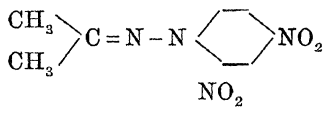
SCIENTIFIC APPARATUS AND LABORATORY METHODS

A NEW METHOD OF DETECTING AND ESTIMATING SMALL AMOUNTS OF ACETONE

AT the recent meeting of the "Medizinischnaturwissenschaftliche Gesellschaft," of the University of Tübingen, Professor Carl Bülow described a new method of detecting and estimating quantitatively small amounts of acetone in urine. The method is based upon the earlier observations of Purgotti[1] and Theodor Curtius,[2] that in boiling alcoholic solutions certain aldehydes and ketones form condensation products with 2.4 dinitro-phenyl-hydrazine. The new product thus obtained with acetone, namely, acetone 2.4 dinitro-phenyl-hydrazon, is quite insoluble in cold water. Its formula is



and its mol. wt. 238.

In the course of a series of researches on monochloracetone and other substituted ketones, Professor Bülow found that the reaction between acetone and dinitro-phenyl-hydrazine goes to completion, even in the cold, in a ten per cent. aqueous solution of muriatic acid. A yellowish, milky precipitate is formed which rapidly changes to fine needle-like crystals, that can readily be filtered off, washed, dried and weighed. These needles are insoluble in hot water as well as in fifty per cent. alcohol. They are consequently washed with hot water, then with alcohol, and finally dried and weighed. 238 grams of the product correspond to 58 grams of acetone.

Bülow's new "acetone reagent" is prepared by dissolving 0.33 grams of 2.4 dinitro-phenyl-hydrazine in 250 cc. alcohol, adding 10 cc. of 10 per cent. hydrochloric acid and heating till the product has completely dissolved.

The test is made by acidifying 10 cc. of urine with 1 cc. of hydrochloric acid, and then adding the "acetone reagent" in sufficient quantity. If the urine contains more than 0.5 per cent. of acetone, a yellowish, milky precipitate forms in a few seconds. By this very simple means every physician can in a short time determine with certainty whether acetone is present or not. Bülow, who is preparing a paper describing the test in greater detail, claims that 0.03 per cent. of acetone may still be estimated quantitatively by this method. It is at his request that I am presenting this report to the readers of SCIENCE at this time.

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1 *Gazetta Chimica Italiana*, 1893.

2 *Jour. prakt. Chem.*, 50, 257.

SPECIAL ARTICLES

MERCURY AND IONIZED HELIUM

Two investigators have recently made preliminary reports that under certain conditions of electrical discharge gaseous helium becomes capable of entering into chemical combination. According to J. J. Manley,[1] mercury and helium, in the presence of electric glow discharge, combine with contraction of volume to form a stable gaseous mercury helide which must be raised to a bright red heat in order to decompose it and to restore the original volume. On the other hand, E. H. Boomer,[2] while finding evidence that helium under electronic bombardment forms solid compounds with mercury, iodine, sulphur and phosphorus, which are stable at low temperature, reports that on allowing the temperature to rise from that of liquid air, the helides of sulphur and phosphorus decompose sharply at $-125°$ C., and those of iodine and mercury at $-70°$ C.

Since in both cases the activation of helium was supposed to take place under conditions where its ionization might be expected, it was interesting to see if combination could be detected with another mode of ionization. We have been engaged in the study of various chemical reactions under the ionizing influence of radon, and therefore were led to carry out the following experiment.

An elongated spherical glass bulb of 5.5 cm^3 volume was carefully evacuated at elevated temperature to 0.0001 mm pressure by means of a mercury vapor pump. Then 191 milli-curies of radon were introduced, at an initial pressure of 0.2 mm which did not change by more than 0.1 mm over a period of 5 hours, as determined by means of a mercury manometer separated from the reaction chamber by a fine capillary to avoid contact with mercury. Having thus established that no gas was evolved from the walls under the alpha-ray bombardment, mercury was run into the vessel up to a mark, so as to occupy approximately one fourth of its volume and to present a surface of about 3 cm^2. Over a period of 22 hours the pressure remained constant within 0.1 mm of mercury, establishing a blank for the vessel containing radon in contact with mercury. The mercury was then withdrawn and 614.1 mm of helium were introduced, which had been purified by passing repeatedly through active charcoal at liquid air temperature, until the nitrogen bands had entirely disappeared. Action of radon on this helium produced no change in pressure of as much as 0.1 mm in 22 hours.

Mercury was then again introduced to the previous

1 *Nature*, 114, 861 (December 13, 1924).

2 *Nature*, 115, 16 (January 3, 1925).

mark and no change of pressure resulted of more than 0.3 mm mercury in 47 hours. The entire chamber with contents was then immersed in liquid air, the pressure was determined and temperature measurement (accurate to 0.03° C.) was made with a platinum resistance thermometer. After 22 hours the temperature and pressure were again determined and no change of pressure exceeding 0.2 mm was found to have taken place, leading to the conclusion that under alpha-ray bombardment no disappearance of helium had resulted. In the great majority of reactions that we have studied the ratio (M/N) of the number of molecules reacting to the number of ion pairs generated is of the order from 1 to 6. Since for a value of M/N equal to unity, the pressure of helium would have decreased by 50 mm in this experiment, there is no evidence of the formation of a helium compound. This negative result with α-particles does not prove that helium and mercury do not interact under electrical discharge, since electron bombardment frequently produces chemically active resonance states, which are not known to be produced by alpha-particles.

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THE NATIVE HOST OF THE CHIGGER

WITHIN the past few years several acarologists have undertaken investigations hoping to answer the question of the native host of our common chigger, named by Dr. H. E. Ewing "The Mexican chigger-mite."[1] Among other studies of the Acarina undertaken by the author was an investigation of the above problem. The results have been most encouraging and seem to have settled this matter, at least in part.

Professor C. V. Riley and many of his students believed that the chiggers fed on various plant juices. Some larval Trombidiidae were then discovered on insects and the conclusion was drawn that all were parasitic on tracheates. During his studies Dr. Ewing came into the possession of a specimen of King snake, *Lampropeltis getulus getulus,* infested with the chigger that attacks man. While prosecuting this study the snake molted and all the mites were cast with the skin. None were reared to maturity, and the conclusion was drawn that the snake did not serve as a natural host. In a short article appearing in SCIENCE[2] during the past year Dr. Ewing reports as follows: "That he has found the hitherto unknown full-grown form of the common chigger, together with strong indications that the rabbit is largely responsible for its spread. The adult chigger has been known to entomologists as Trombicula . . ."

A few years ago several specimens of black snakes, *Zamenis constrictor,* were captured that had small red parasitic mites attached to the skin between the scales. Not having any particular interest in the Acarina at this time the specimens were allowed to escape without further study.

During the summer of 1923 several black snakes, *Zamenis constrictor,* and garter snakes, *Eutoenia sirtalis,* of various sizes were captured that also carried the small red mites between the scales. Specimens were removed, mounted and determined as *Trombicula tlalzahuatl* Murray. These determinations were later confirmed by Dr. Ewing. The hosts were confined and fed, but none of the mites had reached maturity when it was necessary to discontinue the observations.

During the season of 1924 large and small specimens of the black snake, *Zamenis constrictor,* the garter snake, *Eutoenia sirtalis,* the common hog-nosed snake, *Heterodon platyrhinus,* the black hog-nosed snake, *Heterodon platyrhinus niger,* and the eastern ring-necked snake, *Diadophis punctatus,* were captured carrying countless numbers of chiggers. These hosts were taken throughout southern Ohio. Copperheads, rattlesnakes and water snakes, although examined alive, were never found to be infested with the chiggers. The infested snakes were confined in suitable aquaria and fed on newts, toads and frogs. Due to the molting of several of the snakes their parasites were lost, as had been the experience of Dr. Ewing. Observations were made daily, but at no time did any of the snakes appear annoyed by the presence of the numerous parasites. Engorgement was very slow. When engorged to repletion the bright red body protruded beyond the margin of the overlapping scale and was easily seen. After an infested snake has fed and the scales are widely separated due to the engorged condition of the body the parasites, apparently standing on their heads, are very conspicuous. No mites have been found attached beneath the ventral scales or beneath the close set scales of the head.

Throughout late September the engorged larvae, which have been in this condition for several weeks, begin to fall from the host and make their way by very sluggish movements into the loose soil to a depth of from one half inch to an inch. The length of time between apparent engorgement and detachment from the host may be necessary to allow extrication of the mouthparts. From two to three weeks is spent in a quiescent stage similar to the pupal stage of many insects after which the adult emerges, but from all

[1] "The chigger mites affecting man and the domestic animals," H. E. Ewing and A. Hartzell, *Jour. Ec. Ent.,* 2, 2, 1918, p. 261.

[2] "Life history of chigger," H. E. Ewing, SCIENCE—Supplement, 2, LIX, 1924, p. xiv.