mitochondria apparently functions quite differently from the two just described. It is:

10 per cent. sol. chromic sulphate	1 part
8 " " " formalin neutralized with an excess of $CaCO_3$ or Li_2CO_3	1 "

If calcium carbonate is used the pH is about 2.2; if lithium carbonate is used it is about 4.8.

When this fixative is washed out with water and the dehydration proceeds slowly, the dividing nuclei and the cytoplasm appear beautifully fixed. The chromosomes are a trifle shrunken so that in the metaphase they show the split very clearly. The cytoplasm appears quite smooth with sharply delineated vacuoles. In the root tip the growth of the vacuoles and their behavior during mitosis can be easily followed. Unfortunately the mitochondria are dissolved out of the epidermis and cortex and remain only in the central cylinder. If the fixative is washed out with 70 per cent. alcohol and the dehydration is relatively rapid, the cytoplasm appears more granular and the mitochondria are preserved in nearly the whole tissue.

It is evident that there is an important relation between the pH of a bichromate and its fixation image. If it is too acid it will fix the chromatin but not the mitochondria, if it is too basic it will fix the mitochondria but not the chromatin. Certain bichromates in the presence of an oxide or a carbonate of the element which furnishes the cation will buffer at a point where they will fix both nuclear and cytoplasmic elements. Others, as their pH number is raised, suddenly change from nuclear to cytoplasmic fixatives. The pH of this point of change shows quite a range for the various bichromates. Thus ammonium bichromate pH 4.2 and potassium bichromate pH 4.4 are much too basic to fix the chromatin, while lithium bichromate pH 4.6 has the fixation image of chromic acid. Zinc bichromate pH 5.2 will fix both chromosomes and mitochondria with its characteristic fixation image.

A detailed description of the fixation images of various bichromates is being prepared.

CONWAY ZIRKLE

BUSSEY INSTITUTION,
HARVARD UNIVERSITY

SPECIAL ARTICLES

THE MnII SPECTRUM EXCITED BY RARE GAS IONS

THE MnII spectrum was excited by the method recently described by Duffendack and Smith[1] and tested by the writers[2] on the CuII spectrum. In this method rare gas ions on contact with Mn atoms ionize them and simultaneously excite them to the degree that the ionizing potential of the rare gas exceeds that of manganese, 7.4 volts.

An argon ion on contact with a Mn atom can ionize it and excite the resulting Mn^+ ion to the extent of $15.4 - 7.4 = 8.0$ volts. In the process the argon ion is neutralized by combination with an electron taken from the Mn atom and energy to the amount of 15.4 equivalent volts is made available. 7.4 equivalent volts of this is expended in extracting the electron from the Mn atom, leaving eight equivalent volts to be accounted for. Smyth and Harnwell and Hogness and Lunn[3] have demonstrated by positive ray analyses that ionization may occur upon contact between an ion and a molecule. In the investigations cited above[1,2] it has been demonstrated that the excess energy may go toward exciting the ion formed. Hence, when argon ions are used, one may expect to produce by this process Mn^+ ions excited to states whose levels are less than eight volts or 84,800 cm^{-1} above the normal state of Mn^+ but none excited to a higher degree. Consequently, lines of the MnII spectrum whose initial states are below 64,800 cm^{-1} should appear and lines originating in higher states should be absent from the spectrum thus excited. If, however, neon (ionizing potential 21.5 volts) is substituted for argon, Mn^+ ions excited to states whose levels are less than 14.1 volts or 114,210 cm^{-1} are produced and lines from these levels should appear in the spectrum.

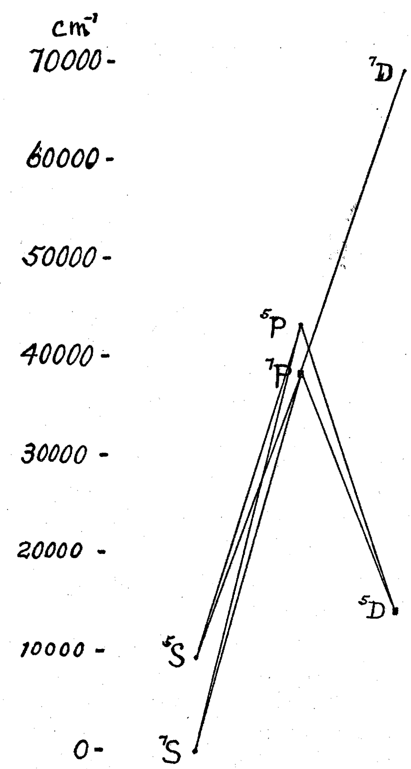
The experimental procedure consisted in photographing the spectra of low voltage arcs in mixtures of argon and Mn vapor and neon and Mn vapor in a tungsten furnace apparatus. The manganese was put into a molybdenum trough mounted inside a cylinder of thin sheet tungsten and insulated from it. This trough constituted the anode of the arc, and the cathode was a tungsten filament mounted inside the cylinder and parallel to its axis. The tungsten cylinder was itself mounted inside a metal water-cooled vacuum chamber, filled to the desired pressure with argon or neon, and was heated by passing a sufficiently large current through it. The manganese in the trough was thus vaporized and any desired vapor pressure could be maintained inside the cylinder. The filament was then heated and a low voltage arc maintained in the mixture of argon or neon and manganese vapor within the furnace. The spectrum of the arc was photographed through quartz windows sealed onto the vacuum chamber.

The results support the hypothesis outlined above. When argon was used, lines originating in the ^7P and

[1] *Phys. Rev.* 29, 914, 1927; *Nature,* May 21, 1927.
[2] *Phys. Rev.* 29, 925, 1927.
[3] *Nature,* Jan. 15, 1927; *Phys. Rev.* 29, 830, 1927; *ibid.,* 30, 26, 1927.

^5P levels (Fig. 1) appeared in the spectrum but none from the ^7D level. When neon was substituted for argon and all other conditions kept the same as before, the $^7P - {}^7D$ lines came out strongly.

This work led us naturally to the analysis of the MnII spectrum. In 1923 Catalan[4] published four multiplet arrangements in the spark spectrum of manganese which can easily be recognized as $^7S - {}^7P$, $^7P - {}^7D$, $^5S - {}^5P$, and $^5D - {}^5P$. The lowest term of the MnII spectrum may be expected to be the ^7S term and so the levels of the septet terms were immediately established, as shown in Fig. 1. Catalan's multiplets



enabled us to determine the relative levels of the quintet system and so the first problem was to find intercombination lines which would fix the positions of the two systems with respect to each other. The difference $^5S - {}^7S$ can be estimated from convergence limits in the MnI spectrum.[5] Dr. O. Laporte, who has given us valuable suggestions on the nature of the MnII spectrum, had recently calculated this difference and furnished us his result, 9,477 cm^{-1}. Using this value, intercombination lines were quickly found which fixed the difference at 9,474.3 cm^{-1} and established the relative positions of the two systems. Lines have been found for the transitions indicated in Fig. 1, and the work of completing the analysis of the spectrum is in progress. The similarity of this spectrum to that of CrI is apparent from a comparison of their diagrams.[6]

J. G. BLACK,
O. S. DUFFENDACK
PHYSICS LABORATORY,
UNIVERSITY OF MICHIGAN

[4] *Phil. Trans. Roy. Soc.* 223, 127, 1923.

[5] McLennan and McLay: *Trans. Roy. Soc. Canada* 20, 15, 1926.

[6] Catalan: *Anales Soc. Esp. de Fis. y Quim.* 21, 84, 1923.

FOG PRECIPITATED BY TREES

THE collection by vegetation of moisture from fog has interested me for a long time. I recently found an opportunity to approximately measure the amount collected by trees.

During the summer west winds blow the moisture-laden air from the Pacific Ocean up and over the hills back of Berkeley, California. Nearly every afternoon fog collects on the hills at elevations above 800 feet and stays until the morning sun dissipates it. Occasionally it remains the entire day.

About twenty-five years ago pine and eucalyptus trees were planted on the sides and tops of the hills over large areas which prior to that time were bare of all but grass. Trees were found only in canyons, while brush covered many of the slopes, particularly those sloping to the north. These trees grew slowly for a number of years but have made very rapid growth in the dry years since 1917. The summers here are nearly rainless and all vegetation on the hills usually dries up during this rainless season, except in protected spots and in canyons where moisture is more plentiful.

I have long noticed that the soil beneath trees is more moist than elsewhere, the additional moisture coming from the collection of water from the fog dripping to the ground. I recently (July 31) collected samples of soil from beneath trees and from ten feet from trees, where soil and other conditions were identical. Samples were collected from surface to 12 inches depth and the moisture determined. Here are the results:

	Percentage of Moisture	
	Under tree	Ten feet from tree
Monterey Pine—Elev. 1,500 ft.	24.4	7.8
Monterey Pine—Elev. 1,600 ft.	28.5	7.7
Eucalyptus —Elev. 1,650 ft.	22.9	9.4

Assuming the weight of soil as 90 lbs. per cubic foot, these differences in percentage are equivalent to the following in inches of rainfall. Pine, elevation 1,500 feet, 2.87 inches. Pine, elevation 1,600 feet, 3.60 inches. Eucalyptus, elevation 1,650 feet, 2.33 inches. The soil was moist much deeper than 12 inches, so the total difference in inches of water collected is much above that shown.

The area of ground covered by trees, where the