tion have been detected paralleling the graying and regenerative stages studied during recovery.

We have also been able to turn the fur of one black guinea pig completely gray by a diet deficient in this factor and have produced graying of hair about the mouths of two young Boston bull pups.

Apparently many of the physical changes of senescence have been produced in these animals in the course of a few weeks by depriving them of the unknown dietary factor which affects particularly the function of the adrenal cortex.

The curative concentrates have been made from yeast, rice bran and liver. Whether the filtrate factor in question is the same as the anti-chick pellagra filtrate factor of Lepkovsky, Jukes and Krause[2] is not at present known.

A full report of these experiments will appear elsewhere.[3]

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BACTERIAL LEAF-SPOT DISEASES[1]

AN investigation has been made of the leaf-spot of Pennsylvania cigar-leaf tobacco, commonly known as "wildfire." Evidence obtained in these laboratories indicates that the organism associated with the leaf-spot, *Phytomonas tabaca,* is a transitory physiological adaptation of the common saprophyte, *Pseudomonas fluorescens.* This organism, in various physiological adaptations, is found in large numbers on normal tobacco. It is apparent from the data obtained in these investigations that all Pennsylvania cigar-leaf tobacco is exposed to this organism throughout the growing and ripening period and that infection in the field is due not to the mere presence of the organism, which is ubiquitous, but to improper host nutrition.

Single cell isolations of various adaptations of the organism have been the subject of physiological and serological studies. The particular adaptation, or what might be termed by the plant pathologist "relative virulence" has been found to vary greatly according to the source of the isolation. Distinct physiological characteristics have been found to be typical of these various isolates. Rapid changes may be made in the laboratory at will, both in the direction of increased and decreased virulence. Serologically, it appears that the "virulence" of the organism is associated with the specific nature and amount of the capsular material of the cell. Although the particular adaptation of the organism is probably related to severity and rapid spread of infection in those cases in which the tobacco plant is suffering from improper nutrition, the evidence indicates on the other hand that the most "virulent" adaptations of the organism are unable to cause economic loss in those cases in which the nutrition of the plant is satisfactory, other things being equal.

The normal tobacco plant of the cigar-filler type is very resistant to infection of economic severity during the growing season. Leaves of such a plant ordinarily contain at maturity between 3 and 4 per cent. nitrogen and between 4 and 5 per cent. potassium. Changing agricultural practices of the past quarter century have resulted in the general production of an abnormal tobacco from the standpoint of nitrogen and potassium content.

Investigations have shown that, contrary to the opinions expressed in publications by other workers, it is not the exact nitrogen level within reasonable limits that is important but the ratio of nitrogen to certain minerals within the plant and, of extreme importance, the stage in which high nitrogen uptake occurs.

Any condition which leads to the accumulation in the plant of a greater quantity of nitrogen than potassium results in poor quality and susceptibility to leaf spot troubles. It is not to be inferred from this that potassium is the only other element which must be available to the plant in order to insure quality and disease resistance. Potassium is, however, the element needed in greatest amount and apparently most frequently deficient in the Pennsylvania area.

It is not during the period of active growth but during the period of ripening that faulty agricultural practices may lead to the greatest susceptibility to leaf-spot. Our investigations have shown that, regardless of the nutrition of the plant prior to this period, the uptake of significant quantities of nitrogen during the ripening period results in an appreciable lowering of the normal resistance of the plant to wildfire. In Pennsylvania certain practices are necessary which accentuate the abnormal condition brought about by significant nitrogen uptake during ripening and greatly increase the susceptibility of those plants taking up large quantities of nitrogen during the ripening period. These include "topping" and "suckering" which take from the plant the possibility of utilizing large amounts of nitrogen at this period in the proliferation of new tissue. It is significant that wildfire was not a problem in Pennsylvania a number of years ago when agricultural practice precluded the possibility of any appreciable ammonification and nitrification at the ripening period.

Practices in Pennsylvania which have been found

[2] Lepkovsky, Jukes and Krause, *Jour. Biol. Chem.,* 115: 557, 1936.

[3] We acknowledge with gratitude help in the interpretation of the tissue changes from Dr. Jesse Carr, of the Department of Pathology, University of California School of Medicine.

[1] Authorized for publication on March 27, 1939, as paper No. 898 in the journal series of the Pennsylvania Agricultural Experiment Station.

to be largely responsible for the severity of leaf-spot infections are, in the order of their importance: (1) the incorporation of large quantities of organic nitrogen in the tobacco soils, a portion of which in some seasons may remain to be ammonified during the ripening period; (2) the use of too much nitrogen and insufficient potash in the fertilization treatment; (3) the use of excessive amounts of lime, which interferes with the normal potassium uptake of the plant; and (4) in some cases poor tilth, which also interferes with mineral uptake.

Practices tending to produce a normal resistant plant of high quality and good yield are as follows: (1) the use of another crop such as corn between clover and tobacco in the rotation to reduce the amount of organic nitrogen in the soil; (2) preliminary rotting of all manure used on tobacco in order to avoid the risk of adding large quantities of available energy to the soil; (3) the use of liberal applications of well-rotted manure to improve tilth and aid potassium uptake; (4) the use of suitable applications of a well-balanced fertilizer in which the amount of organic nitrogen is less than the amount of inorganic nitrogen; and (5) suitable cultivation to insure maximum uptake of potassium and other essential nutrient materials.

In the course of these investigations it was considered advisable to study physiologically and serologically several other members of the genus *Phytomonas*, associated with leaf-spots. The data obtained indicate that other members of this genus studied are merely temporary physiological adaptations of *Pseudomonas fluorescens*. A brief study of predisposing factors in these diseases further emphasizes the similarity of bacterial leaf-spot diseases and the relation of the pathological condition to the improper nitrogen-mineral nutrition of the host. The results of these investigations will be published in detail in a Bulletin of the Pennsylvania Agricultural Experiment Station.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A SYSTEM OF INDEXING 2×2 INCH SLIDES

THE handling of microfilm (35 mm) used in research and teaching can be divided into three major phases: (1) the filing of negatives; (2) the filing and indexing of positive or negative film-strip reprints of library material; (3) the filing and indexing of 2×2 inch monochrome or natural color slides for use in teaching or in research where color must be recorded.

Considerable interest has been shown in the use of film-strip,[1, 2] particularly with reference to its bibliographic service. However, its value for teaching is distinctly limited by the inflexible sequence of the images on the film and the technical difficulties in using it for projection in natural colors.

The use of film-slides (2″×2″) has received less consideration in scientific journals, perhaps due to the fact that such slides do not serve a new purpose, but merely constitute a means of doing an old job better. Film mounted between cover glasses is little subject to injury, and the slides can be rearranged for various purposes by different individuals. They have therefore greater usefulness for longer periods of time than film-strip. As compared with larger sizes of lantern slides, the lower cost, the greater ease of carrying many slides and reduced breakage of the microfilm slides makes them a very valuable aid to teaching and research. Since the results of research can never be utilized to the maximum extent unless they are adequately exposed through effective teaching, it is apparent that the use of microfilm slides, particularly those in color, is well worth the consideration of those engaged in either teaching or research.

The cost of film-slides and their greater versatility of arrangement and use ordinarily requires that large departmental or institutional slide collections be used by several individuals. This necessitates a system of filing and indexing which will enable each user to find slides conveniently, not only in his own major field, but in those of his colleagues as well. Usually information concerning the subject illustrated on the slide and its source is required whenever a slide is used.

Several individuals have cooperated in devising a system for filing and indexing slides that effectively meets these requirements and has proven efficient and very useful in this department. The system is divided into three parts: a subject index, a slide file and a negative file. All may be housed in a filing cabinet designed for 3×5 inch cards.

The subject index is the central part of the system and is responsible for its usefulness. A picture of the slide subject (contact print) is attached with dry mounting tissue to the upper left-hand corner of a 3×5 inch card where it may be readily seen in thumbing through the index. The subject is placed in the remaining space at the top of the card. For brevity the major subjects of the index are abbreviated (G—genetics, E—embryology) and followed by a descriptive sub-title. On the rest of the card is recorded the number of the slide represented, the number of the negative from which it was made, bibliographic ref-

[1] Lee R. Dice, SCIENCE, 89: 39, 1939.
[2] Atherton Seidell, SCIENCE, 89: 32, 1939.