

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 kilo-

watts 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.

MICHAEL P. MCINTYRE

Department of Geography,  
San Jose State College

### 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