successfully reared second litters, weaning 9 out of 11 young born alive on the 135th day of subsistence of these mothers on Diet A–2. Obviously the stock diet fed to these mice (Nos. 8 and 12) prior to the start of the feeding experiment in which Diet A–2 has been used, can not be regarded as playing a role in determining the success in reproduction and lactation of these mice with their second litters.

It is interesting to note, in reporting our success with the C_{57} mice, that there may be a strain difference in mice as regards reproduction and even continued maintenance of life on artificial diets, since attempts to duplicate our results using Diet A–2 and a different strain of mice have been unsuccessful to date.

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FERTILE TETRAPLOIDS OF SESAME, SESAMUM INDICUM LOEW, INDUCED BY COLCHICINE

Sesamum indicum Loew is a plant of the family Pedaliaceae which originated in tropical Asia and has been cultivated since ancient times for the high quality oil of its seeds. Although it has been used in all the tropical and subtropical countries for so many years, it is known only in its diploid form of 26 chromosomes.

In September, 1940, the axillary buds of some sesame plants were treated with 0.5 per cent. colchicine in lanolin and others with 0.4 per cent. colchicine emulsion.[1] With either of the two preparations severe burning and dying back of the leaves occurred, followed by the formation of callus-like tissues and new buds.

When new branches developed the four-celled mucilage-producing glands of the leaves were larger on some than on others. Leaves with larger glands had correspondingly larger but fewer stomata than those with smaller glands. Chromosome counts in the pollen mother cells of the branches with large glands revealed that a few of them had the tetraploid number, 52, while others had between 26 and 52. Some of the branches with 52 chromosomes were fertile. It is highly probable that if only a small number of plants had been treated with colchicine, no fertile branches would have been obtained.

Most of the normal branches were severed, but a few were left to furnish material for a direct comparison between fertile tetraploids and diploids on the same plant. The data in Tables 1 and 2 were obtained from 20 of these plants.

TABLE 1

Type of branch	Number of glands per cm^2 of leaf area	Size of glands	Total volume of glands per cm^2 of leaf area
	per cent.	per cent.	per cent.
Diploid ...	100	100	100
Tetraploid.	68	264	180

TABLE 2

Variety	Type of branch	Average number of seeds per pod	Average weight of 1,000 seeds	Average weight of seeds per pod	Comparative weight of seeds per pod
			grams	grams	per cent.
Jaffa	Diploid	91	3.41	0.310	100
	Tetraploid	90	5.04	0.454	146
Colombiano	Diploid	58	2.60	0.151	100
	Tetraploid	55	4.23	0.233	154
Criollo	Diploid	55	2.56	0.141	100
	Tetraploid	56	4.12	0.231	164
Selection 3	Diploid	53	2.58	0.137	100
	Tetraploid	52	4.19	0.218	159

The average increase in size of seeds obtained by doubling the chromosome number was 56 per cent. There was no reduction in the number of seeds per pod nor in the number of pods per branch.

By subsequent colchicine treatment, hybridization and selection, haploids, diploids, triploids, tetraploids, hexaploids and octoploids have been obtained. Field tests of the comparative seed yields, quantity of mucilage, and per cent. of oil of the various types have not yet been completed.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A MODEL GEYSER

GEYSERS, which are special types of hot springs that gush or erupt into the atmosphere at various intervals, are one of the most intriguing of natural phenomena and have held the interest of geologists and laymen alike for many years. As a result of this interest, many theories and modifications have been presented to explain the cause and manner of the eruptions. In addition, there have been a number of experimental geysers constructed throughout the last 100 years,

[3] The expenses of this investigation were defrayed in part by a grant to G. R. C. from the Research Fund of the Yale University School of Medicine.

[1] Prepared by L. F. Randolph, of the Department of Botany, Cornell University, and Division of Cereal Crops and Diseases, Bureau of Plant Industry, Washington, D. C.

more or less. Some models have worked directly on, or upon some modification of, the most widely accepted geyser principles, whereas others have been merely jets of water or steam thrown into the air at intervals by some foreign influence.

Allen and Day[1] recently studied the hot springs, including geysers, of Yellowstone National Park and have not only presented some interesting new facts, but have also entered into a thorough discussion of older theories and observations. The reader is referred to their work for a concise discussion of geyser principles and occurrences.

In general, the recognized requirements for continued geyser action are: (1) A subterranean chamber connected by a tube vent or orifice with the surface of the ground. (2) A heat supply in excess of the surface boiling point temperature of water. (3) An intermittently replenished inflow to the heating area and tube vent of water which is cooler than boiling temperatures.

When the construction of a working model was undertaken by the authors, several disadvantageous conditions became apparent, namely, (1) specific literature and statistical data on geyser model construction are sparse and not readily available; (2) models, observed by the writers, generally were built so that they had little or no semblance to natural conditions and usually required an outside stimulus in operation or; (3) the expense and involved apparatus used in working models that did partially approach natural phenomena were prohibitive of simple and cheap construction. Proceeding on the lines, therefore, that the desired objective was a model which would simulate, as near as possible, the field characteristics of most geysers and which, at the same time, would be relatively inexpensive and easily built, the model construction herein described was undertaken.

Landscape: The landscape, which also acts as a catchment basin, and returns ejected water to the system, measures 5 feet by 5 feet in plan dimension. It was built on a 3-ply veneer wood base (salvaged packing box) to which 1-inch by 2-inch cleats were fastened on the underside for stability and for a foundation so that the sides, made of 1-inch by 4-inch boards, could be nailed securely. Three holes were drilled in the central area of the box-like structure thus formed, and into these a vent pipe (glass tube) and two glass drainage funnels were inserted. Wet excelsior, that had been soaked in a very thin mix of plaster of paris, was then placed in the box and was shaped into the desired topography. This, in turn, was covered by wet burlap cloths and over the cloths a heavy, thick plaster of paris coating was applied and smoothed out to conform with the previously formed relief. Care was taken to insure that the drainage funnels were at the lowest elevations of the landscape and that the geyser orifice was relatively high.

After the plaster had set for 24 hours, the first of a series of 6 coats of shellac were applied to the modeled surface. Possibly it was not necessary to apply this number of shellac thicknesses, but, in so doing, a sufficiently tough skin was developed to withstand continual drenching by the hot waters for a period of 14 hours without appreciably softening the underlying plaster.

Inasmuch as all other necessary details of the construction and geyser set-up are shown on the accompanying sketch (Fig. 1), they are not repeated here.

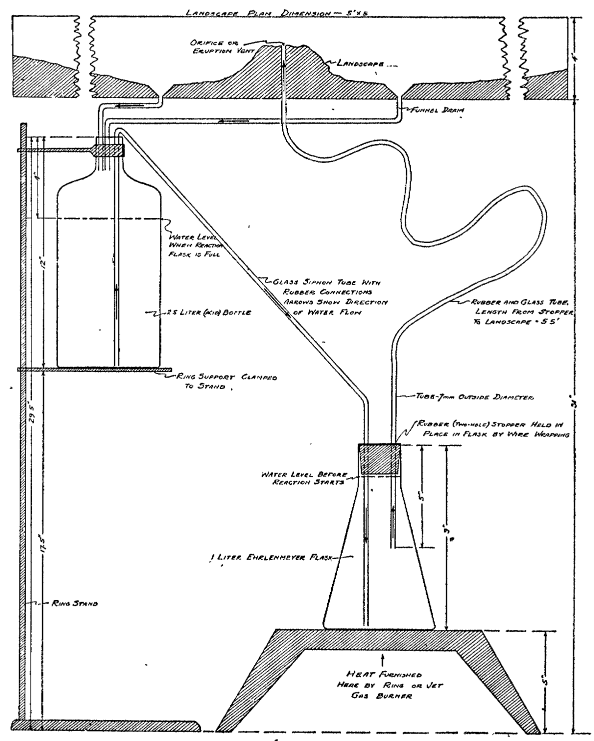

FIG. 1. A model geyser.

When the geyser is "playing," hot water and steam are ejected every 1.5 minutes approximately to a maximum height of 3.5 feet. The period between eruptions varies slightly with the temperature of the water system. When the circuit becomes heated to a uniform temperature through the continued return of warm water which has been ejected, the eruption period becomes stabilized. 15–20 cc of water must be added to the system about every hour in order to replace that which has been discharged and lost as steam. The new water is introduced by simply pouring it out over the landscape where it enters the circuit through the drain funnels.

[1] E. T. Allen and Arthur L. Day, Publication No. 466, Carnegie Institution of Washington, pp. 171–231, 1935.

Delicate adjustments of conditions must be established for satisfactory operation of the model, but fortunately they can be made readily and with ease as the equipment is being put into operation. For instance, the height of the reservoir above the heating chamber and the heat applied are variables that must be controlled. That is, under a given heat constant the reservoir can not be too high or proper siphoning action will not develop and continual steaming of the heating chamber will result. Conversely, if the reservoir is too low there may not be enough back pressure to cause an eruption through the orifice and a bubbling back into the reserve water may ensue. The adjustments can be made by raising or lowering the ring stand, or the heat may be increased or lessened, or both reservoir height and heat may be varied. The reservoir can not, of course, be elevated above the landscape in this model (see Fig. 1).

Since different atmospheric pressure conditions will govern the particular interrelations of heat, water supply, etc., no studies of the operating temperatures and gas consumption were made. These factors are largely dependent upon the altitude of the locality in which the model is operated, and, therefore, should be expected to vary somewhat.

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ORIGIN OF DIPEPTIDASE IN A PROTOZOAN

PARAMECIUM is apparently the sole diet of the ciliate *Didinium nasutum.* Dipeptidase extracts from both organisms show identical pH optima (7.4–7.6) for the hydrolysis of alanylglycine. When deprived of food Didinium continues to divide, but there is no change in the quantity of dipeptidase present. For example, a parent Didinium has exactly twice the enzyme content of each of its daughter cells and four times that of each of the cells produced by the succeeding division. *Paramecium multimicronucleatum,* which is somewhat larger than the largest Didinium, is entirely ingested by Didinium in about one minute. Immediately after ingestion a single large food vacuole is present in the Didinium and this vacuole divides into a large number of small ones in about twenty minutes. Morphological changes indicating digestion of the Paramecium occur rapidly.

High values for the dipeptidase content of *P. multimicronucleatum* were obtained by the addition of liberal quantities of dried brewer's yeast to a previously boiled hay infusion. The enzyme content of single individuals of *P. multimicronucleatum* was readily determined, but marked variations between individuals are usual. Thus, individual variations in physiological condition as well as in size make the selection of quantitatively uniform individuals infeasible.[1] Greater uniformity could be obtained with genetically pure strains of *P. aurelia* supplied by T. Sonneborn, but the enzyme content of these was too low for this work.

When single didinia were fed single paramecia and left for various time intervals up to four hours, the enzyme content was consistently found to equal the sum of that of predator plus prey within the range of individual variation of the paramecia (the enzyme content of the didinia can be predicted precisely). The dipeptidase content of groups of twenty-five organisms from single cultures of each species is quite constant. When twenty-five *Paramecium multimicronucleatum* were added to a drop containing twenty-five hungry didinia, the paramecia were all eaten in about one half hour, some didinia eating two and some none. When such didinia were left for four hours and the dipeptidase content then determined, it was found that the enzyme content was equal to that of the original didinia plus that of the ingested paramecia. Uniform extraction of the dipeptidase and sterility of the extract was obtained by repeated freezing and thawing with dry ice. This procedure does not impair the dipeptidase activity. It is to be borne in mind that the methods employed show the enzyme content of the cells and do not indicate the intracellular enzyme activity. In view of the digestion time allowed (about the duration of one cell-generation) one may conclude either that Didinium dipeptidase is synthesized at exactly the same rate that paramecium dipeptidase is being destroyed or else, and more probably, that paramecium dipeptidase is taken over quantitatively by Didinium.

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[1] H. Holter and W. Doyle, *Jour. Cell. Comp. Physiol.,* 12: 295–308, 1938.

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