fluence such as well. Thus the maximum temperature for root growth of *Opuntia versicolor* is about 42° under normal conditions of aeration, but when the percentage of oxygen is reduced to 1.2 no growth occurs at 30° although it may go on at 20°. This being the case, both the optimum as well as the maximum temperature for growth are greatly reduced.

The optimum temperature for the growth of the shoot in corn is about 33.7° and the maximum temperature is about 46.5°, while the corresponding temperatures for the root are probably somewhat less. In percentages of oxygen less than 10, and except as indicated above, and for soil temperatures below 30°, the growth rate is below normal. However, in 3.6 per cent. oxygen the most rapid growth rate is about 30°, but when the amount of oxygen is reduced to 3 per cent., 20° is apparently about the optimum temperature for growth.

Observations on the relation of the roots of the Rough lemon to the oxygen supply at relatively low soil temperatures indicate that the minimum temperature under certain conditions may also be modified. The Rough lemon has apparently a fairly high minimum temperature for root growth, or at least the rate of growth under normal conditions of soil aeration is relatively slow at 18° C. In 2 per cent. oxygen, however, although growth continues at 26° and at 22°, it does not go on at 20° or at 18° C. In this instance the minimum temperature for growth may have been raised.

The observations above summarized on the relation of root growth to the oxygen supply are apparently in accord with the known variation in the respiratory ratio (of the shoot) which is associated with differences in temperature, being least at those that are medium, that is 15° C., or less.[1]

The ecological bearing of the influence of the temperature of the soil on the oxygen relation of roots can only be suggested. The ecological significance of soil aeration has been referred to in an earlier paper[2] and it need merely be suggested in this place that the oxygen relations of the species with especial regard to the temperature of the soil should also be taken into account. It is quite clear from the summary above given of typical results in relation to several species, and which can probably be extended to other species as well, that in puddled soils with consequent poor aeration, and in summer, the matter of oxygen supply to the roots must be acute. And, in certain species, as, for instance in varieties of corn, in order to attain to a fair rate of root growth at a time of high soil temperatures the aeration of the soil must be good indeed, otherwise, as shown in another paragraph, the rate of growth is very considerably cut down.

The conclusions arrived at and as reported in this notice offer additional reasons for extensive studies on the temperature-aeration relations of the soil, and suggest the desirability of intensive investigations on the oxygen relation of roots as an important physiological factor of ecological moment.

W. A. CANNON

COASTAL LABORATORY,
CARMEL, CALIFORNIA

[1] Palladin's "Plant Physiology," Livingston, p. 190.

[2] "The Ecological Significance of Soil Aeration," W. A. Cannon and E. E. Free, SCIENCE, N. S., Vol. 45, p. 178, 1917.

DISPERSITY OF SILVER HALIDES IN RELATION TO THEIR PHOTOGRAPHIC BEHAVIOR

IN a recent article appearing in the *Journal of Physical Chemistry*, 27, 1–51, Wightman, Trivelli and Sheppard report that in general the larger the silver halide grain and the larger the range in grain size in the emulsion, the more rapid the paper in its action towards light. The authors support their conclusions by means of exhaustive research by means of photomicrographs. There can be no doubt that in the case of their experiments "the relative speed of the emulsions increases rapidly with the increase of average size and range of size of the particles contained therein." However, that this is not always the case is shown by the example quoted in the Eastman Monograph No. 1, p. 104, written by Trivelli and Sheppard, where comparison of two emulsions showed that the one having grains one third the linear dimensions was more than 19 times as fast and that the same was true of individual grains in the same emulsion. Koch and Du Prel (*Physik. Zeit.*, 17, 536 (1916)) conclude that it is not possible to formulate a definite relationship between the grain size and sensitivity with the information at present available, but that it is certain that the largest grains in an emulsion are by no means the most sensitive.

Theoretical consideration: On the basis of the nuclear theory, the speed should depend on the *number of grains affected*, on the basis of the sub-halide theory, the speed should depend on the *amount of halide* affected. From both the continuous wave theory and the quantum theory of light the number of grains affected or the amount of halide affected should increase with the dispersity. Theoretically, then, the smaller grained emulsions should be more sensitive.

Discrepancy between the results of Wightman, Trivelli and Sheppard and the theoretically expected results is perfectly explained by adsorption. Adsorption increases with specific surface, the latter increasing with dispersity. The retarding effect of the adsorbed halide might neutralize or completely reverse the purely dimensional effect. With much adsorption we should expect the sensitivity to be inversely proportional to the adsorption or inversely proportional to the dispersity. Hence the larger-grained

emulsion would be more sensitive. The effect of range of size can also be explained by adsorption as the small grains adsorb relatively more soluble halide than the larger ones, leaving the larger ones relatively freer and therefore more sensitive than if the small ones had not been present.

Experiments performed in this laboratory show that large-grained emulsions are more sensitive when unsensitized, but that after sensitization the relative speeds are reversed. The sensitization process used is one of removing adsorbed retarding halide. We are forced to conclude that intrinsically small-grained emulsions are faster; that adsorbed halide may neutralize or reverse the purely dimensional effect so that where there is much adsorption the large-grained ones seem the faster; that unless one knows not only the ratio of size of the grains, but also relative amounts of adsorbed retarders, it is impossible to predict the relative speeds of two emulsions.

The above investigation is at present nearing completion, and the complete results will be published in the near future.

FRANK E. E. GERMANN
MALCOLM C. HYLAN
DEPT. OF THEORETICAL AND PHYSICAL CHEMISTRY, UNIVERSITY OF COLORADO

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE LOS ANGELES MEETING

THE seventh annual meeting of the Pacific Division held in conjunction with the fourth annual meeting of the Southwestern Division and the summer session of the American Association for the Advancement of Science at Los Angeles from September 17 to 20, 1923, was from every point of view a pronounced success.

While the various eclipse expeditions of the preceding week had in most cases been somewhat disappointing on account of weather conditions, yet the occasion of the eclipse had drawn together many distinguished astronomers from all parts of the world and their assemblage under the auspices of the Pacific Division was a dominating feature of the Los Angeles meeting.

The symposium on "Eclipses and Relativity" on the opening day of the meeting proved to be a very attractive feature of the general sessions and was largely attended.

The Research Conference, held at the luncheon hour on Monday, September 17, was participated in by practically the entire convention and the following program was presented:

Research activities of the California Institute of Technology: PROFESSOR EARNEST C. WATSON, California Institute of Technology, Pasadena.

The Scripps Institution: ACTING DIRECTOR F. B. SUMNER, Scripps Institution for Biological Research, La Jolla.

The causes of variation in yield in citrus trees: ACTING DEAN HERBERT J. WEBBER, University of California Agricultural Experiment Station, Riverside.

Petroleum research: DR. LAIRD J. STABLER, University of Southern California, Los Angeles.

On Monday evening, September 17, the meeting was formally opened with an address of welcome by President von KleinSmid, of the University of Southern California, to which response was made by Dr. C. E. Grunsky, chairman of the executive committee.

The address of the retiring president, Professor E. P. Lewis, of the University of California, was then delivered. Dr. Lewis chose as his subject: "The contributions of astronomy to civilization," thus further emphasizing the astronomical character of the Los Angeles meeting. He gave a masterly survey of the progress of astronomical knowledge from the earliest times showing that the race has benefited not only materially but ethically and spiritually through the labor of astronomers. He held out the hope that through the discoveries of Einstein and others some of the most illusive problems of space and time may be brought within the range of human comprehension. As a notable contribution to a popular understanding of these abstruse questions the publication of this address in SCIENCE will be welcomed.

Wednesday evening, September 17, Dr. John C. Merriam, president of the Carnegie Institution of Washington, spoke on "The meaning of history as illustrated by the records secured at Rancho La Brea." The perfect preservation of the specimens entrapped in the asphalt beds of La Brea and the wonderful succession of life represented constitutes a unique historical record and furnishes indubitable proof of the evolution of existing species from these remote types. It is hoped that Dr. Merriam will arrange the substance of this interesting address for publication.

Dr. R. B. von KleinSmid, president of the University of Southern California, gave an interesting discourse on the "Psychology of Crime," a subject in which he has specialized for many years. It was a notable addition to the program provided for the general sessions.

Too much can not be said in praise of the very efficient preparations made for the meeting by the local committees. The accommodations for the various meetings of the affiliated societies were all that could be desired and the courteous hospitality extended to visitors was the occasion of much favorable comment.

Over 500 registered for the meetings, including 253 members of the association. Twenty-three affiliated societies held meetings under the auspices of the Pacific Division. Reports of some of these meetings,