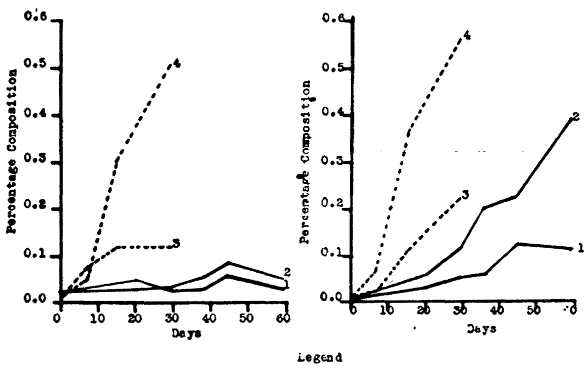
plants. The foliage was darker green. The plants were stunted and contained considerable starch. This starch, however, rapidly disappeared after four days. The leaves wilted and died in twenty-four hours after the appearance of the first symptoms without changing color, or exhibiting any of the symptoms associated with the nitrate-supplied plants.

Data from the analysis of the four groups of plants showing the ammonium nitrogen in the leaves and stems are graphically shown in Fig. 1.

Middle leaves—Ammonia N Middle stems—Ammonia N



1. Plus K Plus Nitrate N
2. Minus K Plus Nitrate N
3. Plus K Plus Ammonium N
4. Minus K Plus Ammonium N

FIG. 1. Nitrogenous fractions of Rutgers tomato plants receiving nitrate and ammonium nitrogen and plus-potassium and minus-potassium nutrient solutions.

The comparatively high concentration of ammonium nitrogen in those plants supplied with ammonium, but no potassium, apparently was responsible for the rapid deterioration and collapse of the leaf tissue. Carbohydrates likewise decreased very rapidly as ammonium increased in the foliage. However, the cause of the injury must be attributed to the lack of potassium in preventing ammonium from being converted to amino and protein nitrogen. The chemical reactions involved in the metabolic cycles of potassium-deficient plants supplied with nitrate or ammonium nitrogen differ only in the fact that the ammonium plants have at hand a large supply of readily assimilated nitrogen. The nitrate plants, on the other hand, must first form ammonia through the reduction of nitrates. These facts account for the rapid completion of the cycle of chemical reactions in the potassium deficient plants supplied with ammonium, requiring less than two weeks to bring them about, while it required three to eight weeks for similar processes to take place in the plants supplied with nitrate. This is probably responsible for the two different types of deficiency symptoms observed.

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NEW JERSEY AGRICULTURAL
EXPERIMENT STATION

POLYPLOIDY IN SOYBEAN, PEA, WHEAT AND RICE, INDUCED BY COLCHICINE TREATMENT

WHEN day-old seedlings of soybean, pea and wheat (*Mei-Yü* variety) and 2-day-old seedlings of paddy rice (*Mar-Tze-Tao* variety) were soaked in 0.05–0.1 per cent. solutions of colchicine for 24 or 48 hours under ordinary conditions of temperature and light, the plants that developed were found to be tetraploid, as shown by microscopic examination of their root-tips. Compared with normal plants, those from treated seedlings generally had thicker and rougher leaves, larger cells, larger nuclei and larger stomata. In plants grown from seedlings that had received the 24-hour treatment both shoots and roots were notably more sturdy than those of the controls. When soybean seeds were placed in 0.05 per cent. colchicine solution and allowed to germinate there, the resulting plants showed these same peculiarities. When seedlings of soybean and pea were immersed in 0.05 per cent. colchicine solution for 24 hours in darkness, their leaves soon died but new leaves were formed after a week or two. When a film of lanoline containing 1 per cent. of colchicine was applied to shoot tips of soybean and pea seedlings, or when 4–6 drops of 0.05 per cent. colchicine solution was applied in the same way, treatment resulted in shortening of internodes and curling of leaves.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A MODIFIED KENDALL TUBE FOR PURIFYING NITROGEN[1]

KENDALL[2] has described a method of purifying nitrogen in a glass tube containing a double roll of copper gauze, heated by radiation from a nichrome coil at the center of the tube. Oxygen is removed by direct combination with the heated copper gauze, which slowly becomes tarnished. The tarnished gauze is restored to bright copper by slow flushing of the tube with hydrogen, and can be so used interminably.

In our studies of bacterial enzymes, we have used

[1] This work has been aided by the Graduate Medical Research Fund of the University of Minnesota.
[2] E. C. Kendall, SCIENCE, 73: 394, 1931.

such a Kendall tube for the production of oxygen-free nitrogen from regular tank nitrogen of reputed 99.44 per cent. purity. Our experience with this original design is quantitatively summarized in Fig. 1, where

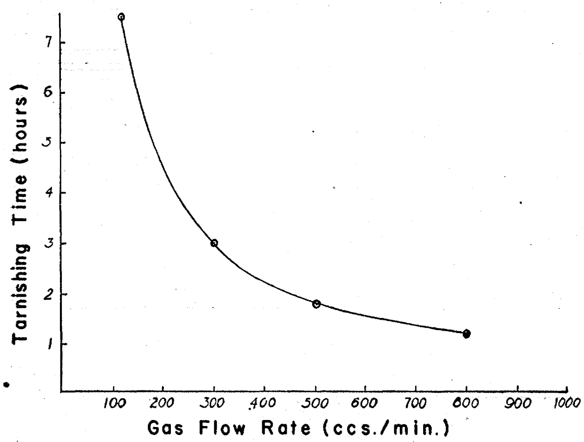

FIG. 1

the time at which tarnishing of all the gauze is complete is plotted against corresponding rates of gas flow.

It is the purpose of this paper to describe a slight modification in design of tube, providing for increased capacity. Both the original design and the new design are shown in cross section in Fig. 2.

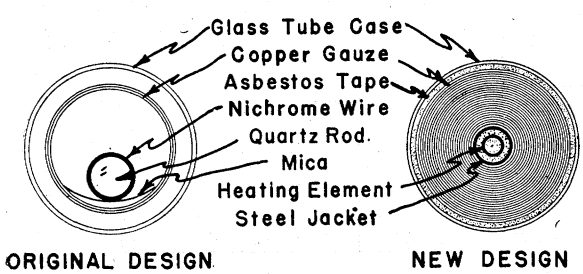

FIG. 2

If a Calrod[3] heating element is used as a source of heat, the copper gauze may be tightly wrapped around the heating element to a thickness just below the inside diameter of the glass case. The heating element which we find satisfactory draws 500 watts at 115 volts, is 23¾ in. in length, and has 17-inch effective heating surface. One-inch asbestos tape is wrapped tightly about the copper gauze bundle at several points about four inches apart to provide a snug fit of the bundle in the glass case, and to prevent channeling of the gas through the tube. It is essential that this asbestos packing be very tight. Care should be taken that the materials entering the tube do not become greasy from handling, as this grease will distil off the materials on heating, and condense on the inside of the tube.

[3] Manufactured by General Electric Company.

The new design has two advantages over the original. (1) The capacity for oxygen removal is considerably increased, the new having 10 to 12 times the capacity of the original. (2) Provision is made for more intimate contact between gases and the hot gauze. If the Reynolds number[4] is calculated for gas flow in the original tube according to the equation, Reynolds number $= \frac{D u \rho}{\mu}$, it is found that at a gas flow of 100 cc/min, the Reynolds number is 1.5. Since u, the velocity of flow, is directly proportional to the Reynolds number, this number for any flow velocity can easily be computed from this one calculation; *e.g.*, at 1,000 cc/min, the Reynolds number is 15. When the Reynolds number is less than 2,100, viscous flow obtains. Therefore flow in the original tube is of the viscous type whenever the gas flow rate is below 100,000 cc per minute. It may be possible, therefore, for oxygen molecules to pass from one end of the tube to the other through the open central portion of the tube without coming into contact with the hot copper. Removal of oxygen should therefore be more complete with the new design. This point must be settled, however, by further experimental work. At the same time, gas flow is unrestricted. Calculations of Reynolds numbers for the new design would be without meaning, since the circuitous path imposed upon the gas insures turbulent flow.

Our tube was constructed by the Central Shops of the University of Minnesota.

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COLD EXTRACTION APPARATUS

OFTENTIMES one wishes to extract a solute from solution without the use of heat. In biological chemistry, especially, there are many substances which are easily destroyed by boiling solvents.

The author has designed and built a special cold extraction apparatus which is schematically shown in Fig. 1. The apparatus works on the principle that two immiscible liquids, such as water and benzene, for example, will not mix, but will rise and separate on the top of the heavier one similar to oil on water. The long column A is half filled with the aqueous solution to be extracted. Benzene or any other immiscible liquid which is lighter than water is allowed to run down the inner tube C, passing through a porous glass filter at the bottom. The latter disperses the organic solvent into many small bubbles which extract as they rise through the water and separate at the top. The upper liquid containing the extracted

[4] Badger and McCabe, "Elements of Chemical Engineering." Second Edition. McGraw-Hill Book Company, 1936.