received his training under the late Dr. William James Beal, of Michigan. In his address, Dr. Bessey briefly outlined the history of botanical gardens throughout early and modern times and stressed their value to colleges and schools of to-day. He pointed out that not only is such a garden of value to the school, but it becomes a center of interest for all persons of the community as it preserves many types of vegetation, flowers and trees which have or may become practically extinct.

DISCUSSION

MICROCLIMATIC STUDIES IN OKLAHOMA AND OHIO

IN October, 1935, the Soil Conservation Service, in cooperation with the Weather Bureau and with funds supplied by the Works Progress Administration, established 200 weather stations spaced about three miles apart throughout Blaine, Kingfisher and Logan Counties in Oklahoma. Each was supplied with a rain gage, anemometer, wind vane, psychrometer and thermometers, and was operated by a farmer from the relief rolls.

The results obtained were of sufficient value to justify the establishment, in March, 1937, of a similar microclimatic study in the Muskingum Valley in Ohio by the Soil Conservation Service in cooperation with the Weather Bureau and the Muskingum Watershed Conservancy District, with funds supplied by the Ohio Works Progress Administration. Here 500 weather stations, each including a self-recording rain gage in addition to the instruments supplied in Oklahoma, were spaced approximately four miles apart in the 8,000 square miles of the watershed.

At both projects the records obtained by the observers are mailed to headquarters daily and are used in the preparation of detailed climatic maps, the most significant of which are those of rainfall. Those for the Oklahoma Climatic Center show the rainfall distribution for every fifteen-minute interval and the accumulation of rainfall by fifteen-minute intervals for each storm. In Ohio similar maps are prepared for half-hour intervals. Distribution maps of temperature, relative humidity, fog, dust and wind velocity and direction are prepared to help explain the rainstorms and to permit their classification into types. Supplementary maps show the rainfall accumulation for each day on which rainfall occurred and the daily accumulations for each month as well as for the entire year.

More than a year of records had accumulated in Oklahoma before the Ohio project was established. The maps prepared from the Oklahoma records revealed many facts that have a fundamental bearing on climatology and meteorology.

The battery of rain gages is regarded as a single instrument for obtaining simultaneous samples in different parts of rainstorms in sufficient number to determine their characteristics. During the course of the study a large number of storms have been sampled in this manner. Rainstorms are subject to the same kind of observation and classification as other phenomena, and through the analysis of those observed a beginning on a taxonomy of rainstorms has been made. It has been found that rainstorms have characteristics of size, shape, internal structure, distribution of intensity and migration patterns.

Ignorance of the morphology of rainstorms has prevented the interpretation of the precipitation records of a single station in terms of the storm that produced it. Hence, in the past, much emphasis has been placed on detailed statistical treatment of precipitation records of single stations and very little on the areal distribution and characteristics of individual storms.

Two types of rainstorms, distinctive as to form, internal structure and behavior pattern, have been recognized. One type, of comparatively short duration and high intensities (the cold front type), is especially significant in the production of gully and sheet erosion and occasional local floods. The other type, of long duration and lower intensities, but ordinarily bringing larger amounts of rainfall (the warm front type), is significant in stimulating mass or gravity movements of soil, such as slumping, field slides and caving of gully walls and heads, and is invariably the cause of major floods.

The Ohio study is especially important because it covers an entire drainage area which is one of the outstanding flood control laboratories in the country. A forty-million dollar flood control and water conservation project is now being constructed cooperatively by the Federal Government, the State of Ohio and the Muskingum Watershed Conservancy District. The operation of the project will be of continuing value to all three of these agencies.

The Muskingum watershed offers an ideal location for such a study, since the Muskingum Watershed Conservancy District, in cooperation with the U. S. Geological Survey and the Soil Conservation Service, operates more than thirty stream-gaging stations and will as soon as they are constructed be operating fourteen flood control dams and reservoirs, and since the Soil Conservation Service has already established in the center of the area an extremely detailed study of rainfall and runoff and of the influence of agronomic practices on runoff.

On the Ohio project the rainfall maps are being used as in Oklahoma for the study of rainstorm morphology, but in addition they will be used to determine the amount of rainfall and the time of its occurrence on the minor watersheds above stream-gaging stations. These data will be related to the runoff as measured at the gaging stations in the expectation that it will be possible to forecast discharge and stage from the records of selected rain gages.

Rainstorm morphology is seen to have implications in a number of related fields. It reveals the limitations in existing determinations of rainfall intensity-frequency and indicates ways in which such determinations may be improved; it suggests a new approach to the problem of flood hazards and forecasting; has a definite bearing on the statistical study of the relation between climate and crop yields, and suggests important refinements in soil erosion experiments. In addition, it raises the suspicion that variations in annual rainfall may be due to the random distribution of individual rainstorms, in which case forecasting of rainfall through extrapolation would be quite impossible. The maps of wind velocity and direction have revealed facts regarding the characteristics of surface fronts, of basic importance to air mass studies in meteorology, which could not have been obtained in any other way. The value of these microclimatic studies lies not so much in continued observations over a long period of years as in the obtaining of simultaneous observations at sufficiently short intervals to permit the study of many individual rainstorms. In a few years enough could be learned about the characteristics of storms in these two areas to make it possible to approach the climatic problems relating to soil and moisture conservation, land use and flood control on a more intelligent basis.

C. W. THORNTHWAITE

SOIL CONSERVATION SERVICE,
WASHINGTON, D. C.

CHROMOSOME ALTERATIONS BY CENTRIFUGING

IN my previous publications[1] I showed that in centrifuging of germinated seed of *Vicia Faba, Nicotiana Langsdorffii,* wheat, etc., various alterations were induced in the somatic chromosome sets. Monosomic, trisomic, tetrasomic and polysomic cells and cell regions were found as well as such with tetraploid and hypertetraploid chromosome number. Occasionally cells with chromosome fragments were also observed. A student of mine (I. Rajably) induced the same chromosome alterations by centrifuging in barley, *Vicia sativa* and in *Matthiola.* He even produced a tetraploid *Matthiola* plant.

[1] D. Kostoff, *Archivio Botanico,* 11: 91–96, 1935; *Compt. Rend. Acad. Sci. USSR,* 2: 71–76, 1935; *Zeitschr. Induct. Abstamm. Vererbungslehre,* 69: 301–302, 1935.

The results of my more recent experiments are:

(1) *Nicotiana Langsdorffii.* Besides the chromosome alterations, I obtained in F_2 generation a variegated plant (leaves and flowers), which gave in F_3 green: variegated : white, in various ratios, depending on the capsule from which the seed was collected. I grew during the last twelve years each year thousands of seedlings of *N. Langsdorffii,* from which only 30 to 100 were usually transplanted for raising adult plants; nevertheless, I never have found variegated seedlings among those I grew. It should be mentioned here that variegated plants develop only from variegated seedlings.

(2) *Crepis capillaris.* Professor Dr. G. Lewitzky, of Leningrad, sent me kindly seed from *Crepis capillaris,* for which I wish to express here my gratitude. Centrifuging germinating seeds, collected last year, chromosome alterations were induced as those mentioned above, involving A, B and D chromosome.

(3) *Hybrid. Nicotiana rustica* × *N. tabacum.* A large number of seed was produced by crossing *N. rustica* with *N. tabacum.* Germinated seed were centrifuged and then transplanted. Many of them died. One plant out of 81 adult hybrids came out to be a chromosome chimera, forming a branch with doubled chromosome number ($2 \times 48 = 96$). This branch was self-fertile, giving rise further to amphidiploid *N. rustica* × *tabacum,* while all F_1 hybrids and the other branches of the chromosome chimera were self-sterile.

A more detailed description of the experiments will be given later.

DONTCHO KOSTOFF

INSTITUTE OF GENETICS, ACADEMY OF SCIENCES OF USSR, MOSCOW

A SIX-CHROMOSOME ASCARIS IN CHINESE HORSES

A BRIEF note with the above title was published in Volume 9 of the *Peking Natural History Bulletin* in December, 1934. As that scientific journal does not have a wide circulation in America, and the chromosomes of *Ascaris megalocephala bivalens* and *univalens* have had so much historical and practical value for biologists, I am asking for the privilege of announcing this discovery in SCIENCE. The first material came from six worms brought to this laboratory by a man who had been asked to collect Ascaris from Chinese horses because we wanted to make our own slides to illustrate mitosis and maturation phenomena for classwork. In 1935 he brought six more, but these were all dead, and now this year he has brought twenty-two new ones in very good condition, and we have plenty of material to work out oogenesis, spermatogenesis and cleavage.

The behavior of the chromosomes is just the same as in the classical Ascaris material, except that there