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Editor: Jennifer Evans

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Test the Efficiency of Your Home's Central Air Conditioning System

(In developing the Texas Home Energy Analysis Training series [HEAT] to instruct residential energy advisors, researchers at the Center for Energy Studies have developed a number of energy conservation strategies applicable to Texas homes and climatic conditions. The following simple tests for air conditioning efficiency are based on the HEAT Manual *[Governor's Office of Energy Resources, 1979] by Jim Broughton, Jerold Jones, and Carl Crow of the CES Conservation Division. The Texas Governor's Office of Energy Resources has sponsored the HEAT project, now in its second year as part of the federally funded state conservation plan.*

For more information about energy conservation, contact the customer service department of your local utility or the Texas Energy Extension Service, Center for Energy and Mineral Resources, Texas A&M University, College Station, Texas 77843.)

In homes the most common type of central air conditioning system is the split system, so called because the evaporator is located in the house above the furnace, whereas the condensing unit is located outside. Piping between the evaporator and the condensing unit carries refrigerant through the system. Other types of central systems, i.e., self-contained conditioning units and absorption refrigeration units, are used less frequently. The tests described here apply specifically to the split-type central system. To determine whether your system is operating efficiency, carry out the following seven tests.

If you discover through the tests that your system does not seem to be operating properly, call on a serviceperson rather than attempting to make repairs yourself, except where specifically noted in the tests. (For example, you should be able to clean and replace your system's air filter, but you should not attempt to clean the fins of the condensing unit.)

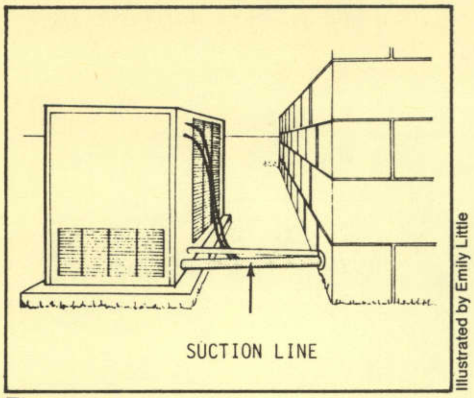

Figure 1

TEST 1—Check the suction line for proper insulation.

Start the air conditioner and allow it to run for at least five minutes before making the test. Go outside and locate the condensing unit. Two pipes, one large and one small, protrude from the rear of the condensing unit and enter the exterior walls of the house. The larger pipe, known as the suction line, carries refrigerant to the condensing unit from the evaporator and should be cold to the touch. Check to see that the suction line is wrapped with an insulating material so that little bare metal is exposed (figure 1). If the line is not insulated, the homeowner should purchase the appropriate insulating material from an air conditioning supply and wrap the suction line, making sure to overlap each wrap approximately three-quarters of an inch.

After checking the suction line insulation, see if moisture is condensing on the pipe at the entry to the condensing unit. If the pipe is not damp, the refrigerant level of the system may be low; however, a qualified air conditioning repairperson should be called to make a more thorough check only after completing Test 6.

TEST 2—Check to see that the air motion through the condensing unit fin-tube assembly (heat exchanger) is not restricted.

The condensing unit fan creates the air motion designed to carry the heat generated by the evaporation and compression of the refrigerant away from the fin-tube assembly (condenser). Inevitably, dirt and debris, such as leaves and grass, will become lodged in the condenser fins. This debris restricts the air motion over the fins and decreases the air conditioner's efficiency. A severely clogged unit may cause the compressor to overheat and burn out.

To check, pass a hand in front of the finned-tube heat exchanger on the condensing unit. Move your hand from side to side and down the fins, noting the location of any points where air motion is restricted (figure 2). Air blockage at any location other than the central portion of the fin assembly means that the air intake side of the assembly should be cleaned by a serviceperson.

Also check that no large objects are located within several feet of the intake side. Even bushes and tall weeds can interfere with the air flow across the heat exchanger.

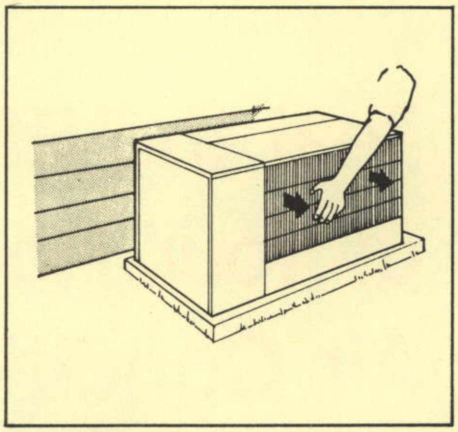

Figure 2

TEST 3—Check the air filter and clean or replace it if dirty or clogged.

Locate the furnace unit, usually in a closet inside the house or the attic, and find the filter access panel. The air filter will usually be located in the return air duct near the fan intake (figure 3).

Take off the access panel and remove the air filter. Check to see that it is clean and unclogged. A dirty filter will retard air flow across the evaporator coils and will eventually allow dirt to accumulate on them, thus reducing the evaporator's efficiency. Air motion within the house will also be affected, a condition that could prevent proper thermostatic operation and system control. A clogged filter can even lead to mildew buildup on the registers, walls, and return air intakes. So take care to check and clean the air filter

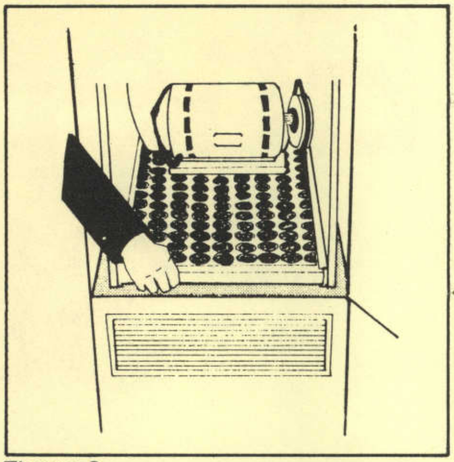

Figure 3

monthly during the time the system is in operation.

If a dirty and clogged air filter is a disposable type, such as fiberglass, it should be discarded and replaced. (Sometimes the filter will be missing altogether.) Some systems utilize a permanent plastic foam or aluminum mesh air filter that may be washed, in the direction opposite to the air flow, with mild soap and water. Be careful not to tear the filter when cleaning. A filter-coating chemical spray should be applied to a permanent filter after cleaning so that it will attract and hold dust. Disposable filters require replacement about once a month, and permanent filters should be cleaned once every month and replaced if torn or excessively dirty.

When replacing a filter, be careful to choose a replacement that entirely fills the filter frame and that is the same thickness as the original. In addition, check to see that the filter is securely in position before replacing the access panel.

If in Test 1, frost, rather than beads of water, is found on the suction line, remove the filter, replace the access panel, and run the air conditioner for about five minutes. Now, check for frost on the outside suction line again. If frosting is still a problem, have the system checked by a qualified serviceperson. If no frost appears, clean and/or replace the filter.

TEST 4—Check for adequate air circulation inside the home.

Locate the supply air vent in the largest room inside the house and check to see that air motion can be felt at a distance of about ten feet from the vent. This may require extending your arm above your head into the air stream.

If you cannot feel air motion at this distance, an air restriction may be present. The problem may be caused by a slipping fan belt, clogged evaporator coils or air filter, duct air leakage, or an unbalanced duct system.

TEST 5—Check the accuracy of the thermostat by comparing it to temperature measurements made with a fixed thermometer. Check the thermostat to see that it is level.

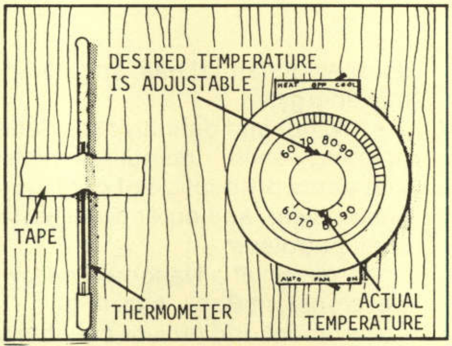

Figure 4

This test requires an accurate glass bulb thermometer with a fairly wide temperature range. Tape the thermometer to the thermostat for the air conditioning system (figure 4). After allowing the thermometer to come to an equilibrium temperature, compare its reading to that of the fixed indicator on the thermostat. The readings should be within a degree of each other.

A discrepancy may indicate that the thermostat is not level and/or not calibrated properly. If the temperature readings are widely discrepant, the thermostat may be broken or mislocated and will need attention from a qualified serviceperson. Be sure that the thermostat is not located in direct sunlight, stagnant air locations, or hot or cold drafts.

To check that the thermostat is level, cut the power to the furnace unit and remove the thermostat's cover. Look near the top or bottom edge for a "level" line or two plastic pins flattened on their top edges. Use a small carpenter's level to lay across the leveling pins or along the leveling line (figure 5). If necessary,

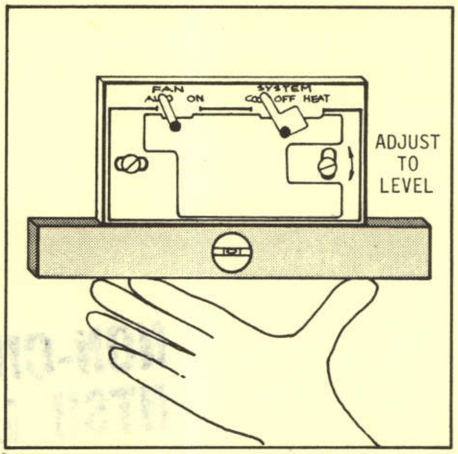

Figure 5

loosen the baseplate mounting screws and rotate the thermostat body until it is level. Be careful not to jar or to tamper with the thermostat's mechanism. Then tighten the screws, replace the cover plate, and recheck the temperature readings. If the readings still disagree by more than 1°, a serviceperson should be consulted.

TEST 6—Measure the difference between supply air and return air temperature.

For this test you will need two glass bulb thermometers like the

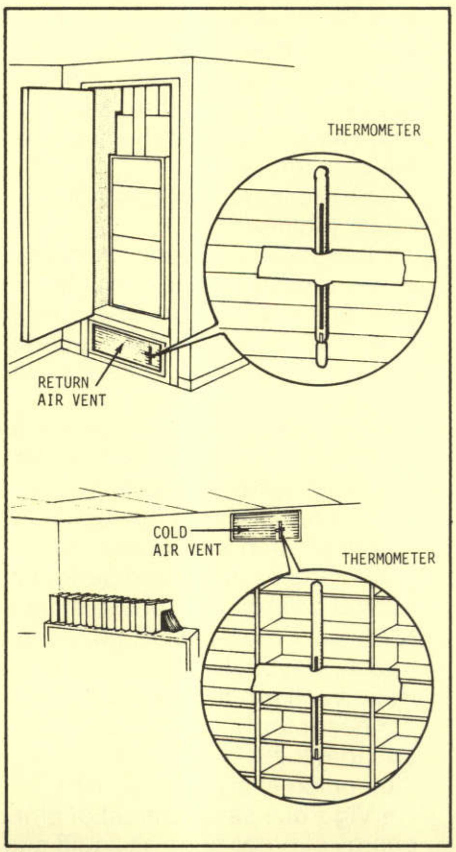

Figure 6

one used in the previous test. First, locate the return air grill, usually found beneath the furnace closet door, and tape one of the thermometers to the grill. Tape the other thermometer to the supply air register in the largest room of the house (figure 6). Start the air conditioner and run it for about ten minutes, allowing the thermometers to reach equilibrium.

Calculate the difference in the temperature readings. An 8°–12° difference indicates that the system is operating less efficiently than it should, a 12°-16° difference is satisfactory, and a 16°-20° difference is quite adequate. A marginal reading may indicate a need for additional refrigerant if air circulation was found to be adequate in Test 4. In this case, call a qualified technician.

TEST 7—Check the duct system for air leaks and appropriate insulation.

Beginning at the top of the furnace unit, just above the evaporator coils, feel about the duct for air leaks, making a note of any that are found. Then follow the duct into the attic and feel for leaks there. Leaks may be repaired with good-quality duct tape, which can be purchased in two-inch or wider rolls from an air conditioning parts supplier. The tape is made especially for this purpose and is fireproof. If leaks require taping, make the repairs and recheck the suction line outside for condensation (Test 1).

The duct system should also be properly insulated (R-7 to R-11) in order to insure system efficiency. The lack of duct insulation not only will result in increased energy consumption, but also can reduce the useful life of air conditioning equipment. A vapor barrier of thin plastic sheeting must be placed on the outside of the insulation for duct systems used for cooling. All tears and seams in the vapor barrier should be taped.

If your air conditioning system checks out all right, but you would still like to save money on your summer utility bills, do not overlook a no-cost, highly effective measure: set your thermostat at 80°–82° and use portable fans to create breezes. Roughly speaking, each degree above 75° will save you a hefty 4–5 percent on the costs of running the system.

CES Publications

Energy Projections: Oil, Natural Gas, and Coal in the USSR and Eastern Europe
by George W. Hoffman, August 1978, 42 pages (UT/CES-PS-3).

This study is a comprehensive survey of forecasts of USSR and Eastern Europe energy supply and demand and a brief evaluation of the energy-related geographic and geologic constraints these countries face.

More than 97 percent of the energy resources of Eastern Europe and the Soviet Union are located in the Soviet Union. Of that 97 percent, roughly 90 percent are found east of the Ural Mountains, far from population centers.

Many different sources have published conflicting projections of Soviet and Eastern Europe energy, and data from these sources are compared in a series of annotated tables. An appendix, cowritten by the author and Dr. Edward Hewett, discusses sources of information on the energy resources and trade of these countries, and a bibliography of ninety-five publications completes the report.

(Dr. Hoffman is chairman of the UT Department of Geography.)

The Soviet and East European Crisis: Its Dimensions and Implications for East-West Trade
by Edward A. Hewett, August 1978, 29 pages (UT/CES-PS-2).

In this policy study, Dr. Hewett projects to 1980 the aggregate energy balance in Eastern Europe and the USSR and explores the implications of that projection for East-West trade. Simple extrapolation suggests that serious problems lie ahead for Eastern Europe in its quest to develop and maintain domestic and international sources of energy. With a continuing trend of lower-than-planned growth rates of coal and oil and high consumption growth rates, the energy balances projected by the Soviet Union and Eastern Europe appear unrealizeable.

The study predicts that the Soviet and East European energy crisis will have a strong depressing effect on East-West trade while stimulating Soviet/East European trade.

(Dr. Hewett is an associate professor of economics.)

U.S. Oil Geography in 1990: Scenarios and Implications for Economic Policy
by E. Victor Niemeyer and James W. McKie, October 1978, 66 pages (UT/CES-PS-5).

The geography of crude oil movements, refining location, and shipment of refined products to markets in the United States has been changing at an accelerating pace since 1970. What patterns will exist in 1985–89 depend in part on underlying structural changes now in progress and in part on policy decisions to be made in the near future. This report analyzes several possible scenarios and identifies the factors likely to be most important in determining the economic geography of the domestic oil industry.

By use of an analytical computer model, a base case is developed and several situations are explored, including the effects of (1) restricted product imports, (2) transcontinental pipelines, (3) high and low Alaskan production, and (4) a Texas superport.

The authors find that a consistent pull exists on refining activity in the Gulf region toward the east, which can be offset by local economics and construction of Texas superports.

(Dr. Niemeyer was a research associate at the Center for Energy Studies, and Dr. McKie is chairman of the UT Department of Economics.)

Want to receive CES Executive Summaries?

To be included on the mailing list to receive executive summaries of major Center for Energy Studies research reports, both technical and policy-related, please send your name, affiliation or organization, address, and area(s) of interest to: Jennifer Evans, Center for Energy Studies, ENS 143, The University of Texas at Austin, Austin, Texas 78712.

An Economic Comparison between the Coal Slurry Pipeline Proposed by Houston Natural Gas Corporation and Two Comparable Unit Train Models
by Ted Evans Hyde, March 1979, 207 pages (UT/CES-PI-5).

A conversion to coal for electric power generation will require massive investments on the part of the utilities, and consumers will ultimately bear this cost. Thus new possibilities for controlling such costs should be of interest to all. The conclusion of this study is that a coal slurry pipeline proposed by Houston Natural Gas Corporation is likely to be an effective method of holding down coal transportation costs on a high-volume, long-distance movement.

Utilizing a computer model, the study compares the slurry pipeline operation with two unit train systems for transporting 15 million moist tons of coal from Wyoming to Amarillo, Lubbock, Temple, and Angleton, Texas. The direct costs of the pipeline were found to be substantially lower than those of the rail systems over thirty years.

The demand for coal in Texas was predicted to be large enough to support the slurry pipeline and to increase tonnage moved by rail as well. However, unless legal barriers related to the pipeline's water requirements are overcome quickly, railroads will capture the entire coal transport market into Texas, leaving little hope for a slurry line in the future.

(Mr. Hyde prepared this report as a master's thesis in economics.)

To order Center for Energy Studies publications, contact the National Technical Information Service, P.O. Box 1552, Springfield, Virginia 22151 (703/557-4650).

CES Update

Environmental

Two short courses on **air pollution topics** will be held in July and August.

The courses are conducted by the Center for Energy Studies and the UT Department of Civil Engineering; they are funded by the US Environmental Protection Agency:

July 10–13—Control of Gaseous Emissions—Little Rock, Arkansas

August 21–24—Control of Particulate Emissions—New Orleans, Louisiana

For further information about the short courses, contact the program manager, Dr. Cooper.

Geothermal

Dr. Myron H. Dorfman, director of the Geothermal Division, led a delegation of **American scientists to meet with Soviet** representatives to discuss the geology of geopressured basins.

Other delegation members were Dr. Don Bebout, coordinator of geothermal studies at the UT Bureau of Economic Geology; Dr. Dale Zinn, former assistant director of the Geothermal Division; and Dr. Robert Loucks, bureau research scientist.

The two delegations met in Vienna, Austria, under the auspices of the International Institute for Applied Systems Analysis for a week of workshops that began June 18. The meetings, requested by the Soviets, focused on the similarities in the geology of geopressured basins in the United States and in Siberia.

Nuclear Studies

Dr. Dale Klein, director of the Nuclear Division, has been awarded the Outstanding Service Award for 1978–79 by the Central Texas Section of the American Society of Mechanical Engineers (ASME).

Two research projects that may lead to a greater understanding of transmutation of nuclear waste and a third project on a method of recycling depleted uranium are under way in the Nuclear Division.

The three projects, under the supervision of Dr. Klein, are funded by the Texas Atomic Energy Research Foundation.

Fission product transmutation reaction measurements—Nuclear fission generates wastes dominated by two types of radionuclides: actinides, many of which (like plutonium) remain radioactive for thousands to millions of years, and fission products, of which only a few such as iodine-129 and technetium-99, are similarly long-lived.

It may ultimately prove feasible to transmute radioactive wastes by neutron bombardment in order to reduce the need for long-term storage. Although neutron-induced reactions on the actinides and iodine have been investigated extensively, transmutation of technetium-99 has not been widely studied.

This project, being conducted by graduate student William Murphie, will generate new measurement data for the nuclear reactions of technetium-99. The results may be relevant to the eventual feasibility of nuclear waste transmutation.

Determination of toxicity of fission product waste from actinide transmutation—Different types of nuclear reactors yield radioactive wastes of varying mixes. The actinides in these differing wastes may be transmuted to fission products. In this study by nuclear engineering graduate student Duncan Hsu, the goal is to determine the variation in toxicity of the fission products produced by different transmuters. Wastes from three reactor types are being studied: pressurized water reactor fueled with uranium, pressurized water reactor fueled with plutonium, and liquid metal fast breeder reactor.

Simulation of plutonium enrichment in depleted uranium fuel assemblies—This computer modeling study by nuclear engineering graduate student Steve Ganthner is aimed at gathering data and building a picture of an as-yet-untried method of creating nuclear fuel. This method would use an accelerator as the neutron source for breeding plutonium from uranium-238. Such accelerator-bred nuclear fuel would have a substantial advantage over other breeder concepts: the fuel would be bred inside the fuel assemblies (the containers that are placed in the reactors) rather than separately. This system would not require reprocessing, and thus theft of the fissile fuel would be very unlikely because the fuel assemblies' high radioactivity would make them difficult to handle. The main barrier to accelerator-bred nuclear fuel is presently the high cost of accelerator devices.

Services

Energy Information Service librarian Carol Rouse has made a survey of **energy-related materials of use to teachers.**

A limited collection of energy teaching materials are assembled under the heading of curriculum materials in the Energy Information Service. Teachers are encouraged to use the material by visiting the Energy Information Service, located in room 140 of the Engineering-Science Building on the northeast side of The University of Texas at Austin campus. Hours are 8 a.m.–5 p.m. Monday through Friday and 10 a.m.–1 p.m. Saturday.

Types of materials—brochures, curriculum guides, bibliographies, films, videotapes, activity guides, posters, books. (Audiovisual materials are described in lists and brochures; no examples are on hand.)

Sources of free, multiple-copy materials—state and federal government agencies, associations, corporations.

Appropriate classes—kindergarten through twelfth-grade classes in science, social science, government, economics, home economics, geography, civics.

The results of the survey were displayed June 4–6 in the Third Annual Conference on Free Enterprise Education at The University of Texas at Austin.

Solar Studies

Dr. John Howell, mechanical engineering professor, was appointed April 26 to the **Austin Renewable Energy Resources Commission.**

As a member of the advisory commission, Dr. Howell will participate in creating a comprehensive plan for supporting the maximum use of renewable energy resources, especially solar, in the city of Austin.

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UT Austin Energy

Council on Energy Resources Analyzes National Energy Policy

An analysis of national energy policy by University of Texas energy experts has earned praise from Texas Governor William P. Clements, who said he would be "doing a lot of talking" about the report in the months to come.

In a press conference May 17 Governor Clements said the fifty-page document does a good job of explaining the Texas position on energy, which emphasizes that the nation should increase its domestic energy production as an effective response to many of its energy problems.

The report, *National Energy Policy Issues,* was published by the UT Council on Energy Resources and drafted by Dr. William L. Fisher, director of the UT Bureau of Economic Geology, and Dr. Walt W. Rostow, professor of economics and history. It is based in part on research and analysis by other UT faculty and staff, including four members of the Center for Energy Studies: Drs. H. H. Woodson, Hal B. H. Cooper, Jr., Jerold Jones, and Dale Klein.

Dr. Fisher, chairman of the Council on Energy Resources, said at the press conference that the United States is entering into a "tight situation" because the nation's energy production has stagnated over the past two years and because future production from the OPEC countries will fall below levels anticipated in 1977.

In the report prepared for the governor, the UT professors state:

"We may now be at the outer edge of the long-predicted energy crisis of the 1980's. . . . In our judgment, the United States, Western Europe, and Japan confront the gravest economic-strategic crisis since the 1930's. Since the autumn of 1973, we as a nation have substantially wasted 5½ years dealing with the energy problem."

Although their report stresses the need for increased energy production, Dr. Rostow said he is not against conservation, or solar power. But, he said, solar power will not be able to meet the massive energy requirements of the nation in the near future.

The recommendations in the report include:

- Increased domestic production of oil and natural gas, including a prompt move to produce oil and gas from coal and shale and the underground conversion of coal into natural gas.
- Swift deregulation of oil and gas prices with full plowback of windfall profits into energy research and development. Under the Carter Administration's proposal, 50 percent of the profits would go to the federal government for assistance to low-income families and for mass transportation. Dr. Rostow said the issue of oil profits has been "unnecessarily inflamed politically" and that there is no way to have "too much energy investment."
- Vigorous development of other energy sources such as liquid and gas synthetics, unconventional sources of natural gas, and geothermal energy.
- Prompt and definitive resolution of energy-environmental conflicts that affect production of coal, nuclear power, and outer continental shelf petroleum.
- Creation of a National Energy Development Bank, a form of government and private collaboration similar to the Reconstruction Finance Corporation of forty years ago which generated the synthetic rubber industry during World War II.

A limited number of copies of the report, *National Energy Policy Issues,* are available from the Council on Energy Resources, Box X, University Station, The University of Texas at Austin, Austin, Texas 78712.

Three Professors Developing Model of Oil Spill Drift

Three civil engineering faculty members are participating in a large study aimed at **predicting the behavior of oil spills** in the open ocean.

The project is sponsored by the National Oceanic and Atmospheric Administration. The aim of the project is to develop improved means of predicting the behavior of large oil spills.

Profs. Kenneth H. Jehn, Norman K. Wagner, and Richard W. Miksad have nearly completed the project, which includes the development of a computer model that will predict speed and direction of oil spill drift, which is primarily influenced by wind and ocean currents.