the excess of silver is then precipitated with neutral 20% sodium chloride solution, and the excess of free alkali in solution finally determined by titration with standard hydrochloric acid solution using methyl orange as indicator. Having calculated once for all the volume of acetylene under standard conditions of temperature and pressure to which 1 cc. of the standard alkali is equivalent, the acetylene in any sample analyzed follows directly from the volume of standard alkali required for the titration, and this volume of acetylene expressed in terms of the volume of the sample taken, when also reduced to standard conditions of temperature and pressure, gives the percentage of acetylene in the sample.

The method as described is rapid, accurate and simple of manipulation, and has the added advantage of giving accurate results for acetylene in mixtures of ethylene or of a gas of such similar properties as vinyl bromide which is readily absorbed in bromine, fuming sulfuric acid and in neutral or ammoniacal silver nitrate.

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NOTE.

The Use of Coal as a Substitute for Talcum to Induce Rapid Boiling.—While we were attempting to improve the method for the determination of small amounts of iodine, some substitute for talcum was sought which would cause a rapid boiling of the solution. The usual laboratory agents, such as pumice stone, powdered brick, broken glass, glass beads, granite, etc., were tried and found to be unsuitable. The theoretically ideal agent would have to be insoluble in acid and alkali and not acted on by reduction or oxidation.

Carbon in its various forms answers the theoretical requirements. It was found, however, that the various forms of carbon differ greatly in their power to cause rapid boiling of a solution. While powdered charcoal or coke has slight power in this respect, anthracite coal is without exception the very best substance to bring about the rapid boiling of a solution. The formation of bubbles does not take place on the sharp edges and corners alone, but over the hard, smooth surfaces of the coal minute bubbles form with great rapidity, and under some conditions a piece of coal 2 cm. cube can be raised from the bottom of the flask by the rapid formation of bubbles on its surface. It acts in a similar manner in the acidification of a carbonate or sulfite solution. The bubbles of sulfur or carbon dioxide are liberated on the surface of the coal. Coal is equally successful in preventing bumping in Kjeldahl flasks and in the distillation of organic liquids. If the coal is kept under water indefinitely it becomes less active, but heating in an oven will restore its activity, Another great advantage of coal is the fact that it is easily cut with a dental drill and a small glass hook can be inserted in the coal. After the solution has been boiled, if it is so desired, the coal may be removed by a glass rod with a hooked end which passes through the glass hook in the coal. One or two pieces about 1 cm. cube are better than many smaller pieces. As powdered anthracite coal has almost no effect, the specific and unusual properties of hard coal in this regard must be due to its structure in the mass. E. C. KENDALL.

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ON THE QUINONE-PHENOLATE THEORY OF INDICATORS. ON THE REACTIONS OF PHENOLSULFONPHTHALEIN, AND ITS BROMO AND NITRO DERIVATIVES, AND THEIR MONOBASIC AND DIBASIC SALTS.[1]

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The quinone-phenolate theory of indicators was brought out fully in 1908 by one[2] of the authors of this paper to explain the striking changes of color produced by the addition of alkalies to solutions of aurine, phenolphthalein and analogous substances. The chief color change was assumed to be merely the transformation of the faint yellow quinone-phenol, $—C(:C_6H_4:O)(C_6H_4OH)$, into the quinone-phenolate salt, $—C(:C_6H_4:O)(C_6H_4OK)$, common to all these substances and absorbing the violet, blue, and green and transmitting the red light. The theory proposed was an attempt to correlate (1) the relations between the constitution and color changes of the rosaniline, aurine, and phenolphthalein salts on the one hand and (2) the mathematical relations of the tautomeric forms and the affinity constants and reaction velocities of the various acid and salt groups on the other hand, as had been done by the application of the mass law and conductivity and reaction velocity measurements to the urazole series.[3]

The work of Friedländer[4] and of Nietzki[5] and his students showed clearly that lactoidal colorless phenolphthalein (I) changes into salts of a colored quinoidal form (II),

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[1] The material presented in this paper and in two earlier articles (THIS JOURNAL, **39**, 648 and **40**, 1092 (1917)) represents a thesis presented to the Regents of the University of Wisconsin in 1915 by E. C. White, in partial fulfillment of the requirements for the degree of Doctor of Philosophy. The experimental work was performed partly in Johns Hopkins University, and partly in the Forest Products Laboratory, Madison, Wisconsin.

[2] *Am. Chem. J.*, **37**, 72 (1907); **39**, 155, 528 (1908).

[3] *Ibid.*, **39**, 124, 226 (1908).

[4] *Ber.*, **26**, 172 (1893).

[5] *Ibid.*, **28**, 45 (1895); **30**, 175 (1897).