PROFESSOR ADOLPH FRANK,
THE DISCOVERER OF CALCIUM CYANAMIDE.

Chemistry and the World's Food.

By ROBERT KENNEDY DUNCAN.

The Fixation of Nitrogen.

The romantic deportment of the nitrogen atom is fascinatingly interesting to the student of chemistry. Wherever he looks he sees that the living, moving, doing thing in the world is nitrogen; it is at once the most restless and the most powerful of the elements. When nitrogen enters into a collocation of atoms we invariably expect the collocation to do something active, whether good or ill; for the nitrogen compounds have properties and qualities they are never inert

of life element paramount, but the more the question is studied, the more does it appear evident that the carbon constituent of the body is the mere brick and mortar of it, good enough to constitute its physical substratum, and good enough, too, to burn as fats and carbohydrates to maintain its fires, but that the working, building, "vital" thing, the thing that is the moving-spring of protoplasm and that brings about the continuous adjustment of internal to external conditions that we call life, is the versatile, restless nitrogen.

It looks as though the living being constituted a vast unstable plasma in which the nitrogen atom, with oxygen on the one hand and carbon or hydrogen on the other, very much as it is in nitro-glycerine, swings the atoms of the living body through all the multiplex atomic relations of growth and decay. The lability of living substance is the lability of the nitrogen atom, and we may say, with much more propriety than "Ohne Phosphor kein Gedanke," "Ohne Stickstoff kein Leben"—no life without nitrogen.

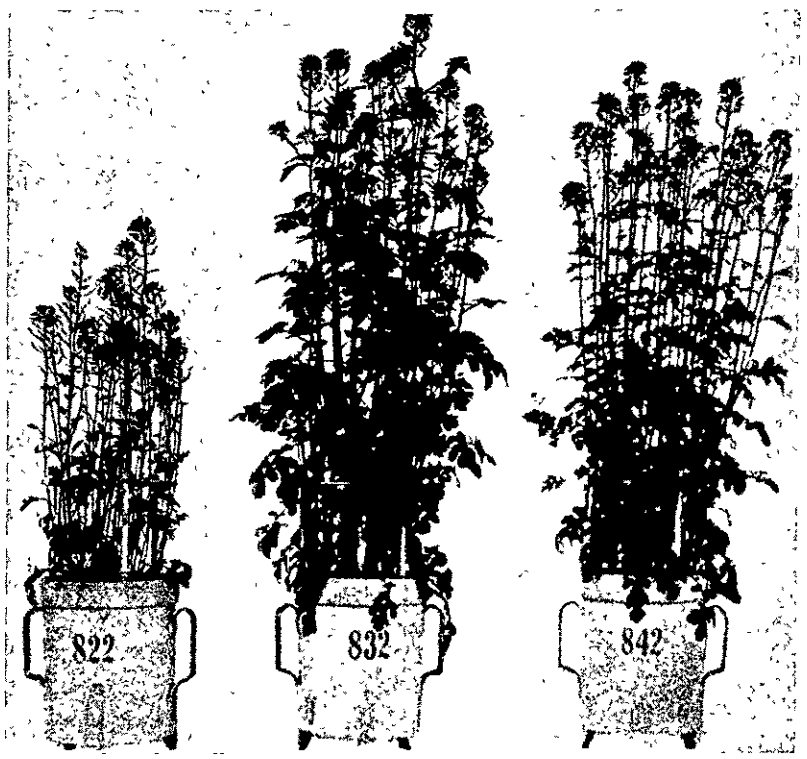
And yet—and this is a most interesting thing—this nitrogen, which when combined with elements of another kind is so energetic and so useful, is, in its care-free, solitary condition, a stubborn lazy, inert gas. In this the elemental conditions it is one of the most abundant and pervading bodies on the face of the earth. It constitutes four-fifths of the air that blows in our faces, and so much of it there is that every square yard of earth's surface has pressing down upon it nearly seven tons of atmospheric nitrogen.

Chemically speaking, it is all but unalterable, though the "all but" is vastly important to us.

One or two metals, such as calcium and magnesium and a few compounds of metals, may be made to unite with it. We find, too, that certain organisms, bacteria—"nitrifying microbes" they are called—have within their little bodies laboratories for attaching nitrogen to other elements, though the mechanism of this action no man understands.

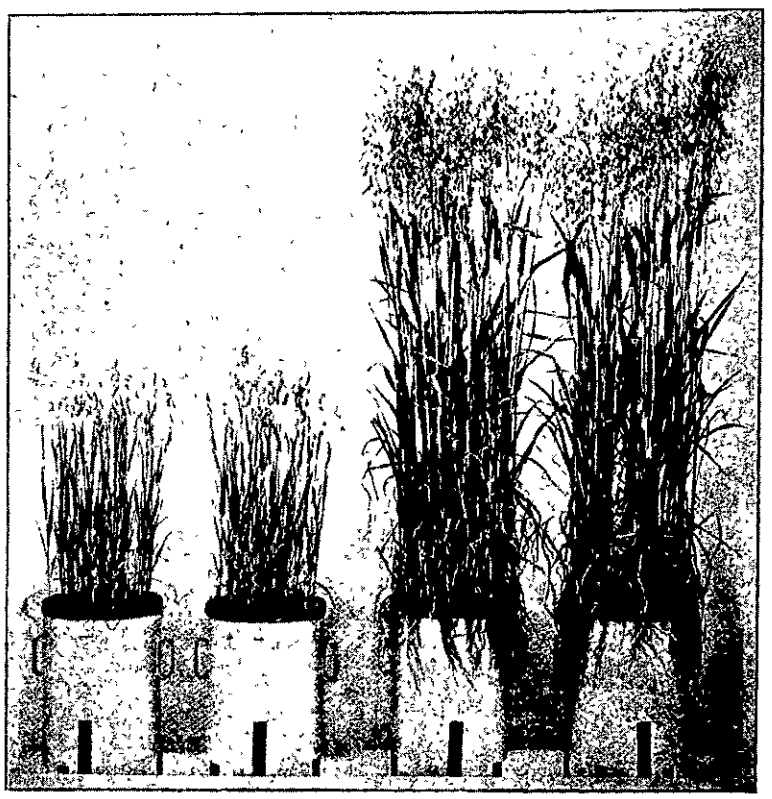
Still, again, we find that the lightning flash will cause the nitrogen and oxygen of the air to combine in the path of its streak to form nitrous acid, or that it will cause the nitrogen and water vapour to react to form ammonia. Outside, however, of the minute quantities which are extracted from the air in these various ways, the whole great ocean of atmospheric nitrogen under which we live and move maintains, in a chemical sense, a listless, useless lethargy.

Now, nitrogen which is united with other elements (it matters very little which) and which is so temperamentally nervous and active and useful we call "fixed" nitrogen, while the nitrogen which exists in the elemental lethargic condition of the nitrogen of the air we call "free" nitrogen, and the object of this paper is to present the various modern attempts to solve the problem of transforming



A. B C.

AN EXPERIMENT WITH MUSTARD.
(A) WITHOUT FERTILISER; (B) FERTILISED WITH AMMONIUM SULPHATE; (C) FERTILISED WITH KALKSTICKSTOFF.



A. B.

DEMONSTRATION WITH OATS.
(A) WITHOUT FERTILISER; (B) FERTILISED WITH AMMONIUM SULPHATE.

So it is that, entering into combination with a few other atoms, it will yield us the most delicate and delicious of perfumes, while it is equally ready to join forces with others to produce substances whose smell of utter vileness has the psychological effect of causing the experimenter to "wish he was dead." In the aniline dyes it enhances our clothing with a thousand beautiful colours, and in still another thousand forms it enters the chambers of the sick in the healing guise of all the synthetic medicines. It lurks in prussic acid, the ptomaines, and a host of deadliest poisons; it drives our bullets in the form of gunpowder; it explodes our mines as dynamite and guncotton; it dissolves our metals as nitric acid; it extracts our gold as cyanide; and in an infinity of ways it menaces or ministers to mankind. Nitrogen-containing substances, then, are active substances, and their activity seems to be due to a certain "temperamental nervousness" of the nitrogen atom which sends it flying on the slightest pretext from one atomic community to another. On this account we call nitrogen a "labile" element.

But it is only when we consider nitrogen in its relation to life that we see how truly momentous is this fact of its lability. We have been accustomed in the past to ascribe to carbon the role

THE EFFECT ON CARROTS.
GROWN WITHOUT FERTILISER. FERTILISED WITH KALKSTICKSTOFF.