## SCHUBERT POLYNOMIALS, THE BRUHAT ORDER, AND THE GEOMETRY OF FLAG MANIFOLDS

## NANTEL BERGERON AND FRANK SOTTILE

To the memory of Marcel Paul Schützenberger

## **CONTENTS**

1.	Summary	375
	1.1. Suborders of the Bruhat order and the $c_{uv}^w$	375
	1.2. Substitutions and the Schubert basis	377
	1.3. Identities when $\mathfrak{S}_v$ is a Schur polynomial	379
2.	Preliminaries	
	2.1. Permutations	382
	2.2. Schubert polynomials	382
	2.3. The flag manifold	383
3.	Orders on $\mathscr{G}_{\infty}$	
	3.1. The <i>k</i> -Bruhat order	385
	3.2. A new partial order on $\mathscr{S}_{\infty}$	388
	3.3. Disjoint permutations	390
4.	Cohomological formulas and identities for the $c_{uv}^w$	392
	4.1. Maps on $\mathscr{S}_{\infty}$	392
	4.2. An embedding of flag manifolds	
	4.3. The endomorphism $x_p \mapsto 0$	396
	4.4. Identities for $c_{uv}^w$ when $u(p) = w(p)$	398
	4.5. Products of flag manifolds	399
	4.6. Maps $\mathbb{Z}[x_1, x_2,] \to \mathbb{Z}[y_1, y_2,, z_1, z_2,]$	401
	4.7. Products of Grassmannians	403
5.	Identities among the $c^w_{uv(\lambda,k)}$	405
	5.1. Proof of Theorem E(ii)	
	5.2. Proof of Theorem G(ii)	
	5.3. Cyclic shift	
6.	Formulas for some $c_{uv(\lambda,k)}^{w}$	
	6.1. A chain-theoretic interpretation $\dots$	412
	6.2. Skew permutations.	
	6.3. Further remarks	

Received 26 February 1997. Revision received 9 June 1997.

First author supported in part by a Natural Sciences and Engineering Research Council grant. Second author supported in part by Natural Sciences and Engineering Research Council grant number OGP0170279 and National Science Foundation grant number DMS-9022140.

1991 Mathematics Subject Classification. 05E15, 14M15, 05E05.