$$\left.\begin{array}{l}C_2H_3Hg\\C_2H_3Hg\end{array}\right\} + I = \underbrace{C_2H_3Hg_2\ I}_{\text{Iodide of mercurous methyl.}} + C_2H_3.$$

On the other hand, the action of concentrated sulphuric or hydrochloric acid furnishes hydride of methyl or marsh gas, with deposition of crystals of the corresponding chloride or sulphate.

$$\left.\begin{array}{l}C_2H_3Hg\\C_2H_3Hg\end{array}\right\} + HCl = C_2H_3Hg_2Cl + C_2H_3,H.$$

The salts of mercurous methyl, and the radical mercuric methyl, are both decomposed by the action of a dilute acid and clean zinc, into metallic mercury and gases.

Mercuric methyl furnishes with bichloride of tin a crystalline compound, which decomposes, on addition of water, into chloride of mercurous methyl and a soluble tin salt. The same chloride also is produced by the action of terchloride of phosphorus.

Mercuric methyl is a ready solvent of caoutchouc, resins, and phosphorus. It, however, has but little solvent action on sulphur.

Some interest attaches to the circumstance that iodide of mercurous methyl is easily produced by heating mercuric iodide with mercuric methyl.

Mercuric ethyl.

The author has also prepared the radical of mercuric ethyl. From its proneness, however, to decomposition at the high temperature at which the reaction is effected, he has not been able to obtain more than sufficient to make a qualitative examination of the new body. It boils at a temperature above that of water; and burns with a more lurid flame than is exhibited by mercuric methyl.

III. "On Certain Formulæ for Differentiation." By Arthur Cayley, Esq., F.R.S. Received November 26, 1857.

(Abstract.)

In seeking for a formula in the theory of multiple definite integrals, I was several years ago led to investigate the successive differential coefficients of $(\sqrt{x+\lambda}-\sqrt{x+\mu})^{2i}$, and the results which I then obtained are given in my paper, "On certain formulæ for differentiations, with applications to the evaluation of definite inte-

grals*." I subsequently sought for the successive differential coefficients of the more general expression $\{(x+\lambda)(x+\mu)\}^{\frac{1}{2}k}(\sqrt{x+\lambda}-\sqrt{x+\mu})^{2i}$, but the investigation was not finished. My attention was recalled to the subject by two remarkable identities obtained in Prof. Donkin's memoir, "On the equation of Laplace's Functions, &c.†," by a comparison of his results with those of Prof. Boole, which identities I perceived to belong to the class of formulæ above referred to: the first of the two identities is in fact readily deduced from a formula in my paper; the demonstration of the second is much more difficult, and I have only succeeded in making it depend on the establishment of the equality of the coefficients of two expressions of the same form. I have since resumed the unfinished investigation above referred to. The several results which I have obtained are given in the present memoir. I remark that, putting for shortness $P=2x+\lambda+\mu$, $Q=\sqrt{(x+\lambda)(x+\mu)}$, $R=(\sqrt{x+\lambda}-\sqrt{x+\mu})^2$, the subject to which the results all belong is the differentiation of the expression $P^\alpha Q^\beta R^\gamma$; the before-mentioned expression $\{(x+\lambda)(x+\mu)\}^{\frac{1}{2}k}(\sqrt{x+\lambda}-\sqrt{x+\mu})^{2i}$ is of this form, and the question in relation to it is to obtain the development of $\partial_x^r P^\alpha Q^\beta R^\gamma$, where $\alpha=0$. The question arising from the second of Prof. Donkin's identities is to obtain the development of $(P^{-1}Q_4\partial_x)^\gamma P^\alpha Q^\beta R^\gamma$, where $\alpha=\gamma-\beta$. As the demonstration of these identities is one of the objects of the present memoir, I have given in the first section their reduction to the form in which they are considered. The second section treats of the development of the expression $\partial_x^r P^\alpha Q^\beta R^\gamma$ where $\alpha=0$; the third section of that of the expression $\{P^{-1}Q^4\partial_x\}^r P^\alpha Q^\beta R^\gamma$ where $\alpha=\gamma-\beta$; the fourth section contains the application of the formulæ to the demonstration of the two identities and some other applications of the formulæ.

* Cambridge and Dublin Mathematical Journal, t. ii. pp. 122, 128 (1847).

† Philosophical Transactions, 1856, pp. 43–57.