bromo compounds are brilliant yellow, the iodo derivatives are somewhat deeper in color and the nitro substitution products are yellow to golden-brown. They are insoluble in water, slightly soluble in alcohol and most organic solvents, but are easily purified by recrystallization from acetic acid. They dissolve readily in concd. sulfuric acid with the production of brilliant red colors. Melting points were determined with short-scale thermometers and the mercury column totally immersed.

Measurements of the absorption of these compounds in acetic acid by Walter C. Holmes indicate that the maximum absorption occurs too far in the red end of the spectrum to allow use of direct absorption measurement methods.

Summary

5-Bromo-, 5-chloro-, 5-iodo- and 5-nitrovanillins have been condensed with the isomeric 2-thio-3-tolyl-4-thiazolidones.

WASHINGTON, D. C.

[CONTRIBUTION FROM THE CHEMICAL LABORATORY OF IOWA STATE COLLEGE]

A QUALITATIVE COLOR TEST FOR THE GRIGNARD REAGENT

BY HENRY GILMAN AND F. SCHULZE[1]

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In connection with studies involving the Grignard reagent a need was felt for a sensitive qualitative test which could be carried out in a short time. When organomagnesium halides are treated with such reagents as carbon dioxide and isocyanates a smooth reaction occurs and the products obtained lend themselves to ready identification. However, the preparation of these and other derivatives has inherent disadvantages, in particular, the tediousness and time involved in testing for small quantities.

The idea of the color test which is described here is not novel. It was suggested by experiments made by Ehrlich and Sachs[2] on the preparation of triphenylmethane dyes from *p*-dimethylamino-phenylmagnesium bromide. Furthermore, F. and L. Sachs[3] proposed the use of Michler's ketone (tetramethyl-diaminobenzophenone) as the best reagent for the detection of phenylmagnesium bromide, because of the ready formation of malachite green.

The test as finally developed is readily made as follows. One-half to 1 cc. of the solution to be tested is treated, at room temperature, with an

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[1] This paper is an abstract of a part of a thesis presented by F. Schulze in partial fulfilment of the requirements for the degree of Master of Science in Chemistry at Iowa State College.

A report of this work was made at the Spring Meeting of the American Chemical Society held at Baltimore, Md., in April, 1925.

[2] Ehrlich and Sachs, *Ber.*, **36**, 4296 (1903). Baeyer, *Ann.*, **354**, 152 (1907). Votocek and Matejka, *Ber.*, **46**, 1755 (1913). Holt and Reid, THIS JOURNAL, **46**, 2329 (1924).

[3] F. and L. Sachs, *Ber.*, **37**, 3088 (1904).

equal volume of a 1% solution of Michler's ketone in dry benzene. The reaction product is then hydrolyzed by the slow addition of 1 cc. of water, during which the test-tube is gently agitated to moderate the vigor of reaction. The subsequent addition of several drops of a 0.2% solution of iodine in glacial acetic acid develops a characteristic greenish-blue color when Grignard reagent is present.

Tertiary alcohols are ordinarily formed when Michler's ketone reacts with RMgX compounds.[3,4] With aliphatic Grignard reagents, the tertiary alcohols so formed are readily converted to the corresponding ethylenic derivatives by the loss of water.[4a,4c,4d,4e] However, by observing special precautions the corresponding carbinols can be prepared.[4b] Many compounds containing the carbonyl group are reduced to the corresponding carbinols when warmed with most aliphatic Grignard reagents.[5]

These facts suggested the use of the ethylenic compounds derived from Michler's ketone, and Michler's hydrol (tetramethyl-diaminobenzohydrol) as possible reagents for a color test. They were soon discarded when it was found that they gave colors with a wide variety of compounds other than the Grignard reagent. It was partly in connection with these tests that the importance of the iodine-glacial acetic acid solution was realized.

Compounds Giving Positive Tests.—A comprehensive variety of Grignard reagents gave positive tests. In all, 25 different compounds were tested, and the only one that gave a comparatively weak and yet pronounced test was phenylacetenylmagnesium bromide,[6] ($C_6H_5C\equiv CMgBr$). The RMgX compound can be present in such solvents as benzene, dimethylaniline, pyridine and quinoline[7] in addition to ether which is customarily used.

Phenylcalcium iodide,[8] phenylbarium iodide, sodium-ethyl and sodium-*p*-tolyl also gave positive tests.

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[4] (a) Freund and Mayer, *Ber.*, **39**, 1117 (1906). (b) Fecht, *Ber.*, **40**, 3893 (1907). (c) Busignies, *Compt. rend.*, **149**, 348 (1909). (d) Lemoult, *ibid.*, **149**, 606 (1909). (e) Wahl and Mayer, *Bull. soc. chim.*, [4] **7**, 28 (1910).

[5] Rheinboldt and Roleff, *J. prakt. Chem.*, **109**, 175 (1925).

[6] This correlates with unpublished results on the lesser activity of phenylacetenylmagnesium bromide towards azo compounds and aryl esters of sulfonic acids.

[7] F. and L. Sachs (Ref. 3) did not get malachite green when the addition compound of quinoline and phenylmagnesium bromide was treated with Michler's ketone. They interpreted this as a definite reaction product between quinoline and phenylmagnesium bromide, as is the case with carbonyl compounds and phenylmagnesium bromide, for example. A sufficient amount of the acetic acid solution does give the color test.

[8] When the supposed ethylcalcium iodide was prepared according to the method of Beckmann [*Ber.*, **38**, 904 (1905)] no positive test was obtained. However, the compound did not liberate ethane when hydrolyzed, and it may have been calcium iodide. Beckmann did not prepare any derivative of his ethylcalcium iodide. Further studies on organocalcium halides are in progress.

The test was used by Gilman [THIS JOURNAL, **45**, 2639 (1923)] in some unsuccessful attempts to prepare directly organoberyllium halides.

Compounds Not Giving Positive Tests.—Apparently no color is obtained from compounds which have the -MgX group attached to an element other than carbon. A variety of -OMgX, -NMgX, -SMgX and -AsMgX[9] compounds was studied. The absence of tests with such compounds makes the test for the Grignard reagent particularly valuable in showing the completion of a reaction when an excess of RMgX compound is not used.

No tests were obtained with the following: ethylzinc iodide, zinc diethyl, mercury diethyl, mercury di-*p*-tolyl, *p*-tolylmercuric iodide and lead tetraethyl. These results might have been predicted because the compounds mentioned do not add to the carbonyl group.

Magnesium chloride, bromide and iodide, and basic magnesium halides gave no tests. These compounds are almost invariably present in Grignard reagents.

Delicacy of Test.—Ethylmagnesium bromide was progressively diluted with ether, and a positive test was obtained in a 0.037 *M* solution.[10] Inasmuch as the color deepens generally with the increasing size of the R group in the RMgX compounds, the concentration obtained with ethylmagnesium bromide may be taken as a maximum for the sensitivity of the test.[11]

Intermediate Colors.—When Michler's ketone is added to the solution containing the RMgX compound, a yellow precipitate or a yellow solution results. The careful addition of water develops a deep green color which disappears when more water is added. The apparent absence of this green color is not to be taken as a proof of the absence of Grignard reagent, for the color is very easily missed with dilute solutions.

No more than 1 cc. of the acetic acid-iodine solution is required to develop the greenish-blue color when the Grignard reagent is present.

Schmidlin and Escher[12] have reported the development of a deep blue color when cyclohexylmagnesium bromide is added to Michler's ketone. This addition compound, formed both in cold and on warming ether solution, gave unaltered ketone when hydrolyzed by acids. Wahl and Meyer[4e] make no mention of the blue color, but they do confirm essentially the recovery of much unchanged ketone. However, they did get a reaction after protracted digestion, but the yield of ethylenic hydrocarbon was very poor.

Interference of Magnesium.—Obviously, if the sample removed for testing contains unaltered magnesium the final addition of acetic acid

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[9] Job, Reich and Vergnaud [*Bull. soc. chim.*, **35**, 1404 (1924)] found that -AsMgX compounds react readily with carbon dioxide. They reported no other reactions with the carbonyl group, but stated that arsenylmagnesium halides are much less active than the Grignard reagent towards esters, aldehydes and ketones.

[10] The ethylmagnesium bromide was quantitatively estimated by the gas method of Gilman, Wilkinson, Fishel and Meyers [THIS JOURNAL, **45**, 150 (1923)].

[11] Phenylmagnesium bromide gives a strong positive test in a concentration not greater than 0.02 *M*.

[12] Schmidlin and Escher, *Ber.*, **41**, 447 (1908). See also Ref. 4 a. Under the conditions described in this paper cyclohexylmagnesium bromide did not appear to act unlike other -CMgX compounds.

will cause reduction of Michler's ketone to the corresponding hydrol, and under the conditions of the test a deep blue or purple color develops slowly. This color is unlike that formed by the Grignard reagent. However, when unchanged magnesium (or other metal) is noted in the sample, it is recommended that the solution be filtered subsequent to hydrolysis and prior to the addition of the glacial acetic acid-iodine solution. This alteration in procedure is desirable when one removes a sample from a highly viscous or solid reaction product, such as that formed in the preparation of acids. In such cases any unchanged magnesium may not be evident.

Summary

A qualitative color test is described for the Grignard reagent. The test color is only shown by those organomagnesium halides having the -MgX group attached to carbon.

AMES, IOWA

[CONTRIBUTION FROM THE DRUG CONTROL LABORATORY IN COÖPERATION WITH THE COLOR LABORATORY, BUREAU OF CHEMISTRY, UNITED STATES DEPARTMENT OF AGRICULTURE]

AZO DYES FROM ALKALOIDS OF IPECAC ROOT AND THEIR IDENTIFICATION BY MEANS OF THE SPECTROSCOPE[1]

BY S. PALKIN AND H. WALES

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In a recent paper[2] a method was outlined for the identification of phenols, based on the coupling of these substances with diazonium compounds and the measurement of the absorption spectrum maxima of the dyes thus formed. The present paper describes the application of this principle to the identification of certain ipecac alkaloids which are either phenols or amines. The proposed method identifies the cephaeline obtained from a few drops of fluid extract of ipecac in a mixture of 100 cc. of other drugs, if not unduly complicated by interfering substances.

The alkaloids of ipecac have been studied by Paul and Cownley,[3] Hesse[4] and Carr and Pyman.[5] Carr and Pyman have shown that ipecac contains five alkaloids, namely, emetine, cephaeline, psychotrine, methylpsychotrine and emetamine. According to these authors cephaeline and psychotrine are phenolic, and emetamine is probably an amine.

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[1] Read before the Division of Chemistry of Medicinal Products at the Baltimore Meeting of the American Chemical Society, April, 1925.

[2] Palkin and Wales, THIS JOURNAL, **46**, 1488 (1924).

[3] Paul and Cownley, *Pharm. J. Trans.*, [3] **25**, 111, 690 (1894–5); *Pharm. J.*, [4] 7, 98 (1898).

[4] Hesse, *Ann.*, **405**, 1 (1914).

[5] Carr and Pyman, *J. Chem. Soc.*, **105**, 1591 (1914); **111**, 419 (1917).