TABLE I

REACTION OF KETONES 1 WITH CSI TO YIELD OXATHIAZINES 5 AND OXAZINES 6[a]

Compd	R	R'	Solvent	% 5	Mp, °C	% 6	Mp, °C
a	Ph	Me	Ether	41.5	122.5	28.4	184.5
			CH_2Cl_2			43.0	
b	Ph	Et	Ether	41.2	113–113.5	7.7	132.5–133
			CH_2Cl_2			14.8[b]	
c	Me	Ph	Ether			70.6	166.5
d	$PhCH_2$	Ph	Ether			61.0	137–137.5
e	Ph	Ph	Ether	28.4	233.5–234.5	13.6	220–222
f			Ether	30.3	258.5–260	19.8	210–211

[a] Yields are for pure isolated products. [b] After 11 days' reaction time; 2-benzoylbutyramide [J. Büchi, P. Schneeberger, and R. Lieberherr, *Helv. Chim. Acta*, **36**, 1402 (1953)] was also isolated from this reaction in 34.5% yield.

lent of CSI, cyclization, and hydrolysis on work-up leads to **6**. Alternatively, cyclization of **3** with loss of HCl would give oxathiazines **5**. Further mechanistic studies are in progress and will be detailed in our full paper.

Despite the biological importance of uracil derivatives, and the intense interest in their chemistry,[10] few examples are known containing alkyl or aryl substituents on both the 5 and 6 positions.[10,11] The ready availability of starting materials and the nearly quantitative conversion of oxazines **6** to uracils **7** by treatment with concentrated aqueous ammonia provide a new regiospecific two-step synthesis of 5,6-disubstituted uracils which is more advantageous than most conventional routes.[12]

Acknowledgment.—Support of this research by a grant from the National Science Foundation is gratefully acknowledged.

(10) D. J. Brown, "The Pyrimidines," Wiley-Interscience, New York' N. Y., 1962.

(11) (a) M. Draminski and B. Fiszer, *Rocz. Chem.*, **43**, 499 (1969); *Chem. Abstr.*, **70**, 115100v (1969). (b) M. Ohoka, S. Yanagida, and S. Komori, *J. Org. Chem.*, **37**, 3030 (1972).

(12) Reference 11, pp 31–115, 227–237.

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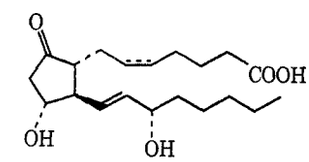
Syntheses of 11-Dehydro-13,14-dihydro-PGE$_1$ and PGD$_2$

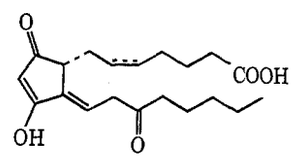
Summary: The syntheses of 11-dehydro-13,14-dihydro-PGE$_1$ (**9b**) and PGD$_2$ (**6b**) was achieved from diols **8** or **4**, respectively.

Sir: The formation of the triketo acid **2a** by oxidation of PGE$_1$ (**1a**) with Jones reagent has been reported by Pike, *et al.*[1] Similarly, we obtained the mixture of **2b** and **3**, at the ratio of 1:3 by oxidation of PGE$_2$ (**1b**) under the same condition (at 0°, for 20 min). **2b** had the following properties: uv $\lambda_{max}^{50\%\ EtOH}$ 282 nm; ir (liquid film) ν 3500–2500, 1707, 1560 cm^{-1}; nmr ($CDCl_3$) δ 6.50 (t, 1 H, C_{13} proton), 5.47 (s, 1 H, C_{10} proton), 5.35 (m, 2 H, C_5 and C_6 protons), 3.41 (d, 2 H, C_{14} protons). **3** had the following properties: uv $\lambda_{max}^{50\%\ EtOH}$ 231 nm; ir (liquid film) ν 3400, 3400–2500, 1740, 980 cm^{-1}; nmr ($CDCl_3$) δ 6.80 (dd, 1 H, C_{13} proton), 6.28 (d, 1 H, C_{14} proton), 5.38 (m, 2 H, C_5 and C_6 protons), 4.27 (q, 1 H, C_{11} proton).

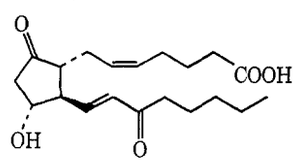
5 was formed, together with **6a** and **7a**, by oxidation of **4** under the same condition. There is a presumption that migration of the trans double bond to C_{12} will lower PG-like biological activity, and it is known that the saturation of the trans double bond to single bond retains its activity.[2] For these reasons we have synthe-



1a, no 5,6 double bond
b, 5,6 double bond



2a, no 5,6 double bond
b, 5,6 double bond



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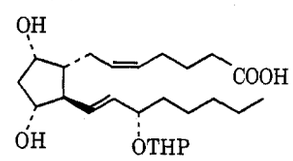

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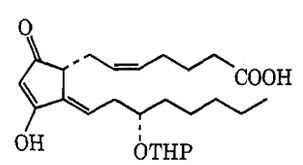

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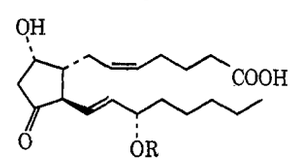
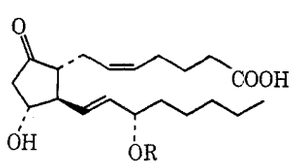
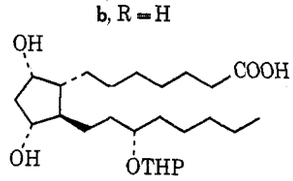


6a, R = THP
b, R = H



7a, R = THP
b, R = H



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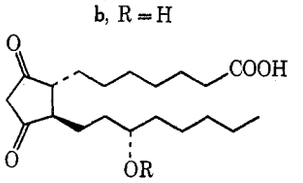
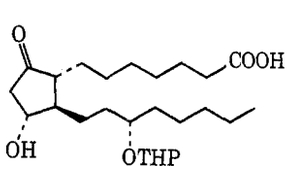


9a, R = THP
b, R = H



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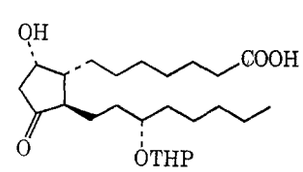

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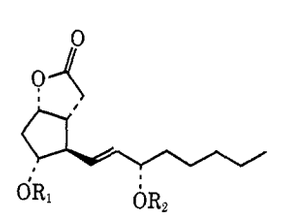
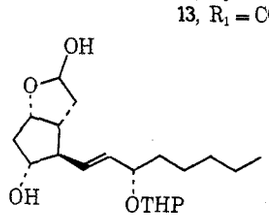


12, R_1 = $COCH_3$; R_2 = H
13, R_1 = $COCH_3$; R_2 = THP



14

(1) J. E. Pike, F. H. Lincoln, and W. P. Schneider, *J. Org. Chem.*, **34**, 3552 (1969).

(2) E. Ånggard, *Acta Physicol. Scand.*, **66**, 509 (1966).

sized **9b**. **9a** was obtained by oxidation of **8** with Jones reagent in 42% yield after purification. **10** and **11** were also obtained by oxidation of **8** by the same procedure.

Hydrolysis of **9a** in AcOH–H_2O (2:1) at 40° for 2 hr afforded 11-dehydro-13,14-dihydro-PGE_1 (**9b**): uv $\lambda_{max}^{50\%\ EtOH}$ 245 nm; ir (liquid film) ν 3600–2200, 1705, 1660, 1580 cm^{-1}; nmr ($CDCl_3$) δ 5.13 (s, 1 H, C_{10} proton); 48% yield. **9b** exists in the enolic form on the basis of ir and nmr data and does not show the PG-like biological activity.

Oxidation of **4** with Jones reagent under a mild condition (at −30° for 15 min) gave a mixture of **6a** and **7a** along with a trace of **5** in 75% total yield. It is very interesting that **6a** and **7a** are formed in a ratio of 2–3:1. **6a** was isolated from the mixture of **6a** and **7a** by column chromatography on silica gel (**6a** is less polar than **7a**) and hydrolyzed into PGD_2 (**6b**) in AcOH–H_2O (2:1) at 40° for 2 hr in 45% yield. **6b** was obtained as white crystals: mp 68° (recrystallized from EtOAc–*n*-hexane); ir (KBr) ν 3400–2500, 1740, 1700, 975 cm^{-1}; nmr ($CDCl_3$) δ 5.32 (m, 4 H, olefinic protons), 4.48 (m, 1 H, C_9 proton), 4.12 (m, 1 H, C_{15} proton), 2.83 (dd, 1 H, $C_{10\beta}$ proton), 2.42 (m, 1 H, $C_{10\alpha}$ proton), 2.43 (m, 1 H, C_8 proton). Similarly, PGE_2 (**7b**) was formed by hydrolysis of **7a**.[3]

(3) Ir, nmr, and R_f value on tlc were completely the same as those of authentic PGE_2.

PGD is one of the by-products in the biosynthesis of PGE.[4] The isolation and determination of the structure of PGD[4] have been already reported, but the chemical synthesis of PGD has not yet been reported.

The starting material **4** was obtained as follows. **12**[5] was converted into **13** quantitatively using 1.5 equiv of 2,3-dihydropyran and a catalytic amount of *p*-toluenesulfonic acid in methylene chloride at 25° for 15 min. Reduction of **13** by means of 5 equiv of diisobutylaluminum hydride in toluene at −60° for 15 min afforded **14** in 95% yield. **4** was formed by Wittig reaction of **14** with 4-carboxy-*n*-butylidenetriphenylphosphorane[6] in dimethyl sulfoxide in 68% yield.

8 was obtained by catalytic reduction of **4** with PtO_2 in ethanol at room temperature in 92% yield.

(4) E. Granström, W. E. Lands, and B. Samuelsson, *J. Biol. Chem.*, **243**, 4104 (1968); P. S. Foss, C. J. Sih, C. Takeguchi, and H. Schnoes, *Biochemistry*, **11**, 2271 (1972).

(5) E. J. Corey, T. K. Schaaf, W. Huber, U. Koelliker, and N. M. Weinshenker, *J. Amer. Chem. Soc.*, **92**, 397 (1970).

(6) R. Greenwald, M. Chaykovsky, and E. J. Corey, *J. Org. Chem.*, **28**, 1128 (1963).

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