ceased on May 18, indicating that the tissues below the inflorescence had then reached maturity. The second phase (DE) involving the growth of the inflorescence-bearing axis showed conspicuous irregularity of elongation at the start, but growth was fairly regular from May 19 to 29, then, with some irregularities, diminished and finally ceased June 11. The summation of the two phases (AB) shows that the growth of the entire scape had two maxima: the first of brief, the second of longer duration.

The term scape is here used to designate the flowering shoot of Corallorhiza, although features of growth and anatomical details not yet analyzed suggest that this member includes a reduced vegetative stem terminated by a raceme.

We are now in a position to emphasize certain unique features of the growth system of this plant.

The scape meristem at the base of the first internode is conjoined with that of the first sheathing scale. Its cell division and extension constitute the elongation of the first stages of the scape. Our measurements show that growth during this time is dependent upon growth-promoting substances contained in the basal region. Growth proceeded at a remarkably uniform rate, implying that materials were flowing upward from the base without accretion from the newly-formed cells. The meristematic cells passed into cell layers which in mature form lost their original character, but simultaneously those above that zone took on the meristematic character and produced new cell tracts.

The basal cells of the scape below the meristem passed into a mature condition, but the meristem was progressively pushed upward, carrying ahead of it the terminal portion, which was then in an embryonic condition. During this stage, the internode bearing the third scale was being differentiated above it. The coordinated growth of the node and the scape above it duplicated the growth of the basal internode with the result that the intact apex of the third scale was pushed up through the tip of the second, from which it and the node soon emerged completely. The scape then included an elongating basal internode a few centimeters in length and a similar meristem in a younger stage in the internode above. The salient feature of this activity of two coordinated meristems is shown by the graphs of Fig. 1.

A unique system of translocation of material then prevailed. Carbohydrates and other building materials synthesized in the underground organs were hydrolyzed and moved upward to the meristem and through it to the meristem of the upper internode and then into the embryonic inflorescence. This movement was not, as ordinarily, through vessels, sieve-cells or other conduits, the only xylem element recognized being a few spiral vessels. This feature of solute translocation through an active meristem is unknown in any other plant in so far as the present writers are informed. No effective agency can be predicated. The rate of conduction is so adequate that surplus starch is accumulated through the length of the scape, not excluding the meristematic region.

In the next stage the inflorescence is pushed from the tip of the uppermost scale and is followed by the development of flowers and seed-pods, thus creating a still greater draft on the translocated material. Particular attention was devoted to the influence of the flowers on the rate of elongation of the main axis. The two lower flower-buds diverged from the axis on April 28 concomitant with swelling of the buds. It was noted with great interest that flowers opened only after the region of the axis from which they arose had ceased elongation.

A remarkable feature is the translocation of substances necessary for growth through an active meristem; indeed, during a short period they passed through two meristems. Growth under natural conditions in the open air lacked the salient features of the S-shaped curve characteristic of other plants, as the high rate of acceleration, shown by the summation graph, was in the early stage of development.

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GUANIDINO ARSENICALS

FOLLOWING up the recent work from these laboratories on amidino arsenicals,[1] the study of the guanidino arsenicals has been undertaken, since our search of the literature has failed to reveal any compounds of this type, and certain of the closely related ureido arsenicals, like carbarsone (*p*-ureidobenzenearsonic acid), possess useful therapeutic properties.

Of the various methods[2] which have been employed for the synthesis of guanidine derivatives related to the kind we have in mind, one of the simplest is that utilized by Ville[3] for the preparation of N-guanylsulfanilic acid (I) by condensing sulfanilic acid with cyanamide.

$H_2NC(:NH)NHC_6H_4SO_2OH$ (I)
$H_2NC(:NH)NHC_6H_4AsO(OH)_2$ (II)
$H_2NCONHC_6H_4AsO(OH)_2$ (III)
$H_2NC(:NH)NHC_6H_4As:AsC_6H_4NHC(:NH)NH_2$ (IV)

A similar condensation therefore was attempted between cyanamide and arsanilic acid, and the ana-

[1] Linsker and Bogert, *Jour. Am. Chem. Soc.* (a) 65: 932–935, 1943; (b) 66: 191, 1944.
[2] Bischoff, *Jour. Biol. Chem.*, 80: 345, 1928.
[3] Ville, *Comp. rend.*, 104: 1281, 1887; *Bull. soc. chim.* [2], 49: 41, 1888.

logous N-guanylarsanilic acid (II) was obtained in the form of its monohydrate, as lustrous transparent colorless prismatic crystals, $C_7H_{10}AsN_3O_3 \cdot H_2O$, which lost weight and became white and opaque when heated *in vacuo*. This opaque product, which gave analytical figures agreeing with those calculated for $C_7H_{10}AsN_3O_3$, when heated darkened around 250–260°, gradually turning black but was still unmelted at 350°.

The same guanylarsanilic acid (II) was obtained by the interaction of arsanilic acid, the methyl sulfate addition product of thiourea and alkali, according to the Rathke procedure, as utilized by Wheeler and Merriam[4] for the synthesis of *o*-guanidinobenzoic acid from anthranilic acid. The hydrolysis of this guanyl arsanilic acid to carbarsone (III) is now being investigated.

Preliminary experiments have also been carried out in the reduction of the guanylarsanilic acid to the corresponding 4,4′-diguanidinoarsenobenzene (IV), but the product awaits final purification and identification. The synthesis of other guanidino arsenicals, including derivatives of both tri- and pentavalent arsenic, is also under way and will be reported later.

Full experimental details and analytical results will be published elsewhere.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A STANDARD PENICILLINASE PREPARATION

IN 1943, Lawrence[1] reported that Clarase was capable of inactivating penicillin, and suggested this enzyme preparation as an agent in the sterility test for penicillin. Later, both Stanley[2] and Lawrence[3] showed that the penicillin destroying power of Clarase was due to a bacterial air-borne contamination in the preparation of a specific lot (1351) of the enzyme. Clarase, Lot 1351 of the Takamine Laboratories, Clifton, N. J., is now used in the Official Food and Drug Administration sterility test for penicillin. In a great number of determinations in our laboratories, the use of Clarase has been found to present a number of difficulties. The preparation of the Clarase solution is lengthy and the solution is difficult to sterilize by filtration. From 24 to 36 hours are required to inactivate the penicillin which is to be tested for sterility. A more powerful penicillin inactivating agent which could easily be sterilized and standardized appears therefore very desirable.

Harper[4] prepared penicillinase preparations from paracolon bacilli for use in the sterility test and for inactivating penicillin in blood samples. Ungar[5] described a penicillinase preparation produced from the culture medium of a strain of *B. subtilis*. The preparation was used successfully for both the penicillin sterility test and exudates of body fluids from patients under penicillin treatment. However, neither of the investigators gave quantitative methods of standardizing their preparations. If a material is to be used routinely as a penicillin inactivating agent, it should be of known activity.

Using the bacterium NRRL-B569[6] and a modified procedure of Benedict and Schmidt,[7] we have prepared a very active penicillinase preparation which was sterilized by filtration and standardized according to the method of McQuarrie and Liebmann.[8] Aliquots containing 2,000 penicillinase units were lyophilized and sealed in sterile bottles. Bottles were stored until needed, then diluted with sterile water. The resulting solution was aseptically added to the penicillin sample to be tested for sterility.

The penicillinase was tested for its effect on bacteria likely to be present in unsterile penicillin preparations or in blood samples. In all cases the enzyme preparation had no effect on the growth of these organisms. In fact the growth in those tubes to which penicillinase had been added was more luxuriant than in those to which Clarase had been added in parallel tests. This would indicate the fact that either the nature of the enzyme itself or its associated impurities serve as growth-promoting substances. This may be of distinct advantage in the test.

Samples of penicillin were tested for sterility by both the official FDA method and by FDA method with 100 units of our penicillinase substituted for the Clarase. When Clarase was used a minimum of 36 hours was required for complete destruction of the penicillin. With our penicillinase preparation, less than one hour was required. By adding higher concentrations of the enzyme, an almost immediate destruction can be effected.

Preliminary studies with blood samples from animals infected with *Staph. aureus* indicate that the

[4] Wheeler and Merriam, *Am. Chem. Jour.*, 29: 491, 1903.
[1] C. A. Lawrence, SCIENCE, 98: 413, 1943.
[2] A. R. Stanley, *ibid.*, 99: 59, 1944.
[3] C. A. Lawrence, *ibid.*, 99: 15, 1944.
[4] G. J. Harper, *Lancet*, ii: 569, 1943.
[5] J. Ungar, *Nature*, 154: 236, 1944.
[6] Kindly supplied by Dr. R. D. Coghill, of the U. S. Northern Regional Research Laboratories.
[7] Private communication from Dr. R. G. Benedict, of the U. S. Northern Regional Research Laboratories.
[8] E. B. McQuarrie and A. J. Liebmann, *Arch. Biochem.*, in press.