legislation in California are discussed. A review of the present interstate quarantines applying to California is presented, together with recommendations as to the maintenance or abolishment of each measure. There is an extensive bibliography and a thorough index.

It is an admirable report. Nevertheless the reader will do well to bear in mind the background from which it has emerged, not only as a justification for at times interpolating a bit between the lines, but as a basis for appreciation of what the committee has accomplished. The agricultural authorities of the state of California were pioneers in the development of the idea of plant quarantine and the application of quarantine legislation. As a result of years of such training faith has been deeply implanted and firmly rooted in the minds of California agriculturists that such measures are vital to their very existence. Under such circumstances, for an officially appointed California committee, composed of members who have imbibed a belief in quarantine almost with their mothers' milk, to have presented an unfavorable report would be almost unthinkable. On the other hand, it is a tribute to the intellectual honesty of the members of the committee that the reviewer—an avowed enemy of the quarantine system—can think of no critical phrase to apply to the report more condemnatory than "unduly cautious."

An uncompromising critic may be justified in pointing out that by the initial limitation of subject-matter the committee escaped the necessity of dealing with some disagreeable things and that in making their recommendations they have at times stopped somewhat short of entirely logical conclusions and have expressed themselves with much less emphasis than might reasonably have been employed.

For example: The principle that quarantines must depend upon natural barriers is definitely recognized (p. 94) in the remark that ". . . ordinarily a plant quarantine can be considered sound only when supported by an effective barrier to natural dispersal." It is clear that few existing interstate quarantines are supported in any considerable degree by such barriers. The logical conclusion that such quarantines should be placed in the hands of a federal agency and established along natural lines of defense rather than along purely artificial political boundaries is discussed (p. 117). But the committee goes no farther than to recommend (p. 253) that interstate quarantines be subject to review and disapproval by the Federal Secretary of Agriculture.

One other such case: The state of California has long maintained a quarantine against the alfalfa weevil, a quarantine that was not long since lauded by a former state director of agriculture as having stopped the insect at the state line. But the weevil has been found in California, widely distributed behind the quarantine lines and has probably been in the state for some time. It is evident that, coordinate with the quarantines, there should be set up an extensive and effective scouting service if the quarantines are not at times to assume a more than faintly ludicrous aspect. Attention is called to these circumstances (p. 136) and such a service is recommended, but not—in the reviewer's opinion—with the emphasis and prominence that would have been justified. In fact, one can not escape the feeling that the conspicuous failure of this quarantine, a failure that was inevitable and that now appears unimportant, has been "soft pedalled" just a wee bit in the report. It was an impossible quarantine to begin with and should frankly be jettisoned without the qualifying "if . . . within a few years . . ." (p. 197).

But criticisms such as this should not be allowed to detract from respect for the important work that the committee has done. Opponents of the quarantines at least can no longer say that no careful study has been made. Nor can they say that supporters of the quarantines never recommend the rescinding of a measure that has proven unnecessary. The committee has definitely recommended the abolition of three and is evidently lukewarm about some others. This is making progress.

Furthermore, the committee has recognized the need for deeper study of the problems of plant quarantine and has urged that such studies be made. Their report should serve as an excellent beginning, for they have touched in at least some degree upon practically every phase of the subject that one can suggest and have to at least some extent illuminated each.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A METHOD FOR STUDYING DROUGHT RESISTANCE IN PLANTS

THE best measure of the drought resistance of a plant according to Maximov,[1] is its capacity to withstand permanent wilting. It is practically impossible to use this criterion for the study of drought resistance of plants having leathery, sclerophyllous or needle-like leaves. For conifers it is not only difficult to recognize the incidence of wilting but even impossible to determine the onset of death. Any one can

[1] N. A. Maximov, "The Plant in Relation to Water." Translated by R. H. Yapp. London, 1929.

readily distinguish between fresh flexible needles and dry brittle ones, but the determination of any definite intermediate stage is liable to great human error. It is desirable, therefore, to develop a method—which will be as free as possible from errors of human judgment—and which, furthermore, will subject the plants in question to a condition of drought somewhat similar to that encountered in natural habitats.

In temperate regions of average precipitation drought usually occurs in the form of a few days with hot dry winds, following a period of deficient rainfall. Accordingly, a simple machine was devised for subjecting plants to atmospheric drought. This consisted of a closed illuminated chamber inside which potted plants rested on a table revolving over trays of calcium chloride. Trials in this chamber gave gratifying results. The species supposed to be most drought-resistant endured longest in the drought chamber.

A more elaborate machine provided with temperature control was next constructed. This machine consists of an illuminated chamber with revolving table, through which air, dried by calcium chloride, is forced (Fig. 1). The desiccating chamber is illuminated by two 50-watt mill-type incandescent lamps. Dry air enters at the top, passing over wet- and dry-bulb thermometers and an electric heating element. The heating element is turned off and on by a toluene-mercury thermo-regulator operating through a 2-pole relay. A transformer 110–20 volts provides low voltage current for the mercury switch. The revolving table is supported by two opposed vertical and radial thrust type ball-bearings. Power is supplied by a one fourth horse-power motor through a reducing gear. Potted plants are placed on the revolving table, which has a 4-inch rim of 2-mesh hardware cloth. The table turns at the rate of 35 revolutions per minute. Access to the plant chamber is through a 12-inch door having a glass window.

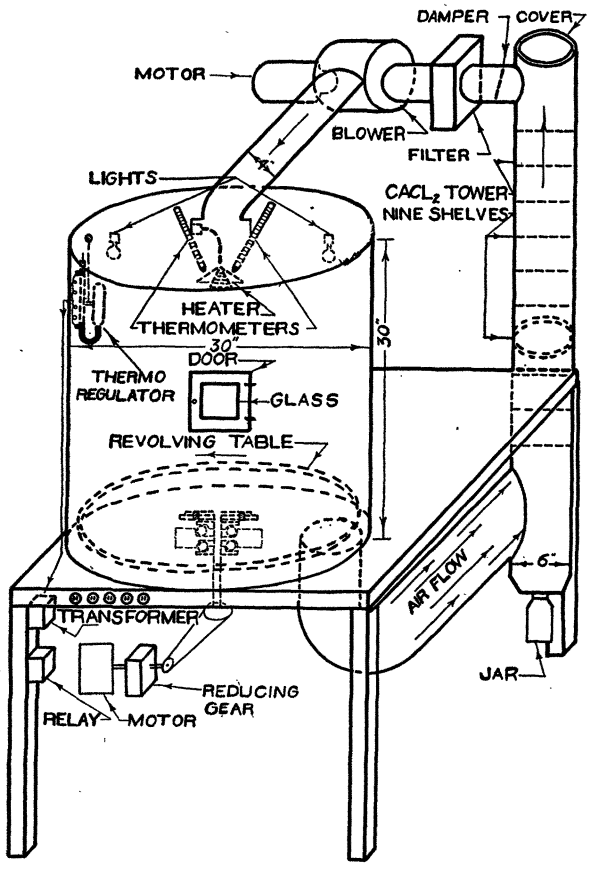

FIG. 1. Diagraphic drawing of apparatus for testing drought resistance.

After leaving the plant chamber the air enters the lower part of a tower containing nine wire shelves filled with calcium chloride. These shelves are supported on a rack, which may be removed bodily. Two racks of shelves are provided so that the calcium chloride may be quickly changed after it has absorbed too much moisture to function effectively as a desiccant. The tower, rack and trays are of copper. A removable glass jar is provided at the base of the tower for collecting dissolved calcium chloride. After leaving the tower the air passes through a filter of glass wool, thence through the blower and into the plant chamber.

The toluene thermo-regulator is sensitive to a change in temperature of a fraction of a degree and may be set for any value desired. The effectiveness of the calcium chloride in removing moisture from the air depends upon how dry the salt is. In its anhydrous form it is very effective. For rapidly moving air a large surface of the desiccant must be exposed. The air velocity is such that a complete air change occurs inside the chamber every 20 to 30 seconds.

It is assumed that the severity of the drought conditions is, with other conditions constant, a function of the evaporating power of the air or saturation deficit. Accordingly, most plants are tested at 35 to 40 degrees C., a temperature which the plants are apparently able to withstand, and which with low humidities gives a high saturation deficit.

The plants to be tested are weighed, selected for uniformity and potted in tin cans with a weighed amount of uniform fine sand. After allowing two to four weeks, or more, for the plants to become established, the cans are filled from below to a definite moisture content, sealed with paraffin and placed in the desiccating chamber. The machine is run con-

tinuously until all the plants are dead. The length of time each plant survives is used as a criterion of drought resistance, together with the moisture content of the soil at death. Ordinarily only a few plants remain alive until they have exhausted the soil moisture to critical values.

A description of a sample run follows. The plants tested were white spruce, *Picea canadensis,* of three different classes, *viz.:* 2–0 (two-year old seedlings), 3–0 (three-year old seedlings) and 2–1 (three-year old trees which have had two years in the seed-bed and one year in the transplant bed). Ten plants of each class were used. The temperatures averaged 38 degrees C. and the relative humidity about 10 per cent. The soil moisture at death was above 14 per cent. for all pots. The results are shown in Table 1.

TABLE 1

Class of stock	Number of days surviving	
	Mean	Standard error
2–0	20.2	1.2
3–0	21.4	1.5
2–1	13.2	.9

In this case the transplant stock proved to be far less resistant to atmospheric drought than either of the two classes of seedlings.

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A MODIFIED SABOURAUD MEDIUM SUITABLE FOR CULTIVATION OF ACID-FAST ACTINOMYCETES

THE study of five strains of Actinomycetes isolated at this hospital during the past four years from the blood of patients suffering both from acute and chronic ailments, has demonstrated the practical value of a simple medium such as Sabouraud's. By means of a modified formula for this medium one strain of Actinomycetes was found to be acid-fast, although it was non-acid-fast on such media as standard Bordet-Gengou, potato, synthetic phosphate and Difco Sabouraud.

The formula which we employ consists of 4 per cent. maltose, 1 per cent. Difco peptone, 1.8 per cent. flaked agar dissolved in unfiltered beef heart or veal infusion instead of water. No adjustment in reaction is made. Glycerine and other carbohydrates may be added if desired. Slanted agar favors development of acid fastness in about four days. A grayish brown powdery substance develops upon the upper portion of the slant simultaneously with the appearance of the acid-fast portions of growth.

The strain was isolated from the blood of a case of acute mastoiditis complicated by sinus thrombosis, septicemia and arthritis. The acid-fast component appeared in young cultures (seventy-two hours) on this medium as branching non-acid-fast mycelia containing acid-fast pleomorphic portions. Old cultures consisted of non-acid-fast oval components and mycelia interspersed with acid-fast oval-shaped components. The acid-fast characteristic was inhibited on all other media. The other strains of Actinomycetes were consistently non-acid-fast on all media employed so far.

Sabouraud's medium, in which unfiltered meat infusion is employed in place of water, is therefore recommended for cultivation of Actinomycetes isolated from human tissue. An attempt is being made to standardize this type of unadjusted unfiltered medium.

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SPECIAL ARTICLES

EXPERIMENTAL ANALYSIS OF VITO VOLTERRA'S MATHEMATICAL THEORY OF THE STRUGGLE FOR EXISTENCE

IN the last four years I have carried on an experimental investigation of the processes of the struggle for existence among unicellular organisms. Experiments on the competition between two species for a common place in the microcosm agreed completely with Volterra's theoretical equations, but as regards the processes of one species devouring another our results are not concordant with the forecasts of the mathematical theory. All this extensive experimental material is described in my book on "The Struggle for Existence," which is now ready for publication. Since, however, this book will appear only after some time, I am taking the liberty of communicating here briefly the main results of our investigations.

The competition between two species for a common place in the microcosm may be either (1) a competition for a certain fixed and limited amount of energy, or (2) a competition for a source of energy kept continually at a certain level. In order to investigate the first of these problems experiments were made with two species of yeast cells producing alcoholic fermentation: *Saccharomyces cerevisiae* and *Schizosaccharomyces kephir.* If we calculate the coefficients of multiplication in these species, and if by studying the factor which limits their growth (alcohol produc-