain. Formed by reactions between nitrogen oxides and the water vapor in the atmosphere.
nitric oxide - See nitrogen oxides.
nitrogen dioxide - See nitrogen oxides.
nitrogen fixation - The process of chemically converting nitrogen gas (N_2) from the air into compounds such as nitrates (NO_3s) or ammonia (NH_3) that can be used by plants in building amino acids and other nitrogen-containing organic molecules.
nitrogen oxides (NO_x) - A group of nitrogen-oxygen compounds formed when some of the nitrogen gas in air combines with oxygen during high-temperature combustion; they are a major category of air pollutants. Along with hydrocarbons, they are a primary factor in the production of ozone and other photochemical oxidants that are the most harmful components of photochemical smog. They also contribute to acid precipitation (see nitric acid). Major nitrogen oxides are nitric oxide, NO; nitrogen dioxide, NO_2; nitrogen tetroxide, N_2O_2.
nitrous oxide - A gas, N_2O. Nitrous oxide comes from biomass burning, fossil fuel burning, and the use of chemical fertilizers. It is of concern because in the troposphere it is a greenhouse gas and in the stratosphere it contributes to ozone destruction.

NOAA - National Oceanic and Atmospheric Administration.
Nonbiodegradable - Not able to be consumed and/or broken down by biological organisms. Nonbiodegradable substances include plastics, aluminum, and many chemicals used in industry and agriculture. Particularly dangerous are human-made nonbiodegradable chemicals that are also toxic and tend to accumulate in organisms, i.e., nonbiodegradable synthetic organic compounds. (See biodegradable and bioaccumulation.)
nonconsumptive water use - Use of water for such purposes as washing and rinsing where the water, albeit polluted, remains available for further uses. With suitable purification, such water may be recycled indefinitely.
Nonpersistent - Refers to chemicals that break down readily to harmless compounds, as, for example, natural organic compounds break down to carbon dioxide and water.
nonpoint sources - Sources of pollution such as general runoff of sediments, fertilizer, pesticides, and other materials from farms and urban areas as opposed to specific points of discharge such as factories. Also called diffuse sources. (Contrast point sources.)
nonrenewable resources - Resources such as ores of various metals, oil, and coal that exist as finite deposits in Earth's crust and that are not replenished by natural processes as they are mined. (Contrast renewable resources.)
nontidal wetlands - Inland wetlands not affected by tides.
no-till agriculture - The farming practice in which weeds are killed with chemicals (or other means) and seeds are planted and grown without resorting to plowing or cultivation. The practice is very effective in reducing soil erosion.
NPL - See National Priorities List.
NRCS - Natural Resources Conservation Service, formerly the SCS (U.S. Soil Conservation Service).
nuclear power - Electrical power that is produced by using a nuclear reactor to boil water and produce steam, which, in turn, drives a turbogenerator.
Nuclear Regulatory Commission (NRC) - The agency within the Department of Energy that sets and enforces safety standards for the operation and maintenance of nuclear power plants.
nucleic acids - The class of natural organic macromolecules that function in the storage and transfer of genetic information.
nucleus - Biology: The large body contained in most living cells that contains the genes or hereditary material DNA. Physics: The central core of atoms, which is made up of neutrons and protons. Electrons surround the nucleus.
nutrient - Animal: Material such as protein, vitamins, and minerals required for growth, maintenance, and repair of the body, and material such as carbohydrates required for energy. Plant: An essential element in a particular ion or molecule that can be absorbed and used by the plant. For example, carbon, hydrogen,

nitrogen, and phosphorus are essential elements; carbon dioxide, water, nitrate (NO_3s), and phosphate (PO43s) are the respective nutrients.

nutrient cycle - The repeated pathway of particular nutrients or elements from the environment through one or more organisms back to the environment. Nutrient cycles include the carbon cycle, the nitrogen cycle, the phosphorus cycle, and so on.

nutrient-holding capacity - The capacity of a soil to bind and hold nutrients (fertilizer) against their tendency to be leached from the soil.

observations - Things or phenomena that are perceived through one or more of the basic five senses in their normal state. In addition, to be accepted as factual, the observations must be verifiable by others.

ocean thermal energy conversion (OTEC) - The concept of harnessing the temperature difference between surface water heated by the sun and colder deep water to produce power.

oil field - The area in which exploitable oil is found.

oil shale - A natural sedimentary rock that contains a material, kerogen, that can be extracted and refined into oil and oil products.

oligotrophic - Refers to a lake the water of which is nutrient-poor. Therefore, it will not support phytoplankton, but it will support submerged aquatic vegetation, which get nutrients from the bottom.

omnivore - An animal that feeds more or less equally on both plant material and other animals.

OPEC - Organization of Petroleum Exporting Countries.

optimal range - With respect to any particular factor or combination of factors, the maximum variation that still supports optimal or near-optimal growth of the species in question.

optimum - The condition or amount of any factor or combination of factors that will produce the best result. For example, the amount of heat, light, moisture, nutrients, and so on that will produce the best growth. Either more or less than the optimum is not as good.

optimum population - The population of a resource that will provide the maximum sustainable yield. The yield is reduced at higher or lower populations.

organically grown - Generally refers to produce grown without the use of hard chemical pesticides or inorganic fertilizer. However, as of yet there are no official standards defining the use of the term.

organic compounds/molecules - Classical definition: All living things and products that are uniquely produced by living things, such as wood, leather, and sugar. Chemical definition: All chemical compounds or molecules, natural or synthetic, that contain carbon atoms as an integral part of their molecular structure. Their structure is based on bonded carbon atoms with hydrogen atoms attached. They can be either biodegradable OR nonbiodegradable. (Contrast inorganic compounds.)

organic fertilizer - See fertilizer.
organic gardening/farming - Gardening or farming without the use of inorganic fertilizers, synthetic pesticides, or other human-made materials.
organic molecules - See organic compounds/molecules.
organic phosphate - Phosphate (PO4s3) bonded to an organic molecule.
organism - Any living thing -- plant, animal, or microbe.
organochlorides - See chlorinated hydrocarbons.
OSHA - Occupational Safety and Health Administration. Promulgates regulations concerning measures that must be taken to protect workers.
osmosis - The phenomenon whereby water diffuses through a semipermeable membrane toward an area where there is more material in solution (where there is a relatively lower concentration of water). Has particular application regarding salinization of soils where plants are unable to grow because of osmotic water loss.
Outbreak - A population explosion of a particular pest. Often caused by an application of pesticides that destroys the pest's natural enemies.
Overgrazing - The phenomenon of animals grazing in greater numbers than the land can support in the long run. There may be a temporary economic gain in the short run, but the grassland (or other ecosystem) is destroyed, and its ability to support life in the long run is vastly diminished.
overland flow system - An alternative method of wastewater treatment that involves allowing water to percolate through a field of grass or other vegetation.
oxidation - Chemical reaction process that generally involves breakdown through combining with oxygen. Both burning and cellular respiration are examples of oxidation. In both cases, organic matter is combined with oxygen and broken down to carbon dioxide and water.
ozone - A gas, O_3, that is a pollutant in the lower atmosphere but necessary to screen out ultraviolet radiation in the upper atmosphere. May also be used for disinfecting water.
ozone hole - First discovered over the Antarctic, this is a region of stratospheric air that is severely depleted of its normal levels of ozone during the Antarctic spring because of CFCs from anthropogenic (human-made) sources.
ozone shield - The layer of ozone gas (O_3) in the upper atmosphere that screens out harmful ultraviolet radiation from the sun.
PANs (peroxyacetylnitrates) - A group of compounds present in photochemical smog that are extremely toxic to plants and irritating to eyes, nose, and throat membranes of humans.
parasites - Organisms (plant, animal, or microbial) that attach themselves to another organism, the host, and feed on it over a period of time without killing it immediately but usually doing harm to it. Commonly divided into ectoparasites, those that attach to the outside, and endoparasites, those that live inside their hosts.

parent material - The rock material, the weathering and gradual breakdown of which is the source of the mineral portion of soil.
particulates - (See PM-10 and suspended particulate matter.)
parts per million (ppm) - A frequently used expression of concentration. It is the number of units of one substance present in a million units of another. For example, 1 g of phosphate dissolved in 1 million grams (1 ton) of water would be a concentration of 1 ppm.
passive safety features - Those safety features of nuclear facilities that involve processes that are not vulnerable to operator intrusion or electrical power failures. Passive safety features enhance the degree of safety of nuclear reactors. (See active safety features.)
passive solar heating system - A solar heating system that does not use pumps or blowers to transfer heated air or water. Instead, natural convection currents are used or the interior of the building itself acts as the solar collector.
pasteurization - The process of applying heat to kill pathogens.
pastoralist - One involved in animal husbandry, usually in subsistence agriculture.
pathogen - An organism, usually a microbe, that is capable of causing disease. Such an organism is said to be pathogenic.
PCBs (polychlorinated biphenyls) - A group of widely used industrial chemicals of the chlorinated hydrocarbon class. They have become serious and widespread pollutants, contaminating most food chains on Earth, because they are extremely resistant to breakdown and are subject to bioaccumulation. They are known to be carcinogenic.
percolation - The process of water seeping through cracks and pores in soil or rock.
permafrost - The ground of arctic regions that remains permanently frozen. Defines tundra, since only small herbaceous plants can be sustained on the thin layer of soil that thaws each summer.
persistent - Refers to pesticides or other chemicals that are nonbiodegradable and very resistant to breakdown by other means. Such chemicals therefore remain present in the environment more or less indefinitely.
pesticide - A chemical used to kill pests. Pesticides are further categorized according to the pests they are designed to kill -- for example, herbicides kill plants, insecticides kill insects, fungicides kill fungi, and so on.
pesticide treadmill - Refers to the fact that use of chemical pesticides simply creates a vicious cycle of 'needing more pesticides' to overcome developing resistance and secondary outbreaks caused by the pesticide applications.
pest-loss insurance - Insurance that a grower can buy that will pay in the event of loss of crop due to pests.

petrochemical - A chemical made from petroleum (crude oil) as a basic raw material. Petrochemicals include plastics, synthetic fibers, synthetic rubber, and most other synthetic organic chemicals.
pH - Scale used to designate the acidity or basicity (alkalinity) of solutions or soil, expressed as the logarithm of the concentration of hydrogen ions (Hr). pH 7 is neutral; values decreasing from 7 indicate increasing acidity; values increasing from 7 indicate increasing basicity. Each unit from 7 indicates a tenfold increase over the preceding unit.
pheromones - A chemical substance secreted externally by certain members of a species that affects the behavior of other members of the same species. The most common examples are sex attractants, which female insects secrete to attract males. Pheromones are coming into use in pest control. (See also hormones.)
phosphate - An ion composed of a phosphorus atom with four oxygen atoms attached. PO43s. It is an important plant nutrient. In natural waters it is frequently the limiting factor. Therefore, additions of phosphate to natural water are frequently responsible for algal blooms.
photochemical oxidants - A major category of air pollutants, including ozone, that are highly toxic and damaging especially to plants and forests. Formed as a result of interactions between nitrogen oxides and hydrocarbons driven by sunlight.
photochemical smog - The brownish haze that frequently forms on otherwise clear sunny days over large cities with significant amounts of automobile traffic. It results largely from sunlight-driven chemical reactions among nitrogen oxides and hydrocarbons, both of which come primarily from auto exhausts.
Photosynthesis - The chemical process carried on by green plants through which light energy is used to produce glucose from carbon dioxide and water. Oxygen is released as a by-product.
photovoltaic cells - Devices that convert light energy into an electrical current.
physical barrier - A genetic feature on a plant, such as sticky hairs, that physically blocks attack by pests.
phytoplankton - Any of the many species of algae that consist of single cells or small groups of cells that live and grow freely suspended in the water near the surface. Given abundant nutrients, they may become so numerous as to give the water a green 'pea soup' appearance and/or form a thick green scum over the surface.
plankton - Any and all living things that are found freely suspended in the water and that are carried by currents as opposed to being able to swim against currents. It includes both plant (phytoplankton) and animal (zooplankton) forms.
plant community - The array of plant species, including numbers, ages, distribution, that occupies a given area.

PM-10 - The new standard criterion pollutant for suspended particulate matter. PM-10 refers to particles smaller than 10 micrometers in diameter. Such particles are readily inhaled directly into the lungs.
point sources - Specific points of origin of pollutants, such as factory drains or outlets from sewage-treatment plants. (Contrast nonpoint sources.)
pollutant - A substance the presence of which contaminates air, water, or soil.
pollution - Contamination of air, water, or soil with undesirable amounts of material or heat. The material may be a natural substance, such as phosphate, in excessive quantities, or it may be very small quantities of a synthetic compound such as dioxin that is exceedingly toxic.
pollution avoidance, pollution prevention - A strategy of encouraging development of techniques that would not generate pollutants.
polyculture - The growing of two or more species together. (Contrast monoculture.)
poor - Economically unable to afford adequate food and/or housing.
population - A group within a single species, the individuals of which can and do freely interbreed. Breeding between populations of the same species is less common because of differences in location, culture, nationality, and so on.
population density - The numbers of individuals per unit of area.
population explosion - The exponential increase observed to occur in a population when or if conditions are such that a large percentage of the offspring are able to survive and reproduce in turn. Frequently leads, in turn, to overexploitation, upset, and eventual collapse of the ecosystem.
population momentum - Refers to the fact that a rapidly growing human population may be expected to grow for 50 - 60 years after replacement fertility (2.1) is reached because of increasing numbers entering reproductive age.
population profile. - A bar graph that shows the number of individuals at each age or in each 5-year age group.
population structure - Refers to the proportion of individuals in each age group. For example, a population may be made up predominantly of young people, old people, or a more or less even distribution of young and old.
potential energy - The ability to do work that is stored in some chemical or physical state. For example, gasoline is a form of potential energy; the ability to do work is stored in the chemical state and is released as the fuel is burned in an engine.
Ppm - See parts per million.
pOH - The negative logarithm of the concentration of hydroxyl ions (OHs). Like pH, the scale ranges from 0 to 14, each unit representing a tenfold increase over the preceding unit. The lower the pOH, the higher the concentration of hydroxyl ions.
Precipitation - Any form of moisture condensing in the air and depositing on the ground.

Predator - An animal that feeds on another.
predator-prey relationship - A feeding relationship existing between two kinds of animals. The predator is the animal feeding on the prey. Such relationships are frequently instrumental in controlling populations of herbivores.
preliminary treatment - The removal of debris and grit from wastewater by passing the water through a coarse screen and grit-settling chamber.
Prey - In a feeding relationship, the animal that is killed and eaten by another.
primary pollutants - The air pollutants that are emitted into the air as direct by-products of combustion or other processes as opposed to those (secondary air pollutants) that form as a result of various chemical reactions occurring in the atmosphere.
primary consumer - An organism such as a rabbit or deer that feeds more or less exclusively on green plants or their products, such as seeds and nuts. Synonym: herbivore.
primary energy sources - Fossil fuels, radioactive material, and solar, wind, and water and other energy sources that exist as natural resources.
primary standard - The maximum tolerable level of a pollutant. The standard is intended to protect human health.
primary succession - See succession.
primary treatment - The process that follows preliminary sewage treatment. It consists of passing the water very slowly through a large tank, so that the particulate organic material in the water can settle out. The settled material is raw sludge.
private land trust - A tract of land that is acquired and put into a protected status by a group of private individuals without government funding or support.
producer - In an ecosystem, those organisms, mostly green plants, that use light energy to construct their organic constituents from inorganic compounds.
Production - In the oil industry, refers to the withdrawing of oil reserves.
profligate growth - Growth characterized by extravagant and wasteful use of resources.
property taxes - Taxes that the local government levies on privately owned properties, generally a few dollars per hundred dollars of property value. This is the major source of revenue for local governments.
protein - The class of organic macromolecules that is the major structural component of all animal tissues and that functions as enzymes in both plants and animals.
proton - Fundamental atomic particle with a positive charge, found in the nuclei of atoms. The number of protons present equals the atomic number and is distinct for each element.
protozoan, pl. protozoa - Any of a large group of microscopic organisms that consist of a single, relatively large complex cell or in some cases small groups of cells. All have some means of movement. Amoebae and paramecia are examples.

proven reserves - See reserves.
punctuated evolution - 'Step' model of evolution in which there is little change while an ecosystem is in a balanced state but a shift alters selective pressures and sets into motion fairly rapid charges in almost all, if not all, species in the ecosystem until a new balance is reached.
qualitative - Refers to issues involving purity.
quantitative - Refers to issues involving numbers.
RACT (reasonably available control technology) - Applied to the goals of the Clean Air Act, EPA-approved forms of technology that will reduce the output of industrial air pollutants. (See also MACT.)
radioactive decay - The reduction of radioactivity that occurs as an unstable isotope (radioactive substance) gives off radiation and becomes stable.
radioactive emissions - Any of various forms of radiation and/or particles that may be given off by unstable isotopes. Many such emissions have very high energy and can destroy biological tissues or cause mutations leading to cancer or birth defects.
radioactive materials - Substances that are or that contain unstable isotopes and that consequently give off radioactive emissions. (See isotope and radioactive emissions.)
radioactive wastes - Waste materials that are or that contain or are contaminated with radioactive substances. Many materials used in the nuclear industry become wastes because of their contamination with radioactive substances.
radioisotope - An isotope of an element that is unstable and may tend to gain stability by giving off radioactive emissions. (See isotope and radioactive decay.)
radon - A radioactive gas produced by natural processes in Earth that is known to seep into buildings. It can be a major hazard within homes and is a known carcinogen.
rain shadow - The low-rainfall region that exists on the leeward (downwind) side of mountain ranges. It is the result of the mountain range causing the precipitation of moisture on the windward side.
range of tolerance - The range of conditions within which an organism or population can survive and reproduce, for example, the range from the highest to lowest temperature that can be tolerated. Within the range of tolerance is the optimum, or best, condition.
raw sludge - The untreated organic matter that is removed from sewage water by letting it settle. It consists of organic particles from feces, garbage, paper, and bacteria.
raw wastewater - (See raw sludge.)
reactor vessel - Steel-walled vessel that contains the nuclear reactor.
recharge area - With reference to groundwater, the area over which infiltration and resupply of a given aquifer occurs.

Recruitment - With reference to populations, the maturation and entry of young into the adult breeding population.
relative humidity - The percentage of moisture in the air compared with how much the air can hold at the given temperature.
remediation - The return to the original uncontaminated state. (See also bioremediation and groundwater remediation.)
renewable energy - Energy sources, namely solar, wind, and geothermal, that will not be depleted by use.
renewable resources - Biological resources such as trees that may be renewed by reproduction and regrowth. Conservation to prevent overcutting and protection of the environment are still required, however. (Contrast nonrenewable resources.)
replacement capacity - The capacity of a system to recover to its original state after a harvest or other form of use of biological resources.
replacement fertility/level - The fertility rate that will just sustain a stable population.
reproductive strategy - The particular methodologies seen in nature to enhance the chance of subsequent generations: for example, producing massive numbers of young but offering no care or protection vs. producing few young and caring for them.
reserves - The amount of a mineral resource (including oil, coal, and natural gas) remaining in Earth that can be exploited using current technologies and at current prices. Usually given as proven reserves, those that have been positively identified, and estimated reserves, those that have not yet been discovered but that are presumed to exist.
Resources Conservation and Recovery Act of 1976 (RCRA) - The cornerstone legislation to control indiscriminate land disposal of hazardous wastes.
respiration - See cell respiration.
restoration ecology - The branch of ecology devoted to restoring degraded and altered ecosystems to their natural state.
resurgence - The rapid comeback of a population, especially of pests after a severe die-off, usually caused by pesticides, and the return to even higher levels than before the treatment.
reuse - The practice of reusing items as opposed to throwing them away and producing new items, as, for example, bottles can be collected and refilled (recycling).
reverse osmosis - See microfiltration.
riparian woodlands - The strip of woods that grows along natural watercourses.
risk - The probability of suffering injury, disease, death, or other loss as a result of exposure to a hazard.
risk analysis - The process of evaluating the risks associated with a particular hazard before taking some action. Often called risk assessment.

risk characterization - The process of determining a risk and its accompanying uncertainties after hazard assessment, dose-response assessment, and exposure assessment have been accomplished.
risk management - The task of regulators, involving reviewing the risk data and making regulatory decisions based on the evidence. The process often is influenced by considerations of costs and benefits as well as by public perception.
risk perception - Nonexperts' intuitive judgments about risks, which often are not in agreement with the level of risk as judged by experts.
runoff - That portion of precipitation that runs off the surface as opposed to soaking in.
Safe Drinking Water Act of 1974 - Legislation to protect the public from the risk that toxic chemicals will contaminate drinking water supplies. Mandates regular testing of municipal water supplies.
salinization - The process whereby soil becomes saltier and saltier until finally the salt prevents the growth of plants. It is caused by irrigation because salts brought in with the water remain in the soil as the water evaporates.
saltwater intrusion, saltwater encroachment - The phenomenon of seawater moving back into aquifers or estuaries. It occurs when the normal outflow of freshwater is diverted or removed for use.
Sand - Mineral particles 0.2-2.0 mm in diameter.
sanitary sewer - Separate drainage system used to receive all the wastewater from sinks, tubs, and toilets.
SARA (Title III) - Superfund Amendments and Reauthorization Act section that promulgates community Right-to-Know requirements.
Savanna - A type of grassland usually dotted with trees supported by a wet season and dry season and frequent natural fires, typical of subtropical regions, particularly in Africa.
secondary air pollutants - Air pollutants resulting from reactions of primary air pollutants while resident in the atmosphere. These include ozone, other reactive organic compounds, and sulfuric and nitric acids. (See ozone, PANs, and photochemical oxidants.)
secondary consumer - An organism such as a fox or coyote that feeds more or less exclusively on other animals that feed on plants.
secondary energy source - A form of energy such as electricity that must be produced from a primary energy source such as coal or radioactive material.
secondary pest outbreak - The phenomenon of a small, and therefore harmless, population of a plant-eating insect suddenly exploding to become a serious pest problem. Often caused by the elimination of competitors through pesticide use.
secondary succession - See succession.
secondary treatment - Also called biological treatment. A sewage-treatment process that follows primary treatment. Any of a variety of systems that remove most of the remaining organic matter by enabling organisms to feed on it and

oxidize it through their respiration. Trickling filters and activated-sludge systems are the most commonly used methods.

second basic principle of ecosystem sustainability - Ecosystems run on solar energy, which is exceedingly abundant, nonpolluting, constant, and everlasting.

second-generation pesticides - Synthetic organic compounds used to kill insects and other pests. Started with the use of DDT in the 1940s.

Second Law of Thermodynamics - The fact based on irrefutable observations that in every energy conversion (e.g., electricity to light) some of the energy is converted to heat and some heat always escapes from the system because it always moves toward a cooler place. Therefore, in every energy conversion, a portion of energy is lost. Therefore, since energy cannot be created (First Law) the functioning of any system requires an energy input.

secure landfill - A landfill with suitable barriers, leachate drainage, and monitoring systems such that it is deemed secure against contaminating groundwater with hazardous wastes.

sediment - Soil particles, namely sand, silt, and clay, carried by flowing water. The same material after it has been deposited. Because of different rates of settling, deposits generally are pure sand, silt, or clay.

sedimentation - The filling in of lakes, reservoirs, stream channels, and so on with soil particles, mainly sand and silt. The soil particles come from erosion, which generally results from poor or inadequate soil conservation practices in connection with agriculture, mining, and/or development. Also called siltation.

sediment trap - A device for trapping sediment and holding it on a development or mining site.

seep - Where groundwater seeps from the ground over some area as opposed to a spring, which is the exit as a single point.

selective breeding - The breeding of certain individuals because they bear certain traits and the exclusion from breeding of others.

selective pressure - A fundamental mechanism of evolution. An environmental factor that causes individuals with certain traits, which are not the norm for the population, to survive and reproduce more than the rest of the population. The result is a shift in the genetic makeup of the population. For example, the presence of insecticides provides a selective pressure to increase pesticide resistance in the pest population.

sex attractant - A natural chemical substance (pheromone) secreted by the female of many insect species that serves to attract males for the function of mating. Sex attractants may be used in traps or for the confusion technique to aid in the control of insect pests.

shadow pricing - In cost-benefit analysis, a technique used to estimate benefits where normal economic analysis is ineffective. For example, people could be asked how much they might be willing to pay monthly to achieve some improvement in their environment.

sheet erosion - The loss of a more or less even layer of soil from the surface due to the impact and runoff from a rainstorm.
shelterbelts - Rows of trees around cultivated fields for the purpose of reducing wind erosion.
silt - Soil particles between the size of sand particles and clay particles; namely, particles 0.002 - 0.2 mm in diameter.
siltation - See sedimentation.
sinkhole - A large hole resulting from the collapse of an underground cavern.
slash-and-burn agriculture - The practice, commonly exercised throughout tropical regions, of cutting and burning vegetation to make room for agriculture. The process is highly destructive of soil humus and may lead to rapid degradation of soil.
sludge cake - Treated sewage sludge that has been dewatered to make it a moist solid.
sludge digesters - Large tanks in which raw sludge (removed from sewage) is treated through anaerobic digestion by bacteria.
smog - See industrial smog and photochemical smog.
soft water - Water with little or no calcium, magnesium, or other ions in solution that will cause soap to precipitate (form a curd that makes a 'ring' around the bathtub). (Contrast hard water.)
soil - A dynamic system involving three components: mineral particles, detritus, and soil organisms feeding on the detritus.
soil aeration - See aeration.
soil erosion - The loss of soil caused by particles being carried away by wind and/or water.
soil fertility - Soil's ability to support plant growth; often refers specifically to the presence of proper amounts of nutrients. The soil's ability to fulfill all the other needs of plants is also involved.
soil profile - A description of the different, naturally formed layers within a soil.
soil structure - The composition of soil in terms of particles (sand, silt, and clay) stuck together to form clumps and aggregates, generally with considerable air spaces in between. Structure affects infiltration and aeration. It develops as organisms feed on organic matter in and on the soil.
soil texture - The relative size of the mineral particles that make up the soil. Generally defined in terms of the sand, silt, and clay content.
solar cells - See photovoltaic cells.
solar energy - Energy derived from the sun. Includes direct solar energy (the use of sunlight directly for heating and/or production of electricity) and indirect solar energy (the use of wind, which results from the solar heating of the atmosphere, and biological materials such as wood, which result from photosynthesis).

solar-trough collectors - Reflectors in the shape of a parabolic trough, which reflect the sunlight onto a tube of oil at the focal point. The oil thus heated is used to boil water to drive a steam turbine.
solid waste - The total of materials discarded as 'trash' and handled as solids, as opposed to those that are flushed down sewers and handled as liquids.
solubility - The degree to which a substance will dissolve and enter into solution.
solution - A mixture of molecules (or ions) of one material in another. Most commonly, molecules of air and/or ions of various minerals in water. For example, seawater contains salt in solution.
specialization - With reference to evolution, the phenomenon whereby species become increasingly adapted to exploit one particular niche but, thereby, are less able to exploit other niches.
speciation - The evolutionary process whereby populations of a single species separate and, through being exposed to different forces of natural selection, gradually develop into distinct species.
species - All the organisms (plant, animal, or microbe) of a single kind. The 'single kind' is determined by similarity of appearance and/or by the fact that members do or potentially can mate and produce fertile offspring. Physical, chemical, or behavioral differences block breeding between species.
splash erosion - The compaction of soil that results when rainfall hits bare soil.
springs - Natural exits of groundwater.
standards - Air or water quality levels set by the federal or state government; the maximum levels of various pollutants that are to be legally tolerated. If levels go above the standards, various actions may be taken.
standing biomass - That portion of a population that is not available for consumption but must be conserved to maintain the productive potential of the population.
Starvation - The failure to get enough calories to meet energy needs over a prolonged period of time. It results in a wasting away of body tissues until death occurs.
sterile male technique - Saturating an infested area with males of the pest species that have been artificially reared and sterilized by radiation. Matings between normal females and sterile males render the eggs infertile.
steward/stewardship - A steward is one to whom a trust has been given. In reference to natural lands, stewardship is an attitude of active care and concern for nature.
stomata sing. Stoma - Microscopic pores in leaves, mostly on the undersurface, that allow the passage of carbon dioxide and oxygen into and out of the leaf and that also permit the loss of water vapor from the leaf.
storm drains - Separate drainage systems used for collecting and draining runoff from precipitation.

stormwater - In cities, the water that results directly from rainfall, as opposed to municipal water and sewage water piped to and from homes, offices, and so on. The extensive hard surfacing in cities creates a vast amount of stormwater runoff, which presents a significant management problem.
stormwater management - Policies and procedures for handling stormwater in acceptable ways to reduce the problems of flooding and erosion of stream banks.
stormwater retention reservoirs - Reservoirs designed to hold stormwater temporarily and let it drain away slowly in order to reduce problems of flooding and stream bank erosion.
Stratosphere - The layer of Earth's atmosphere between 10 and 30 miles above the surface that contains the ozone shield. This layer mixes only slowly; pollutants that enter may remain for long periods of time. (See also troposphere.)
strip cropping - The practice of growing crops in strips alternating with grass (hay) at right angles to prevailing winds or slopes in order to reduce erosion.
strip mining - The mining procedure in which all the earth covering a desired material such as coal is stripped away with huge power shovels in order to facilitate removal of the desired material.
submerged aquatic vegetation (SAV) - Aquatic plants rooted in bottom sediments growing under water depend on light's penetrating through the water for photosynthesis.
subsistence farming - Farming that meets the food needs of the farmers and their families but little more. It involves hand labor and is practiced extensively in the developing world.
subsoil - In a natural situation, the soil beneath topsoil. In contrast to topsoil, subsoil is compacted and has little or no humus or other organic material, living or dead. In many cases, topsoil has been lost or destroyed as a result of erosion or development, and subsoil is at the surface.
succession - The gradual, or sometimes rapid, change in the species that occupy a given area, with some species invading and becoming more numerous while others decline in population and disappear. Succession is caused by a change in one or more abiotic or biotic factors that benefits some species at the expense of others. Primary succession: The gradual establishment, through a series of stages, of a climax ecosystem in an area that has not been occupied before, e.g., a rock face. Secondary succession: The reestablishment, through a series of stages, of a climax ecosystem in an area from which it was previously cleared.
sulfur dioxide (SO_2) - A major air pollutant, this toxic gas is formed as a result of burning sulfur. The major sources are burning coal (coal-burning power plants) that contains some sulfur and refining metal ores (smelters) that contain sulfur.
sulfuric acid (H_2SO_4) - The major constituent of acid precipitation. Formed when sulfur dioxide emissions react with water vapor in the atmosphere. (See also sulfur dioxide.)

Superfund - The popular name for the Comprehensive Environmental Response, Compensation, and Liability Act of 1980. This act is the cornerstone legislation that provides the mechanism and funding for the cleanup of potentially dangerous hazardous waste sites to protect groundwater.
surface impoundments - Closed ponds that used to be used to collect and hold liquid chemical wastes.
surface water - Includes all bodies of water, lakes, rivers, ponds, and so on that are on Earth's surface in contrast to groundwater, which lies below the surface.
suspended particulate matter (SPM) - A category of major air pollutants consisting of solid and liquid particles suspended in the air. (See also PM-10.)
suspension - With reference to materials contained in or being carried by water, materials kept 'afloat' only by the water's agitation that settle as the water becomes quiet.
Sustainability - Refers to whether a process can be continued indefinitely without depleting the energy or material resources on which it depends.
sustainable agriculture - Agriculture that maintains the integrity of soil and water resources such that it can be continued indefinitely. Much of modern agriculture is depleting these resources and, hence, is not sustainable.
sustainable development - Development that provides people with a better life without sacrificing or depleting resources or causing environmental impacts that will undercut future generations.
sustainable society - A society that functions in a way so as not to deplete energy or material resources on which it depends.
sustainable yield - The taking of a biological resource (e.g., fish or forests) that does not exceed the capacity of the resource to reproduce and replace itself.
symbiosis - The intimate living together or association of two kinds of organisms.
synergism - The phenomenon in which two factors acting together have a very much greater effect than would be indicated by the sum of their effects separately -- as, for example, modest doses of certain drugs in combination with modest doses of alcohol may be fatal.
synfuels, synthetic fuels - Fuels similar or identical to those that come from crude oil and/or natural gas, produced from coal, oil shale, or tar sands.
synthetic - Human-made as opposed to being derived from a natural source. For example, synthetic organic compounds are those produced in chemical laboratories, whereas natural organic compounds are those produced by organisms.
synthetic organic compounds - See organic compounds.
tar sands - Sedimentary material containing bitumin that can be 'melted out' using heat and then refined in the same way as crude oil.
Taxonomy - The science of identification and classification of organisms according to evolutionary relationships.
tectonic plates - Huge slabs of rock that make up Earth's crust.

temperature inversion - The weather phenomenon in which a layer of warm air overlies cooler air near the ground and prevents the rising and dispersion of air pollutants.
teratogenic - Causing birth defects.
terracing - The practice of grading sloping farmland into a series of steps and cultivating only the level portions in order to reduce erosion.
territoriality - The behavioral characteristic exhibited by many animal species, especially birds and mammalian carnivores, to mark and defend a given territory against other members of the same species.
texture - With reference to solids, the sizes of the particles, sand, silt, and/or clay, that make up the mineral portion.
theory - A conceptual formulation that provides a rational explanation or framework for numerous related observations.
thermal pollution - The addition of abnormal and undesirable amounts of heat to air or water. It is most significant with respect to discharging waste heat from electric generating plants, especially nuclear power plants, into bodies of water.
third basic principle of ecosystem sustainability - Large biomasses cannot be supported at the end of long food chains. The size of consumer populations is maintained such that overgrazing does not occur.
third world - See developing countries.
threatened species - A species the population of which is declining precipitously because of direct or indirect human impacts.
threshold level - The maximum degree of exposure to a pollutant, a drug, or other factors that can be tolerated with no ill effect. The threshold level will vary depending on the species, the sensitivity of the individual, the length of exposure, and the presence of other factors that may produce synergistic effects.
tidal wetlands - Areas of marsh grasses and reeds along coasts and estuaries where the ground is covered by high tides but drained at low tide.
tie-in strategy - In connection with global warming, the idea that society should take actions that not only deal with global warming but also have other beneficial effects. For example, energy conservation not only reduces carbon dioxide emissions but also saves money, reduces acid deposition, and lowers our dependency on foreign oil.
topsoil - The surface layer of soil, which is rich in humus and other organic material, both living and dead. As a result of the activity of organisms living in the topsoil, it generally has a loose, crumbly structure as opposed to being a compact mass. In many cases, because of erosion, development, or mining activity, the topsoil layer may be absent.
total fertility rate - The average number of children that would be born alive to each woman during her total reproductive years if she followed the average fertility at each age.

total product life cycle - Consideration of all steps from the obtaining of raw materials through the manufacture, use, and finally disposal of a product. Consideration of by-products and pollution resulting from each step.
total watershed planning - A consideration of the entire watershed, and planning development and other activities so as to maintain the overall water flow characteristics of the area.
trace elements - Those essential elements that are needed in only very small amounts.
traditional farming - Current farming methods involving intensive use of fertilizers, pesticides, and other chemicals.
tragedy of the commons - The overuse or overharvesting and consequent depletion and/or destruction of a renewable resource that tends to occur when the resource is treated as a commons, that is, when it is open to be used or harvested by any and all with the means to do so.
trait - Any physical or behavioral characteristic or talent that an individual is born with.
transpiration - The loss of water vapor from plants. Water evaporates from cells within the leaves and exits through stomata.
trapping technique - The use of sex attractants to lure male insects into traps.
treated sludge - Solid organic material that has been removed from sewage and treated so that it is nonhazardous.
trickling filter system - System in which wastewater trickles over rocks or a framework coated with actively feeding microorganisms. The feeding action of the organisms in a well-aerated environment results in the decomposition of organic matter. Used in secondary or biological treatment of sewage.
tritium (3H) - An unstable isotope of hydrogen that contains two neutrons in addition to the usual single proton in the nucleus. It does not occur in significant amounts naturally but is human-made.
trophic level - Feeding level with respect to the primary source of energy. Green plants are at the first trophic level, primary consumers at the second, secondary consumers at the third, and so on.
Troposphere - The layer of Earth's atmosphere from the surface to about 10 miles in altitude. The tropopause is the boundary between the troposphere and the stratosphere above. This layer is well mixed and is the site and source of our weather, as well as the primary recipient of air pollutants. (See also stratosphere.)
turbid - Refers to water purity; means cloudy.
turbine. - A sophisticated 'paddle wheel' driven at a very high speed by steam, water, or exhaust gases from combustion.
turbogenerator - A turbine coupled to and driving an electric generator. Virtually all commercial electricity is produced by such devices. The turbine is driven by gas, steam, or water.
turnover rate - The rate at which a population is replaced by the next generation.

ultraviolet radiation - Radiation similar to light but with wavelengths slightly shorter than violet light and with more energy. The greater energy causes it to severely burn and otherwise damage biological tissues.
undernutrition - A form of hunger in which there is a lack of adequate food energy as measured in calories. Starvation is the most severe form of undernutrition.
urban decay - General deterioration of structures and facilities such as buildings and roadways, and also the decline in quality of services such as education, that has occurred in inner city areas as growth has been focused on suburbs and exurbs.
urban environmental coalition - The coming together of urban residents who may be members of various environmental organizations to solve particular environmental problems facing the city.
urban sprawl - The rapid expansion of metropolitan areas through building housing developments and shopping centers farther and farther from urban centers and lacing them together with more and more major highways. Widespread development that has occurred without any overall land-use plan.
UST legislation - Amendments to the Resources Conservation and Recovery Act of 1976, passed in 1984 to address the mounting problem of leaking underground storage tanks (USTs).
vigor - Applied to crop plants or animals, refers to traits for hardiness to disease, drought, cold, and other adverse factors or conditions.
vitamin - A specific organic molecule that is required by the body in small amounts but that cannot be made by the body and therefore must be present in the diet.
volatile organic compounds (VOCs) - A category of major air pollutants present in the air in vapor state, including fragments of hydrocarbon fuels from incomplete combustion and evaporated organic compounds such as paint solvents, gasoline, and cleaning solutions. They are major factors in the formation of photochemical smog.
water cycle - The movement of water from points of evaporation through the atmosphere, through precipitation, and through or over the ground, returning to points of evaporation.
water-holding capacity - The ability of a soil to hold water so that it will be available to plants.
waterlogging - The total saturation of soil with water. Results in plant roots not being able to get air and dying as a result.
watershed - The total land area that drains directly or indirectly into a particular stream or river. The watershed is generally named from the stream or river into which it drains.
watershed management - See total watershed planning.

water table - The upper surface of groundwater. It rises and falls with the amount of groundwater.
water vapor - Water molecules in the gaseous state.
weathering - The gradual breakdown of rock into smaller and smaller particles, caused by natural chemical, physical, and biological factors.
wetlands - Areas that are constantly wet and are flooded at more or less regular intervals. Especially, marshy areas along coasts that are regularly flooded by tide.
wetland system - A biological aquatic system (usually a restored wetlands) to remove nutrients from treated sewage wastewater and return it, virtually pure, to a river or stream. Wetland systems are sometimes used when using treated wastewater for irrigation is not feasible.
Wilderness Act of 1964 - Federal legislation that provides for the permanent protection of undeveloped and unexploited areas so that natural ecological processes can operate freely. Most uses are excluded from such areas, which now total 90 million acres in the United States.
wind farms - Arrays of numerous, modestly-sized wind turbines for the purpose of producing electrical power.
windrows - Piles of organic material extended into long rows to facilitate turning and aeration to enhance composting.
wind turbines - 'Windmills' designed for the purpose of producing electrical power.
work - Any change in motion or state of matter. Any such change requires the expenditure of energy.
workability - With reference to soils, the relative ease with which a soil can be cultivated.
World Bank - A branch of the United Nations that acts as a conduit to handle loans to developing countries.
world view - A set of assumptions that a person holds regarding the world and how it works.
xeroscaping - Landscaping with drought-resistant plants that need no watering.
yard wastes - Grass clippings and other organic wastes from lawn and garden maintenance.
zones of stress - Regions where a species finds conditions tolerable but suboptimal. Where a species survives but under stress.

5.ПРИЛОЖЕНИЕ

5.1.Чтение математических формул и выражений

Mathematical Expressions

Below are some of the more common symbols and expressions used in mathematics, geometry and statistics; in the cases where alternative ways of saying the expressions are given, both are equally common but generally the first is more formal or technical and the second less formal or technical.

+	plus/and
-	minus/take away
±	plus or minus/approximately
×	(is) multiplied by /times or when giving dimensions by)
%	per sent
÷	(is) divided by
=	is equal to/equals
≠	is not equal to/does not equal
≈	is approximately equal to
≡	is equivalent to/is identical with
<	is less than
≤	is less than or equal to
>	is more than
≥	is more than or equal to
x^2	x [eks] squared
x^3	x cubed
x^4	x to the power four /to the fourth
⇒	Implies
⊂	is an element of (a set)
Ø	or {} is an empty set
⋂	Intersection
⋃	Union
C	is a subset of
√	(square) root
$\sqrt[3]{}$	cube root
°	Degree
π	pi [pai]
r	[α: (r)] = radius of circle

πr^2	pi r squared [,pai o: 'skweed] (formula for area of circle)
n!	n [en] factorial
$\int$	the integral of
$\angle$	Angle
$\llcorner$	right angle
Δ	Triangle
$\parallel$	is parallel to
$\perp$	is perpendicular to
'	Minute
"	second (of an arc)
∞	Infinity

Arithmetic

$\frac{1}{137}$	one over one hundred thirty seven (one over one thirty seven)
$7.9 * 1.3$	seven point nine times one point three
2.5^3	two point five to the cube
$2.5^{3.4}$	two point five power three point four
$\sqrt{\frac{2.3}{3.4}}$	square root of two point three over three point four
$\sqrt[3]{2}$	cube root of two
$\sqrt[1.27]{3}$	Three power one over one point thirty seven
$\ln 7.2$	natural logarithm (log) of seven point two
$\lg 2.3$	logarithm(log) base ten of two point three
$\log_{3.4} 5.6$	logarithm base three point four of five point six

Algebra

e^x	e to the x
a^b	a power b (a to the b)
$a : b = c : d$	a over b equals to c over d

$(a+b)^3$	a plus b to the cube
$A_0, A_1, \ldots A_n$	A zero (A knot), A one, up to A n (A sub zero, A sub one, up to A sub n)
A_{mn}	A m n (A sub m n)
$\det\{a_{mn}\}$	determinant of a m n
A'	A prime
$\widetilde{A}$	A tilde
A''	A double prime
$\hat{A}$	A hut
P⊥	P perpendicular
$\prod_{n=1}^{\infty} x_n$	Product of x sub n from n equals to one to infinity
$\sum_{j=2,4,6,\ldots}^{\infty} a_j$	sum of a sub j from j equals to 2, 4, 6 to infinity

Trigonometry

Sin (π/6)	sine of pi over six
tg (30°)	tangent of thirty degrees
Arc sin (x)	arcsine of x

Higher mathmatics

f(x)	f of x
f(x)|x= a	f of x evaluated at x equals to a
f(x) = a	f of x equals to a
f(x) ≡ const	f of x identically constant (identically equals to constant)
$\lim_{x \to x_0} f(x)$	limit of f of x when x tends to zero
f(x,y,z)	f of x, y and z
$\frac{df(x)}{dx}, x = x_0$	derivative of f of x wrt (with respect to – common abbreviation) x evaluated at x equals to x zero (x knot, x sub zero)

$f'(x)$	f prime of x
$f''(x)$	f double prime of x (second derivative of f)
$\frac{\partial f(x,y)}{\partial x}$	partial derivative of f of x comma y wrt x
$\frac{\partial^2 f(x,y)}{\partial x \partial y}$	second partial derivative of f of x comma y wrt x and y
grad f(x),	gradient of f of x (gradient f), divergence of A of r
div A(r),	gradient of divergence of E,
grad div E,	curl of E of r
rot E(r)	
$\nabla(f)$	nabla of f (nabla f)
$\Delta(u)$	delta of u, laplacian of u, BUT! We never use it! Instead: ∇2u – nabla square u.
$\int f(x)dx$	(indefinite) integral of f of x d x
$\int_0^{\pi} f(x)dx$	integral from zero to pi of f of x d x
$\iint_D f(x,y)dxdy$	double integral over the domain D of f of x comma y d x d y
$\oint \varphi(z)dz$	integral over the closed contour of fi of z d z

5.2. Chemical formulas

In chemical formulae full-size and reduced-size numbers, and capital and lower case letters are not distinguished orally.

- NaCl - [,en eı si: 'el]

- $2H_2 + O_2 = 2H_2O$ – [tu:eıtʃ ,tu: || plas ,əu 'tu:|| ,i:kwəlz tu: eıtʃ tu: 'əu]

5.3. The Greek alphabet

Many letters of the Greek alphabet are commonly used in statistics and other branches of mathematics. Here is a complete list of the letters:

Capital letters	Small letters	Name
Α	α	alpha ['ælfə]
Β	β	beta ['bi:tə] US:['beitə]
Γ	γ	gamma ['gæmə]
Δ	δ	delta ['deltə]
Ε	ε	epsilon [ep'saılən] US: [‘epsılon]
Ζ	ζ	zeta ['zı:tə] US:['zeitə]
Η	η	eta ['i:tə] US:['eıtə]
Θ	θ	theta ['θı:tə] US:['θeıtə]
Ι	ι	iota [aı 'əutə]
Κ	κ	kappa ['kæpə]
Λ	λ	lambda ['læmbə]
Μ	μ	mu [mju:]
Ν	ν	nu [nju:] US: [nu:]
Ξ	ξ	xi [ksaı]
Ο	ο	omicron [əu'maıkrən] US: ['omikron]
Π	π	pi [paı]
Ρ	ρ	rho [rəu]
Σ	σ, ς	sigma ['sigmə]
Τ	τ	tau [tau]
Υ	υ	upsilon [ju:p'saılən] US: ['ju:psılon]
Φ	φ	phi [faı]
Χ	χ	chi [kaı]
Ψ	ψ	psi [psaı]
Ω	ω	omega ['əumige] US: [əu'megaə]

5.4. Weights and Measures

The Metric system

length

	Metric	GB & US
10 millimeters (mm)	= 1 centimeter (cm)	= 0,3937 inches (in)
100 centimeters	= 1 meter (m)	= 39,37 inches or 1,094 yards (yd)
1000 meters	= 1 kilometer-(km)	= 0,62137 miles or about $\frac{5}{8}$ mile

surface

	Metric	GB & US
100 square meters (m^2)	= 1 are (a)	= 0,247 acres
100 ares	= 1 hectare (ha)	= 2,471 acres
100 hectares	= 1 square kilometer (km^2)	= 0,386 square miles

weight

	Metric	GB & US
10 milligrams (mg)	= 1 centigram (eg)	= 0,1543 grains
100 centigrams	= 1 gram (g)	= 15,4323 grains
1000 grams	= 1 kilogram (kg)	=2,2046 pounds
1000 kilograms	= 1 tone	= 19,684 cwt

capacity

	Metric	GB & US
1000 milliliters (ml)	= 1 liter (l)	= 1 75 pints (2,101 US pints)
10 liters	=1 decaliter (dl)	= (2,1997 gallons (2,63 US gallons)

Non-metric systems

Avoirdupois Weight

	GB & US	METRIC
	1 grain (gr)	= 0,0648 grams (g)
$437\frac{1}{2}$ grains	= 1 ounce (oz)	= 28,35 grams
16 drams (dr)	= 1 ounce	= 28,35 grams
16 ounces	= 1 pound (lb)	= 0,454 kilograms (kg)
14 pounds	= 1 stone	= 6,356 kilograms
2 stone	= 1 quarter	= 12,7 kilograms
4 quarters	= 1 hundredweight (cwt)	= 50,8 kilograms
112 pounds	= 1 cwt	= 50,8 kilograms
100 pounds	= 1 short cwt	= 45,4 kilograms
20 cwt	= 1 ton	= 1016,04 kilograms
2000 pounds	= 1 short ton	= 0,907 metric tons
2240 pounds	= 1 long ton	= 1,016 metric tons

Troy Weight

system of weights used in England for gold, silver and precious stones

	GB & US	METRIC
24 grains	= 1 pennyweight (dwt)	= 1,555 grams
20 pennyweights	= 1 ounce	= 31,1 grams
12 ounces	= 1 pound (5760 grains)	= 0,373 kilograms

Apothecaries' Weight

used by pharmacists for mixing their medicines; they buy and sell drugs by Avoirdupois weight

	GB & US	METRIC
20 grains	= 1 scruple	= 1,296 grams
3 scruples	= 1 dram	= 3,888 grams
8 drams	= 1 ounce	= 31-1035 grams
12 ounces	= 1 pound	= 373,24 grams

Linear Measure

	GB & US	METRIC
	1 inch (in)	= 25,3995 millimeters (mm)
12 inches	= 1 foot (ft)	= 30,479 centimeters (cm)
3 feet	= 1 yard (yd)	= 0,9144 meters (m)

$5\frac{1}{2}$ yards	= 1 rod, pole, or perch	= 5,0292 meters
22 yards	= 1 chain (ch)	= 20,1168 meters
220 yards	= 1 furlong (fur)	= 201,168 meters
8 furlongs	= 1 mile	= 1,6093 kilometers (km)
1760 yards	= 1 mile	= 1,6093 kilometers
3 miles	= 1 league	= 4,8279 kilometers

6. ЛИТЕРАТУРА

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2. Положинцев Б.И Introduction to ecology. Учебное пособие. СПб.: ООО «Издательство «Химера», 1999. - 96 с.
3. Хорнсби А.С. Толковый словарь современного английского языка для продвинутого этапа, (том 2).М., изд-во «Русский язык», 1982. – 527с.

В 2007 году СПбГУ ИТМО стал победителем конкурса инновационных образовательных программ вузов России на 2007–2008 годы. Реализация инновационной образовательной программы «Инновационная система подготовки специалистов нового поколения в области информационных и оптических технологий» позволит выйти на качественно новый уровень подготовки выпускников и удовлетворить возрастающий спрос на специалистов в информационной, оптической и других высокотехнологичных отраслях экономики.

КАФЕДРА ЛАЗЕРНЫХ ТЕХНОЛОГИЙ И ЭКОЛОГИЧЕСКОГО ПРИБОРОСТРОЕНИЯ

Лазерные технологии не случайно называют технологиями XXI века. Открытые при нашей жизни лазеры уже сегодня широко проникли в медицину, биологию, экологию, промышленность, строительство, транспорт, связь, шоу–бизнес и другие сферы жизни. Лазерные принтеры, лазерные CD–диски, лазерные торговые сканеры и лазерные шоу сегодня известны всем. Менее известны широкой публике, но не менее важны лазерные технологии при лечении болезней глаз, сосудов, опухолей, в микроэлектронике для нанесения и структурирования тонких пленок, для резки и сварки брони, закалки инструментальных сталей, декоративной обработки дерева, камня и кожи, и т.д., а в ближайшей перспективе — для избавления человечества от очков и морщин (да, да — сотни операций по лазерной полировке роговицы глаза и кожи уже проведены), разработка реакций лазерного управляемого термоядерного синтеза и лазерных реактивных двигателей, создание трехмерных объектов за счет прямой трансформации виртуального (компьютерного) образа в материальный объект при взаимодействии лазерного излучения с веществом и многое, многое другое.

История кафедры ЛТ и ЭП делится на 3 разных периода:

Период I — с момента появления лаборатории лазерной технологии в ЛИТМО в 1965 г. до момента организации кафедры охраны труда и окружающей среды (ОТ и ОС) с отраслевой лабораторией лазерных технологий (ОЛЛТ) в 1982 г.

Период II — период развития кафедры ОТ и ОС и ОЛЛТ — 1982–1988 гг.

Период III — с момента создания на базе кафедры ОТ и ОС и ОЛЛТ кафедры лазерных технологий — 1988 г., в дальнейшем преобразованной в кафедру лазерных технологий и экологического приборостроения и по настоящее время.

Охарактеризуем периоды 1, 2 и 3 фактами.

1976 г. — научные работы ОЛЛТ по физическим основам лазерной обработки тонких пленок удостоены Премии Президиума АН СССР за лучшую научную работу в области «Фундаментальных проблем микроэлектроники».

1983, 1984 гг. — работы кафедры удостоены Премии Минвуза СССР за лучшую научную работу.

1986 г. — работы кафедры совместно с рядом других организаций удостоены Государственной Премии СССР.

1988 г. — Кафедра ОТОС с лабораторией ЛТ по инициативе ректора ЛИТМО преобразована в выпускающую кафедру «Лазерных технологий» и начинается систематический выпуск специалистов по специальности 07.23 «лазерная техника и лазерные технологии».

1996 г. — Кафедра ЛТ переименована в кафедру ЛТ и ЭП и осуществляет выпуск специалистов как лазерным технологиям, так и по специальности «инженер–педагог» со специализацией «экология».

2000 г. – лаборатория и кафедра ЛТ признаны Ведущей научной школой Российской Федерации по «Фундаментальным основам лазерных микротехнологий».

2005 г. – этот статус подтвержден.

За период времени с 1988 по 2005 г. кафедра выпустила более 300 специалистов в области лазерных технологий;

За тот же период времени сотрудниками и аспирантами кафедры защищены 2 докторских и более 20 кандидатских диссертаций;

По результатам работ кафедры издано 9 монографий;

Результаты исследований сотрудников кафедры изложены более чем в 500 научных статьях и 50 патентах и авторских свидетельствах;

В настоящее время кафедра активно сотрудничает с университетами и институтами Германии (BIAS, FHS Emden), Китая (HUST), Франции (ENISE), Италии (Lecce University) и др.

В последние годы по приглашению различных зарубежных организаций прочтен ряд курсов лекций по лазерным технологиям.

Основные научные направления кафедры

1). Лазерная обработка пленочных элементов.

2). Лазерное локальное осаждение тонких пленок.

3). Лазерные технологии прецизионной размерной обработки.

4). Создание новых оптических материалов и элементов микро– и нанооптики на базе лазерных технологий.

5). Создание теории субдлинноволновых источников излучения и разработки методов изготовления и контроля ближнепольных зондов.

6). Лазерное медицинское оборудование и инструмент.

7). Фундаментальные исследования в области взаимодействия лазерного излучения с веществом: лазерная абляция и конденсация металлических и композиционных пленок и эффекты самоорганизации.

8). Лазерный трехмерный синтез объемных моделей.

9). Физико–математическое моделирование в задачах дистанционного лазерного зондирования морской среды.

Заведует кафедрой лазерных технологий и экологического приборостроения Заслуженный деятель науки России, Лауреат Государственной Премии СССР, д.т.н., профессор В.П. Вейко. Среди преподавателей кафедры д.т.н., Почетный работник высшего образования, профессор Е.Б. Яковлев, д.т.н., профессор Е.А.Шахно, Почетный работник высшего образования, к.ф.–м.н., доцент Г.Д. Шандыбина, к.т.н., доцент В.В.Барановский, к.ф.-м.н., доцент Ю.И. Копилевич, к.ф.–м.н., доцент А.Н. Проценко.

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