erocallis fulva) and a colony of the tiger lily (*Lilium tigrinum*). His curiosity, aroused by this observation, persisted through the years and led him to undertake extensive studies on sterility and fertility of flowering plants, including the day lily.

Dr. Stout's early major interests included ornithology and archeology, and his decision to pursue botany as a career was not made until he graduated from the University of Wisconsin. This decision was greatly influenced by R. A. Harper, then professor of botany at Wisconsin, and by Zelda Judd Howe, who became Mrs. Stout in 1909.

The 36 years he spent at the New York Botanical Garden were mainly devoted to research on plant breeding, cytology, and genetics, with particular reference to the problems of sterility and fertility of seed plants. He investigated various aspects of the breeding of apples, avocados, cherries, chicory, Chinese cabbage, coleus, day lilies, dates, grapes, lilies, lily-of-the-valley, lobelia, moss pink, narcissus, Norway maple, pears, petunias, poplars, white potatoes, and sweet potatoes.

An investigation of the irregular fruiting of avocado in California and in Florida resulted in the discovery of an extraordinary mechanism of cross-pollination. For seven years, beginning in 1924, he planned, directed, and (with E. J. Shreiner) participated in an extensive program of hybridization of the poplar tree, producing some hybrids with notable hybrid vigor. Studies of the sterilities of the white potato were carried out in cooperation with the U.S. Bureau of Plant Industry; some of the work was done at Presque Isle, Maine. In cooperation with the New York State Agricultural Experiment Station at Geneva, Dr. Stout began an investigation of seedless grapes, in 1919, which included studies of the nature of seedlessness and its heredity and breeding for hardy seedless grapes. These studies were continued until his retirement and resulted in the production of numerous seedlings with seedless or near-seedless berries, some of which evidenced considerable hardiness and promise for commercial use. His investigations of the day lily (*Hemerocallis*), begun in 1911 during his first year at the New York Botanical Garden, were continued throughout his life. They included studies of the taxonomy of the genus, interspecific hybrids, comparative cytology of species and hybrids, self- and cross-incompatibilities, and the selection of seedlings for garden culture. His investigations, besides contributing to knowledge of the phenomena of sterilities and the complexities of their genetics, transformed the day lily from a minor garden plant to one of the most varied and reliable of perennials. The results of his work were published in some three hundred and fifty papers.

After his retirement, he served as a consultant to seed growers, continued his breeding of *Hemerocallis,* published a monograph on *Petunia,* and engaged in a comprehensive study of *Rubus.*

All who knew him were aware of his dedication to science. Hours meant nothing to him. He asked only for the opportunity to devote his energies to those important unsolved problems which had aroused his curiosity. While deeply concerned with the theoretical and basic aspects of cytology and genetics, he appreciated the applied aspects of plant breeding and, like Pasteur, never hesitated to investigate a problem of practical importance, carrying the research as deeply into the fundamentals as time and facilities permitted.

Dr. Stout participated in the activities of the community in which he lived, and his sterling qualities, as a man as well as a scientist, were appreciated by his friends and neighbors, as well as by his colleagues.

He is survived by his wife; a daughter, Elizabeth B. Rausch of Orlando, Florida; a brother, C. D. Stout; and a granddaughter.

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News of Science

Geothermal Power in California

Just a few miles north of Santa Rosa, Calif., at Big Geysers, a concern calling itself the Thermal Power Company is engaged in the somewhat exotic business of drilling bores in the rock to tap subterranean steam with a view to harnessing this natural energy for the production of electrical power. This concept of the economic development of geothermal energy is relatively new, for natural steam emanating from the earth in the form of geysers and fumeroles has been regarded traditionally as a scientific curiosity, and regions exhibiting such phenomena have been set aside as parks and tourist attractions. But in the last few years, a number of nations in many parts of the world have been re-evaluating their thermal areas as something more than mere spectacular scenery. For in our modern mechanized society with its great dependence on fossil fuels as energy sources, the doubling and redoubling of power requirements in the postwar years has placed a heavy strain on these patently exhaustible resources. As a result, energy sources which are essentially inexhaustible, such as falling water, nuclear fission, and geothermal steam, are receiving increased attention.

The theory supporting contentions that subterranean steam is a virtually inexhaustible resource is based on the conversion of both meteoric water and magmatic water to steam. Meteoric water, or ground water, contacting hot rocks near the surface is commonly held responsible for geyser phenomena and is certainly accountable for the occurrence of large quantities of steam; but it is magmatic water, reckoned at about 10 percent of the superheated earth's core and released upon cooling and crystallization of magma into igneous rock, that makes up the bulk of the steam reserve. Taking both of these sources into consideration, Italian scientists at Lardarello, Tuscany, where the pioneer project of this type has produced power for many years, have estimated that at the present rate of energy withdrawal from the proven geothermal area, reserves are sufficient for another 11,000 years.

However, despite the success of the Italian development and its expansion following the war, little attention had

been paid to geothermal development until very recently, when a major project was begun in New Zealand [*Science* **126**, 440 (6 Sept. 1957)]. Taking advantage of an extremely favorable set of natural and economic circumstances on the North Island, the New Zealand government in 1950 launched a widely publicized program to utilize geothermal steam to produce electric power on a large scale. The apparent success in New Zealand (the schedule calls for initial power deliveries this year) triggered a rash of exploration and development schemes in a number of other widely scattered locations around the world. In Mexico, Iceland, El Salvador, Chile, Fiji, the British Windward Island of St. Lucia, and at the aforementioned Big Geysers, drilling programs are in the planning stages or already underway.

The "hot land" at Big Geysers involves 3200 acres extending for about 5 miles along the north side of a fault-line canyon. The release of pressure on the magma below at the time of faulting undoubtedly accounts for the presence of hot rocks relatively near the surface. Proving the presence of steam at a very shallow depth are five active fumerole areas and eight 500- to 600-foot wells drilled with primitive equipment in 1923–25 by a group of local men (among them, the late Luther Burbank) which are today still issuing steam with undiminished force. In 1955, leasing the land from the owners, Geyser Development Company, the Magma Power Company of Nevada drilled a test hole to a depth of 603 feet and also encountered steam. But financial difficulties retarded further exploration. In late 1956 Magma entered into a contract with the newly formed Thermal Power Company under which Thermal agreed to invest a minimum of $230,000 in test drilling, thereby acquiring a one-half interest in the lease. As it stands at the moment, Thermal is about to put down its first deep well, utilizing modern equipment of the type that has plumbed depths of from 1000 to 3000 feet in Italy and New Zealand. To supervise the operation, the company has retained as its consulting engineer Earl P. English, formerly vice president of Bechtel Corporation and consultant for Bechtel in recent drilling of New Zealand wells.

The Big Geysers project is still in the early, speculative stage and the aim is merely to test the energy potential of the property by drilling at many different locations and varying depths. Only after the results are in on this exploration and testing can plans be forthcoming for the economic utilization of the steam. Nonetheless, close observers exhibit a cautious optimism, pointing out that the eight old shallow wells, together with Magma No. 1, are blowing an estimated 6000 kilowatts of energy into the air; to duplicate this in a modern power plant would require the burning of 240 barrels of fuel oil or 1,444,000 cubic feet of gas per day. Temperatures at the 600-foot level have been determined at 600 degrees, and if the heat gradient continues to rise in proportion to depth, 1000- to 1500-foot bores might be expected to have very high temperatures and yield at least the equivalent of 4000 kilowatts per well (New Zealand wells have averaged 6000 kilowatts). So far Big Geysers steam, even for existent shallow bores, has proved to be dry, in contrast to the wet steam found in other areas; wetness constitutes a turbine corrosion hazard. Further, engineering reports on the region state that wells can be drilled as close together as 150 feet without reducing the production of their neighbors, and that the ultimate potential of the property could easily exceed 30 wells, or 100,000 kilowatts, should a substantial portion of the property prove productive.

If such results can be achieved, geothermal steam can compete very favorably in power production. For despite the large hydroelectric projects, both planned and under construction, California is very likely to continue chronically power-short as her population and industrialization maintain their phenomenal rate of increase. Geothermal steam shares with all other energy sources generating electric power the 300- to 400-mile transmission limit due to line loss, but it has a double advantage over hydrogeneration in not being subject to the vagaries of seasonal stream flow or the conflicting water requirements of irrigation vs. power development. Similarly, the sharp increases in fuel prices in the past few years, plus the need for boilers, which constitute 30 to 40 percent of overall power-plant costs, give geothermal steam a real advantage over standard thermal plants.

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Physical Review Letters

The *Physical Review* has announced that, beginning with the 1 July issue, "Letters to the Editor" will no longer appear in the *Review* but will be published in a supplemental semimonthly journal tentatively called *Physical Review Letters*. Because offset printing will be used, it will be possible to publish letters within 2 to 3 weeks after receipt instead of the present 6 to 10 weeks. The new *Physical Review Letters* will also contain abstracts of *Physical Review* articles that are scheduled for future publication.

Initially *Physical Review Letters* will be sent to all subscribers of the *Physical Review*. However, beginning in January 1959, a subscription price of $5 for members of the American Physical Society and $10 for nonmembers will be charged. At that date the publication charge in *Physical Review Letters* will be set at $30 instead of the present $25 per page.

A fast-publishing journal such as *Physical Review Letters* may become very popular with authors and could soon grow beyond reasonable bounds. Therefore the same strict standards that are now in operation for "Letters to the Editor" will be maintained for the new publication. It is expected that, on the average, only about 15 letters will be acceptable for each issue. "Letters" will be accepted only if they contain important new discoveries or deal with topics of high current interest in rapidly changing fields of research. All other contributions, no matter how short they may be, should be submitted for publication as articles in the *Physical Review*. Subscriptions for the new journal will be handled by the American Institute of Physics, 335 E. 45th St., New York 17, N.Y.

Suggestions on Undergraduate Biology Courses

The Committee on Educational Policies of the Division of Biology and Agriculture, National Academy of Sciences–National Research Council, has recently published reports on new approaches to the teaching of systematic botany and parasitism. The studies were prepared (with the aid of a National Science Foundation grant) to test an idea for meeting the recurrent problem of keeping teaching abreast of scientific advances [*Science* **125**, 809 (26 Apr. 1957)]. One method, the committee suggested, is to invite an *ad hoc* panel of competent individuals, each expert in a different branch of a given subject, to redefine course objectives and content. This tactic merely adapts the research symposium to consideration of teaching problems, with the hope of encouraging continuing experimentation and re-evaluation in teaching by individual instructors.

Members of each panel found, despite wide initial differences of view, that they could develop interesting new syntheses of content, with suggestions for adaptations to different teaching situations. The botanical report (published in the *Plant Science Bulletin*, January 1958) takes a broad view of systematic biology that should also interest zoologists. The parasitism report (published in the *Journal of Parasitology*, February 1958) looks toward a basic course on the biology of parasitism. More generally, the committee believes that the reports illustrate the