from this equation are shown in column four in Table I.

TABLE I

STANDARD POTENTIALS OF THE CELL Pt–H_2(g)/HCl(*m*)/AgCl–Ag

Temp., °C.	*E*° (obsd.) (Harned and Ehlers)	*E*° (obsd.) (int. volts)	*E*° (calcd.) (int. volts)	*E*° (calcd.) (abs. volts)	2.30259 *RT/F* (abs. volts)
0	0.23634	0.23641	0.23639	0.23647	0.054195
5	.23392	.23399	.23398	.23406	.055187
10	.23126	.23133	.23137	.23145	.056179
15	.22847	.22855	.22858	.22865	.057171
18	.....	.....	.22682	.22689	.057766
20	.22551	.22559	.22561	.22568	.058163
25	.22239	.22247	.22247	.22254	.059155
30	.21912	.21920	.21917	.21924	.060147
35	.21563	.21571	.21571	.21578	.061139
37	.....	.....	.21425	.21432	.061536
40	.21200	.21208	.21210	.21216	.062131
45	.20821	.20829	.20834	.20841	.063123
50	.20437	.20446	.20445	.20452	.064115
55	.20035	.20044	.20043	.20050	.065107
60	.19620	.19629	.19628	.19635	.066099

The constants of this equation were multiplied by the factor[2] 1.000330 yielding $E°$ in absolute volts: $E°$ (absolute volts) $= 0.22254 - 6.4471 \times 10^{-4}(t - 25) - 3.277 \times 10^{-6}(t - 25)^2 + 8.99 \times 10^{-9}(t - 25)^3$. Values of $E°$ calculated from this equation are shown in column five in Table I. These results should be used in future calculations of the ionization constants of weak acids and bases.

For convenience, the values of the function 2.30259 RT/F in absolute volts are shown in column six of Table I. These values were calculated using the constants listed by Bearden and Watts,[6] $R = 8.3144$ abs. joules mole^{-1} deg.$^{-1}$, $T_0 = 273.16$°K. and $F = 96495.4$ abs. coulombs equiv.$^{-1}$.

DuMond and Cohen[7] list a slightly different value of the Faraday, 96519.4 abs. coulombs equiv.$^{-1}$ on the physical scale corresponding to 96493.1 abs. coulombs equiv.$^{-1}$ on the chemical scale. This value, differing from that of Bearden and Watts by 2 parts in 10^5, would increase 2.30259 RT/F by one digit in the fifth significant figure but this is within the limits of error of the above calculations.

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(6) J. A. Bearden and H. M. Watts, *Phys. Rev.*, **81**, 73 (1951).

(7) J. W. M. DuMond and E. R. Cohen, *ibid.*, **82**, 555 (1951).

DEPARTMENT OF CHEMISTRY
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RECEIVED JULY 18, 1951

A New Synthesis of 4,6-Diamino-2,5-dichloropyrimidine

BY E. C. TAYLOR, JR.,[1] AND P. DRENCHKO

In the course of a program on synthetic pteridines, 4,6-diamino-2-chloropyrimidine was desired as a possible intermediate. Chlorination of 4,6-diamino-2-hydroxypyrimidine with phosphorus oxychloride was unsuccessful; no reaction took place and the starting material was recovered unchanged. Addition of phosphorus pentachloride to the phosphorus oxychloride reaction mixture resulted in the formation of a clear solution, but the product of the reaction proved to be 4,6-diamino-2,5-dichloropyrimidine and not 4,6-diamino-2-chloropyrimidine as expected. The compound was formed in 64% yield, as contrasted with a 12.2% yield by the only previously reported method involving the treatment of 2,4,5,6-tetrachloropyrimidine with ammonia.[2] Such anomalous introduction of halogen by phosphorus pentachloride has been observed previously in the pyrimidine series. Chlorination of 2-amino-4,6-dihydroxypyrimidine with phosphorus oxychloride and phosphorus pentachloride gives largely 2-amino-4,5,6-trichloropyrimidine and some 2-amino-4,6-dichloropyrimidine, and barbituric acid under the same conditions yields 2,4,5,6-tetrachloropyrimidine.[2] Likewise, 2-hydroxy-4-methylpyrimidine has been reported to yield a compound designated as 2:x:x:x-tetrachloro-4-methylpyrimidine upon treatment with the same reagents.[3] Thus it would appear to be a valid generalization that chlorination in the 5-position of a pyrimidine may readily occur if phosphorus pentachloride is employed.

Experimental

4,6-Diamino-2,5-dichloropyrimidine.—A mixture of 200 ml. of phosphorus oxychloride, 130 g. of phosphorus pentachloride and 20 g. of 4,6-diamino-2-hydroxypyrimidine[4] was heated under reflux for two hours, the excess phosphorus oxychloride removed by distillation under reduced pressure and the sirupy residue poured onto ice. The resulting acid solution was adjusted to *p*H 8 with sodium bicarbonate and the precipitate which formed was collected by filtration, washed thoroughly with water and dried. The crude product was then placed in a soxhlet cup and continuously extracted with acetone over a period of 20 hours. Removal of the acetone and crystallization of the residue from ether-petroleum ether gave 18.2 g. (64%) of white needles melting at 303–305°. The reported[2] melting point for 4,6-diamino-2,5-dichloropyrimidine is 302–304°.

Anal. Calcd. for $C_4H_4N_4Cl_2$: C, 26.8; H, 2.3; N, 31.3. Found: C, 27.1; H, 2.4; N, 31.1.

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(1) du Pont Postdoctoral Fellow in Chemistry, 1950–1951.

(2) S. J. Childress and R. L. McKee, THIS JOURNAL, **72**, 4271 (1950).

(3) J. R. Marshall and J. Walker, *J. Chem. Soc.*, 1004 (1951).

(4) A. Bendich, J. F. Tinker and G. B. Brown, THIS JOURNAL, **70**, 3109 (1948).

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RECEIVED OCTOBER 20, 1951

Spallation Products from Cobalt and 240 Mev. Protons

BY GENEVIEVE WAGNER AND EDWIN O. WIIG

The nuclear reactions resulting when thin targets of pure cobalt ($_{27}Co^{59}$) were bombarded with 240 Mev. protons in the 130-inch Rochester cyclotron have been studied. In order to observe the products of the reactions inert carriers were added to a solution of the target and fractions containing the radioisotopes were separated.

The gross decay curve of each chemically separated fraction was resolved to give the half-lives of the individual radioactive species. The specific nuclides shown in Table I were identified on this basis. Further verification was provided by testing for positive and negative β-particles whenever the