I/EC CHEMICAL ENGINEERING REVIEWS

UNIT PROCESSES REVIEW

Friedel-Crafts Reactions

IMPORTANT developments have been made in specific areas of application and study of the Friedel-Crafts reactions but the most significant advance has come through the greatly increased number and variety of applications.

The essential features of the pattern established for the 1955 Review have been continued. Discussion has been limited to material that cannot be adequately covered in the tables and bibliography. Space limitations imposed by the large increase in the number of references have dictated necessary changes. The tables for open-chain acylation and open-chain alkylation have been arranged in the general order of increasing complexity of the substituting reagent, and increasing complexity of the aromatic compound undergoing substitution. The tables for ring-closure acylation and ring-closure alkylation have been abbreviated. They have been arranged in the order of increasing size and number of rings. Only pertinent products are included. Because of its frequent use, polyphosphoric acid has been indicated as PPA throughout the tables. Related reactions of less general interest such as the Fries rearrangement olefin acylation, and chloromethylation have been eliminated except for brief consideration of important features in the discussion section and complete lists of references in the bibliography. The discussion follows almost the same pattern as the tables.

A number of authors have written minor reviews of the modern aspects of Friedel-Crafts reactions (*4A*, *36A*, *65A*, *96A*).

Advantage has been taken of the bulk and easy removal of the *tert*-butyl group as a means of obtaining several substances in good yield which were obtained with difficulty by direct means (*49A*, *77A*). The *tert*-butyl group blocks the two adjacent positions as well as the position it occupies and can be removed readily without disturbing other substituents.

Acylations with phthalic anhydride (*54A*) and its tetrachloroanalog (*55A*) provide useful derivatives for characterizing aromatic hydrocarbons. Buu-Hoï and his associates (*16A*) have found zinc chloride to be a good catalyst for benzylation or allylation of polynuclear aromatic hydrocarbons. Polyphosphoric acid continues in popularity for reactions requiring milder conditions. It does not cleave phenolic ethers (*31A*). Antimony pentachloride is generally inferior to aluminum chloride except in the benzoylation of benzene (*69A*). It is presumed that there is less tie-up of the catalyst in this case. Boron trifluoride seems to function better alone at room temperature than it does with phosphoric acid or ether (*110A*). Silver perchlorate with magnesium oxide is not so good a catalyst as aluminum chloride, antimony pentachloride, or even ferric chloride (*17A*). The effect of acid concentration, olefin to aromatic ratio, reaction temperature, and reaction time have been investigated for the production of chlorocumene (*56A*).

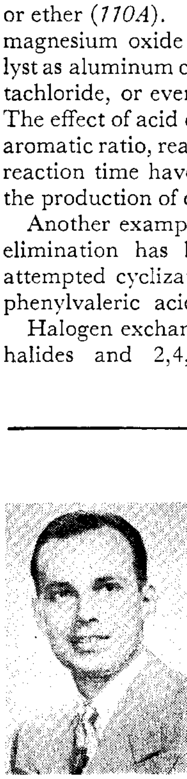
Another example of carbon monoxide elimination has been observed in the attempted cyclization of 2,2-dimethyl-5-phenylvaleric acid (*74A*).

Halogen exchange between aluminum halides and 2,4,6-substituted benzoyl halides has been explained by postulating a partial ionization to give trace amounts of acylonium ions (*5A*). This evidence is claimed to indicate that the acylonium ion is the actual acylating agent. Additives which retard, or even suppress, the reactions do so by solvating the acylonium ion as well as tying up the catalyst. Similar results were obtained using titanium tetrachloride or stannic chloride.

Several kinetic studies have been made which add to mechanistic information (*8A*, *10A*, *11A*, *13A*, *29A*, *39A*, *40A*, *53A*, *82A*, *84A*, *93A–95A*). Acetylation of *tert*-butylbenzene gives only 1.5% of the meta isomer and none of the ortho product (*15A*). There is continued interest in the effects of solvents in modifying the distribution of isomers obtained in alkylations and some acylations (*3A*, *7A*, *12A*, *35A*, *46A*, *47A*, *72A*). Most of these studies have dealt with naphthalene derivatives.

Azulene can be acylated without the use of catalysts (*30A*). 10-Alkylphenothiazines undergo substitutions of the Friedel-Crafts type in the 2-position (*78A*). 2,5-Diphenyl-1,4-dithiadiene suffers desulfurization upon formylation to give a thiophene derivative (*68A*).

Moed and his associates (*61A*) found that the Hoesch reaction using amino



K. LeROI NELSON

Brigham Young University, Provo, Utah

K. LeROI NELSON, associate professor of organic chemistry, Brigham Young University, continues on I&EC's staff of review authors after moving from Wayne University. His research interests include quantitative studies of directive effects in electrophilic aromatic substitution. An interpretive review article on this subject was published by him in the February 1956 *Journal of Organic Chemistry*. Nelson graduated from Utah State Agricultural College and obtained his Ph.D., in 1952, from Purdue University. He has had post-doctoral experience in research at UCLA and taught one year at Purdue before going to Wayne University. Nelson is a member of the ACS, British Chemical Society, Sigma Xi, Phi Lambda Upsilon, AAAS, AAUP, and Utah Academy of Arts, Letters, and Sciences.

OPEN-CHAIN ACYLATION (Aromatics)

Aromatic	*Reagent*	*Product*	*Reference*
1,2,3-$(CH_3O)_3C_6H_3$	$C_6H_5N(CH_3)CHO$, $POCl_3$	1-HCO-2,3,4-$(CH_3O)_3$-C_6H_2	(*26B*)
$C_6H_5N(CH_3)_2$	$HCON(CH_3)_2$ or $C_6H_5N(CH_3)CHO$, $POCl_3$	4-HCO-$C_6H_4N(CH_3)_2$, 50–71%	(*34B*)
2,6-$(CH_3O)_2$-naphthalene	$C_6H_5N(CH_3)CHO$, $POCl_3$, $C_6H_5CH_3$	1-HCO-2,6-$(CH_3O)_2$-naphthalene	(*82B*)
Anthracene	$HCON(CH_3)_2$ or $C_6H_5N(CH_3)CHO$, $POCl_3$	9-HCO-anthracene, 63–84%	(*34B*)
Naphthacene	$C_6H_5N(CH_3)CHO$, $POCl_3$	5-HCO-naphthacene	(*121B*)
Benzene		Acetophenone	(*142B, 170B, 171B, 180B*)
Toluene		4-$CH_3C_6H_4COCH_3$	(*39B, 98B, 180B*)
t-$C_4H_9C_6H_5$	CH_3COCl, $AlCl_3$, CS_2	1.5% 3-(*t*-C_4H_9)$C_6H_4COCH_3$ and 98.5% 4-(*t*-C_4H_9)$C_6H_4COCH_3$	(*22B*)
Biphenyl	$(CH_3CO)_2O$, $AlCl_3$	4-C_6H_5-$C_6H_4COCH_3$	(*33B*)
Diphenylmethane	CH_3COCl, $AlCl_3$, CS_2	4-$C_6H_5CH_2$-$C_6H_4COCH_3$	(*57B*)
$C_6H_5(CH_2)_3C_6H_5$	$(CH_3CO)_2O$, $AlCl_3$, $C_2H_2Cl_4$	4-$[C_6H_5(CH_2)_3]C_6H_4COCH_3$, 50%	(*2B*)
$C_6H_5(CH_2)_4C_6H_5$	$(CH_3CO)_2O$, $AlCl_3$, CS_2	(4-$CH_3COC_6H_4CH_2CH_2)_2$, 74%	(*44B*)
$C_6H_5(CH_2)_5C_6H_5$	$(CH_3CO)_2O$, $AlCl_3$, $C_2H_2Cl_4$	4-$[C_6H_5(CH_2)_5]C_6H_4COCH_3$, 48%, and (4-$CH_3COC_6H_4CH_2CH_2)_2CH_2$, 17%	(*2B*)
C_6H_5Cl	CH_3COCl, $AlCl_3$	4-$ClC_6H_4COCH_3$, 80%	(*98B*)
C_6H_5OH	CH_3CO_2H, BF_3 or $H_4P_2O_7$	4-$HOC_6H_4COCH_3$, 60–70%	(*119B, 131B*)
Anisole	CH_3CO_2H or $(CH_3CO)_2O$, PPA; or $(CH_3CO)_2O$, $AlCl_3$, CS_2	4-$CH_3OC_6H_4COCH_3$	(*35B, 66B, 134B*)
$C_6H_5OCH_2CH_3$	$CF_3CO_2COCH_3$	4-$CH_3CH_2OC_6H_4COCH_3$, 21%	(*13B*)
$C_6H_5OCH_2CH{=}CH_2$	$CH_3CO^+ ClO_4^-$	4-$CH_3COC_6H_4OCH_2CH{=}CH_2$	(*21B*)
$C_6H_5OCH_2CH{=}CHCH_3$	$CH_3CO^+ ClO_4^-$	Resin	(*21B*)
$C_6H_5OCH_2CH{=}CHC_6H_5$	$CH_3CO^+ ClO_4^-$	Resin	(*21B*)
x-$ClC_6H_4OC_6H_5$ (x = 2, 3 or 4)	CH_3COCl, $AlCl_3$, CS_2	4-(*x*-$ClC_6H_4O)C_6H_4COCH_3$ (x = 2, 3 or 4)	(*92B*)
4-$O_2NC_6H_4SC_6H_5$	CH_3COCl, $AlCl_3$, $C_6H_5NO_2$	No ketone	(*167B*)
$C_6H_5NHCOCH_3$	CH_3COCl, $AlCl_3$, CS_2	4-$CH_3COC_6H_4NHCOCH_3$, 85%	(*157B*)
$C_6H_5Si(CH_3)_3$	CH_3COF, BF_3, $CHCl_3$	$CH_3COC_6H_4Si(CH_3)_3$	(*168B*)
$C_6H_5CH_2Si(CH_3)_3$	CH_3COCl, $AlCl_3$	4-$CH_3COC_6H_4CH_2Si(CH_3)_3$	(*141B*)
$C_6H_5CH_2CN$	CH_3COCl, $AlCl_3$, CS_2	4-$CH_3COC_6H_4CH_2CN$ and 3-$CH_3COC_6H_4$-CH_2CN, in nearly equal amounts	(*155B*)
4-$(C_6H_5CH_2CH_2CH_2)C_6H_4CO_2H$	$(CH_3CO)_2O$, $AlCl_3$, $C_6H_5NO_2$	4-$[(4\text{-}CH_3COC_6H_4)CH_2CH_2CH_2]C_6H_4CO_2H$	(*45B*)
1,3-$(CH_3)_2C_6H_4$	CH_3COCl, $AgClO_4$, MgO	2,4-$(CH_3)_2C_6H_3COCH_3$, 30%	(*39B*)
4-$CH_3C_6H_4SH$	CH_3COCl, CS_2	2-CH_3-5-HS-$C_6H_3COCH_3$	(*145B*)
3-$CH_3OC_6H_4C_6H_5$	CH_3COCl, $AlCl_3$, $(CH_2Cl)_2$	2-CH_3O-4-C_6H_5-$C_6H_3COCH_3$, 48%	(*14B*)
4-*X*-C_6H_4OH (X = Br, Cl or F)	CH_3CO_2H, BF_3	2-HO-5-*X*-$C_6H_3COCH_3$ (X = Br, Cl or F) yields range from 44–94%	(*93B*)
3-$ClC_6H_4OCH_3$	CH_3COCl, $AlCl_3$, CS_2	2-Cl-4-CH_3O-$C_6H_3COCH_3$	(*137B*)
4-$FC_6H_4OCH_3$	CH_3COCl, $AlCl_3$, CS_2	2-CH_3O-5-F-$C_6H_3COCH_3$	(*27B*)
2-$ClC_6H_4SCH_3$	CH_3COCl	3-Cl-4-CH_3S-$C_6H_3COCH_3$	(*178B*)
1,2-$(HO)_2C_6H_4$	CH_3CO_2H, PPA	3,4-$(HO)_2C_6H_3COCH_3$	(*129B*)
1,3-$(HO)_2C_6H_4$	CH_3CO_2H, PPA or BF_3	2,4-$(HO)_2C_6H_3COCH_3$, 80–90%, (some diacetylation)	(*119B, 129B, 131B*)
2-$CH_3OC_6H_4OH$	CH_3CO_2H, PPA	3-CH_3O-4-HO-$C_6H_3COCH_3$	(*129B*)
3-$CH_3OC_6H_4OH$	CH_3CO_2H, PPA	2-CH_3O-4-HO-$C_6H_3COCH_3$, 2-HO-4-CH_3O-$C_6H_3COCH_3$ and 2-HO-4-CH_3O-1,5-$(CH_3CO)_2C_6H_2$	(*129B*)
1,2-$(CH_3O)_2C_6H_4$ (also for 1,3-)	CH_3CO_2H, PPA	3,4-$(CH_3O)_2C_6H_3COCH_3$	(*129B*)
2-$O_2NC_6H_4OH$ (also for 4-)	CH_3COCl, $AlCl_3$, $C_6H_5NO_2$	3-O_2N-4-HO-$C_6H_3COCH_3$, 47%	(*89B*)
3-$CH_3OC_6H_4NHCOCH_3$	CH_3COBr, $AlCl_3$, CS_2	3-HO-4-CH_3CO-$C_6H_3NHCOCH_3$	(*59B*)
3-(*n*-$C_4H_9O)C_6H_4NHCOCH_3$	CH_3COBr, $AlCl_3$, CS_2	3-HO-4-CH_3CO-$C_6H_3NHCOCH_3$ and 2,4-$(CH_3CO)_2$-5-HO-$C_6H_2NH_2$	(*59B*)
1,3,5-$(CH_3)_3C_6H_3$	CH_3COCl or $(CH_3CO)_2O$, $AlCl_3$	2,4,6-$(CH_3)_3C_6H_2COCH_3$, 96% (some diacetylation)	(*41B, 127B, 180B*)
3,5-$(CH_3)_2C_6H_3$(*t*-C_4H_9)	CH_3COCl, $AlCl_3$, CS_2	2,6-$(CH_3)_2$-4-(*t*-C_4H_9)$C_6H_2COCH_3$	(*159B*)
3-CH_3-5-(*i*-C_3H_7)$C_6H_3OCH_3$	$RCOCl$, $AlCl_3$, CS_2	2-CH_3-4-CH_3O-5-(*i*-C_3H_7)C_6H_2COR	(*156B*)

R	Yield, %
CH_3	85
C_2H_5	62
n-C_3H_7	50
i-C_3H_7	70
n-C_4H_9	52
i-C_4H_9	71
n-C_5H_{11}	70
n-C_6H_{13}	52
n-C_7H_{15}	61
n-C_8H_{17}	47
n-C_9H_{19}	50
n-$C_{10}H_{21}$	57
n-$C_{11}H_{23}$	52
n-$C_{12}H_{25}$	50
n-$C_{13}H_{27}$	44
n-$C_{14}H_{29}$	44
n-$C_{15}H_{31}$	55
n-$C_{16}H_{33}$	30
n-$C_{17}H_{35}$	30

Aromatic	*Reagent*	*Product*	*Reference*
2,5-$(CH_3O)_2C_6H_3C_2H_5$		2-HO-4-C_2H_5-5-CH_3O-$C_6H_2COCH_3$	(*147B*)
$[3,4\text{-}(CH_3O)_2C_6H_3CH_2]_2$	CH_3COCl	$[2\text{-}CH_3CO\text{-}3,4\text{-}(CH_3O)_2C_6H_2CH_2]_2$	(*9B*)

OPEN-CHAIN ACYLATION (Aromatics) *(Continued)*

Aromatic	*Reagent*	*Product*	*Reference*
2-HO-3-O$_2$N-C$_6$H$_3$CH$_3$	CH$_3$COCl, AlCl$_3$, C$_6$H$_5$NO$_2$	3-O$_2$N-4-HO-5-CH$_3$-C$_6$H$_2$COCH$_3$, 50%	*(89B)*
3-CH$_3$-4-Cl-C$_6$H$_3$OH	CH$_3$CO$_2$H, BF$_3$	2-HO-4-CH$_3$-5-Cl-C$_6$H$_2$COCH$_3$, 85%	*(93B)*
2,4-(HO)$_2$C$_6$H$_3$COCH$_3$	CH$_3$CO$_2$H, PPA	1,3-(CH$_3$CO)$_2$-4,6-(HO)$_2$C$_6$H$_2$	*(129B)*
2-HO-4-CH$_3$O-C$_6$H$_3$COCH$_3$	CH$_3$CO$_2$H, PPA	1,3-(CH$_3$CO)$_2$-4-CH$_3$O-6-HO-C$_6$H$_2$	*(129B)*
2-CH$_3$O-4-HO-C$_6$H$_3$COC$_2$H$_5$	CH$_3$CO$_2$H, PPA	3-CH$_3$CO-4-HO-6-CH$_3$O-C$_6$H$_2$COC$_2$H$_5$	*(129B)*
1,3,5-(HO)$_3$C$_6$H$_3$	CH$_3$CO$_2$H, PPA or BF$_3$	2,4,6-(HO)$_3$C$_6$H$_2$COCH$_3$, 80–90%	*(119B, 132B)*
3,5-(HO)$_2$C$_6$H$_3$OCH$_3$	CH$_3$CO$_2$H, PPA	2,4,6-(CH$_3$CO)$_3$-3,5-(HO)$_2$C$_6$OCH$_3$	*(132B)*
3,5-(CH$_3$O)$_2$C$_6$H$_3$OH	CH$_3$CO$_2$H, PPA	2,4,6-(CH$_3$CO)$_3$-3,5-(CH$_3$O)$_2$C$_6$OH	*(132B)*
1,3,5-(CH$_3$O)$_3$C$_6$H$_3$	CH$_3$CO$_2$H, PPA	1,3,5-(CH$_3$O)$_3$-2,4,6-(CH$_3$CO)$_3$C$_6$	*(132B)*
1,2,3-(CH$_3$O)$_3$C$_6$H$_3$	CH$_3$CO$_2$H or (CH$_3$CO)$_2$O, PPA	2,3,4-(CH$_3$O)$_3$C$_6$H$_2$COCH$_3$	*(66B)*
2,5-(C$_2$H$_5$O)$_2$C$_6$H$_3$OCH$_3$	CH$_3$COCl, AlCl$_3$, CS$_2$	2,5-(C$_2$H$_5$O)$_2$-4-CH$_3$O-C$_6$H$_2$COCH$_3$	*(94B)*
3,4,5-(CH$_3$O)$_3$C$_6$H$_2$OH	CH$_3$CO$_2$H, BF$_3$; or CH$_3$COCl, AlCl$_3$, ether	2,3,4-(CH$_3$O)$_3$-6-HO-C$_6$HCOCH$_3$, 60–70%	*(103B, 119B)*
Indan	CH$_3$COCl, AlCl$_3$, C$_6$H$_6$	5-CH$_3$CO-indan	*(50B)*
1-(C$_2$H$_5$O$_2$C)-indan	CH$_3$COCl, AlCl$_3$, CS$_2$	1-(C$_2$H$_5$O$_2$C)-6-CH$_3$CO-indan	*(3B)*
1-(4-CH$_3$OC$_6$H$_4$)-2-CH$_3$-3-C$_2$H$_5$-6-CH$_3$O-indan	CH$_3$COCl, AlCl$_3$	1-(3-CH$_3$CO-4-HO-C$_6$H$_3$)-2-CH$_3$-3-C$_2$H$_5$-5-CH$_3$CO-6-HO-indan	*(80B)*
Naphthalene	CH$_3$COCl or (CH$_3$CO)$_2$O, AlCl$_3$, many solvents	1- and 2-CH$_3$CO-naphthalene (detailed study)	*(8B, 97B, 100B)*
2-C$_2$H$_5$-naphthalene	CH$_3$COCl, AlCl$_3$, C$_6$H$_5$NO$_2$	2-C$_2$H$_5$-6-CH$_3$CO-naphthalene	*(7B)*
1-HO-naphthalene	CH$_3$CO$_2$H, PPA	1-HO-2-CH$_3$CO-naphthalene, 37%; 1-HO-4-CH$_3$CO-naphthalene, 32%; and some diacetylation	*(135B)*
2-HO-naphthalene	CH$_3$CO$_2$H, BF$_3$	2-HO-1-CH$_3$CO-naphthalene, 93%	*(119B)*
1-HO-2-CH$_3$CO-naphthalene	CH$_3$CO$_2$H, PPA	1-HO-2,4-(CH$_3$CO)$_2$-naphthalene	*(135B)*
1,6-(CH$_3$)$_2$-naphthalene	CH$_3$COCl	1,6-(CH$_3$)$_2$-4-CH$_3$CO-naphthalene	*(28B)*
1-HO-2-HO$_2$C-naphthalene (also for ester)		1-HO-2-HO$_2$C-4-CH$_3$CO-naphthalene	*(88B)*
2-HO-3-HO$_2$C-naphthalene (also for ester)		1-CH$_3$CO-2-HO-3-HO$_2$C-naphthalene	*(88B)*
5-CH$_3$O-2,3-H$_2$-benzofuran		5-CH$_3$O-6-CH$_3$CO-2,3-H$_2$-benzofuran and 5-HO-6-CH$_3$CO-2,3-H$_2$-benzofuran	*(147B)*
2-(C$_2$H$_5$O$_2$C)-4,7-(CH$_3$O)$_2$-6-HO-benzofuran	CH$_3$COCl, AlCl$_3$, C$_6$H$_5$NO$_2$	2-(C$_2$H$_5$O$_2$C)-4,7-(CH$_3$O)$_2$-5-CH$_3$CO-6-HO-benzofuran	*(154B)*
4-CH$_3$-5-HO-coumarin	(CH$_3$CO)$_2$O, AlCl$_3$	4-CH$_3$-5-HO-6-CH$_3$CO-coumarin	*(140B)*
4-CH$_3$-7-HO-coumarin	(CH$_3$CO)$_2$O, AlCl$_3$	4-CH$_3$-7-HO-8-CH$_3$CO-coumarin	*(140B)*
4,7-(CH$_3$)$_2$-5-HO-coumarin	(CH$_3$CO)$_2$O, AlCl$_3$	4,7-(CH$_3$)$_2$-5-HO-6-CH$_3$CO-coumarin	*(140B)*
4-CH$_3$-5,7-(HO)$_2$-coumarin	CH$_3$CO$_2$H, BF$_3$; or (CH$_3$CO)$_2$O, AlCl$_3$	4-CH$_3$-5,7-(HO)$_2$-6-CH$_3$CO-coumarin; and some diacetylation	*(53B, 140B)*
8-HO-quinoline	CH$_3$COCl or (CH$_3$CO)$_2$O, AlCl$_3$	5-CH$_3$CO-8-HO-quinoline	*(172B)*
Diphenylene	CH$_3$COCl, AlCl$_3$, CS$_2$	2-CH$_3$CO-diphenylene	*(6B)*
1-CH$_3$-7-(*i*-C$_3$H$_7$)phenanthrene (Retene)	CH$_3$COCl, AlCl$_3$	1-CH$_3$-3-CH$_3$CO-7-(*i*-C$_3$H$_7$)-phenanthrene	*(166B)*
1,1,4a-(CH$_3$)$_3$-6-CH$_3$O-1,2,3,4,4a,-9,10,10a-H$_8$-phenanthrene	CH$_3$COCl, AlCl$_3$, C$_6$H$_5$NO$_2$	1,1,4a-(CH$_3$)$_3$-6-CH$_3$O-7-CH$_3$CO-1,2,3,4,4a,-9,10,10a-phenanthrene	*(95B)*
Chrysene	CH$_3$COCl, AlCl$_3$	2-, 4- and 5-CH$_3$CO-chrysene	*(36B)*
3-CH$_3$-filicinic acid	CH$_3$COCl, AlCl$_3$	3-CH$_3$-5-CH$_3$CO-filicinic acid	*(152B)*
Toluene	(C$_2$H$_5$CO)$_2$O, BF$_3$	4-CH$_3$C$_6$H$_4$COC$_2$H$_5$, 23–30%	*(180B)*
Phenol	C$_2$H$_5$CO$_2$H, BF$_3$ or PPA	4-HOC$_6$H$_4$COC$_2$H$_5$, 58%	*(30B, 134B)*
Phenol	RCO$_2$H, PPA	4-RCO-C$_6$H$_4$OH	*(134B)*
		R — Yield, %	
		n-C$_3$H$_7$ — 54	
		n-C$_4$H$_9$ — 47	
		n-C$_5$H$_{11}$ — 41	
		C$_6$H$_5$CH$_2$ — 28	
		C$_6$H$_5$CH$_2$CH$_2$ — 27	
Anisole	C$_2$H$_5$COCl; or C$_2$H$_5$CO$_2$H, PPA	4-CH$_3$OC$_6$H$_4$COC$_2$H$_5$, 64%	*(109B, 134B)*
Anisole	RCO$_2$H, PPA	4-CH$_3$OC$_6$H$_4$COR	*(134B)*
		R — Yield, %	
		n-C$_3$H$_7$ — 60	
		n-C$_4$H$_9$ — 72	
		n-C$_5$H$_{11}$ — ..	
		C$_6$H$_5$CH$_2$ — 73	
		4-CH$_3$OC$_6$H$_4$CH$_2$ — 74	
		C$_6$H$_5$CH$_2$CH$_2$ — 50	
C$_6$H$_5$SC$_2$H$_5$		4-C$_2$H$_5$SC$_6$H$_4$COC$_2$H$_5$	*(29B)*
4-CH$_3$O-biphenyl	C$_2$H$_5$COCl, AlCl$_3$	4-(4-CH$_3$OC$_6$H$_4$)C$_6$H$_4$COC$_2$H$_5$	*(32B, 176B)*
Diphenyl ether	C$_2$H$_5$COCl	4-(C$_6$H$_5$O)C$_6$H$_4$COC$_2$H$_5$ and (4-C$_2$H$_5$COC$_6$H$_4$)$_2$O	*(30B)*
C$_6$H$_5$CH$_2$C$_6$H$_5$	(C$_2$H$_5$CO)$_2$O, AlCl$_3$, CS$_2$	(4-C$_2$H$_5$COC$_6$H$_4$)$_2$CH$_2$, 79%	*(1B)*
(C$_6$H$_5$CH$_2$CH$_2$)$_2$	(C$_2$H$_5$CO)$_2$O, AlCl$_3$, CS$_2$	(4-C$_2$H$_5$COC$_6$H$_4$CH$_2$CH$_2$)$_2$, 70%	*(1B)*
(C$_6$H$_5$CH$_2$CH$_2$CH$_2$)$_2$	(C$_2$H$_5$CO)$_2$O, AlCl$_3$, C$_6$H$_5$NO$_2$	(4-C$_2$H$_5$COC$_6$H$_4$CH$_2$CH$_2$CH$_2$)$_2$, 63%	*(7B)*
4-HO$_2$CC$_6$H$_4$(CH$_2$)$_3$C$_6$H$_5$	(C$_2$H$_5$CO)$_2$O, AlCl$_3$, C$_6$H$_5$NO$_2$	4-[4-HO$_2$CC$_6$H$_4$(CH$_2$)$_3$]C$_6$H$_4$COC$_2$H$_5$, 70%	*(2B)*
4-CH$_3$COC$_6$H$_4$(CH$_2$)$_5$C$_6$H$_5$	(C$_2$H$_5$CO)$_2$O, AlCl$_3$, C$_2$H$_2$Cl$_4$	4-[4-CH$_3$COC$_6$H$_4$(CH$_2$)$_5$]C$_6$H$_4$COC$_2$H$_5$, 76%	*(2B)*
3-CH$_3$O-biphenyl	C$_2$H$_5$COCl, AlCl$_3$, (CH$_2$Cl)$_2$	2-CH$_3$O-4-C$_6$H$_5$-C$_6$H$_4$COC$_2$H$_5$, 37%	*(14B)*
4-BrC$_6$H$_4$OH	C$_2$H$_5$CO$_2$H, BF$_3$	2-HO-5-Br-C$_6$H$_3$COC$_2$H$_5$, 33–59%	*(93B)*
4-ClC$_6$H$_4$OH	C$_2$H$_5$CO$_2$H, BF$_3$	2-HO-5-Cl-C$_6$H$_3$COC$_2$H$_5$, 82%	*(93B)*

OPEN-CHAIN ACYLATION (Aromatics) *(Continued)*

Aromatic	*Reagent*	*Product*	*Reference*
2-$ClC_6H_4OCH_3$	C_2H_5COCl	3-Cl-4-CH_3O-$C_6H_3COC_2H_5$	*(30B)*
2-$FC_6H_4OCH_3$	C_2H_5COCl, $AlCl_3$, CS_2	3-F-4-CH_3O-$C_6H_3COC_2H_5$, and some (3-F-4-CH_3O-$C_6H_3)_2C{=}CHCH_3$	*(31B)*
4-$FC_6H_4OCH_3$	C_2H_5COCl, $AlCl_3$, CS_2	2-CH_3O-5-F-$C_6H_3COC_2H_5$	*(27B)*
2-$ClC_6H_4SCH_3$	C_2H_5COCl	3-Cl-4-CH_3S-$C_6H_3COC_2H_5$	*(178B)*
1,2-$(HO)_2C_6H_4$ (also for 1,3-)	$C_2H_5CO_2H$, PPA	3,4-$(HO)_2C_6H_3COC_2H_5$	*(129B)*
2-$CH_3OC_6H_4OH$	$C_2H_5CO_2H$, PPA	3-CH_3O-4-HO-$C_6H_3COC_2H_5$	*(129B)*
3-$CH_3OC_6H_4OH$	$C_2H_5CO_2H$, PPA	2-HO-4-CH_3O-$C_6H_3COC_2H_5$, 2-CH_3O-4-HO-$C_6H_3COC_2H_5$, and 2-HO-4-CH_3O-1,5-$(C_2H_5CO)_2$-C_6H_2	*(129B)*
1,2-$(CH_3O)_2C_6H_4$ (also for 1,3-)	$C_2H_5CO_2H$, PPA	3,4-$(CH_3O)_2C_6H_3COC_2H_5$	*(129B)*
3-CH_3-4-Cl-C_6H_3OH	$C_2H_5CO_2H$, BF_3	2-HO-4-CH_3-5-Cl-$C_6H_2COC_2H_5$, 46%	*(93B)*
2,4-$(HO)_2C_6H_3COCH_3$	$C_2H_5CO_2H$, PPA	2,4-$(HO)_2$-5-CH_3CO-$C_6H_2COC_2H_5$	*(129B)*
2,4-$(HO)_2C_6H_3COC_2H_5$	$C_2H_5CO_2H$, PPA	2,4-$(HO)_2$-1,5-$(C_2H_5CO)_2$-C_6H_2	*(129B)*
2-CH_3O-4-HO-$C_6H_3COC_2H_5$	$C_2H_5CO_2H$, PPA	2-CH_3O-4-HO-1,5-$(C_2H_5CO)_2$-C_6H_2	*(129B)*
1,2,3-$(HO)_3C_6H_3$	C_2H_5COCl	2,3,4-$(HO)_3C_6H_2COC_2H_5$, 75%	*(23B)*
1,3,5-$(HO)_3C_6H_3$	$C_2H_5CO_2H$, PPA	2,4,6-$(HO)_3$-1,3,5-$(C_2H_5CO)_3$-C_6	*(132B)*
3,5-$(HO)_2C_6H_3OCH_3$ (also for di- and tri- ether	$C_2H_5CO_2H$, PPA	3,5-$(HO)_2$-2,4,6-$(C_2H_5CO)_3C_6OCH_3$	*(132B)*
2-CH_3O-naphthalene	C_2H_5COCl, $AlCl_3$, $C_6H_5NO_2$	2-CH_3O-6-C_2H_5CO-naphthalene	*(85B)*
1-HO-naphthalene	RCO_2H, PPA	1-HO-2-(or 4-)RCO-naphthalene	*(135B)*

R	Yield, % 2-RCO	Yield, % 4-RCO
C_2H_5	42	1
n-C_3H_7	72	3
n-C_4H_9	53	trace
n-C_5H_{11}	46	0

Aromatic	*Reagent*	*Product*	*Reference*
1-HO-2-CH_3CO-naphthalene	$C_2H_5CO_2H$, PPA	1-HO-2-CH_3CO-4-C_2H_5CO-naphthalene	*(135B)*
Chrysene	C_2H_5COCl, $AlCl_3$, CS_2	6-C_2H_5CO-chrysene, 57%	*(24B)*
Biphenyl	RCOCl, $AlCl_3$, CS_2	4-RCO-biphenyl (R = n-C_3H_7, n-C_7H_{15}, n-$C_{11}H_{23}$, n-$C_{15}H_{31}$)	*(122B)*
$C_6H_5SC_2H_5$		4-$C_2H_5SC_6H_4CO$-(n-C_3H_7)	*(29B)*
$C_6H_5NHCOCH_3$	RCOCl	4-$RCOC_6H_4NHCOCH_3$ (R = n-C_3H_7, n-C_4H_9, n-C_5H_{11})	*(84B)*
$C_6H_5CH_2NHCHO$	RCOCl, $AlCl_3$, CS_2	4-$RCOC_6H_4CH_2NH_2$, 25–30% (R = n-C_3H_7, n-C_4H_9, n-C_5H_{11}, i-C_5H_{11}, n-$C_{11}H_{23}$)	*(84B)*
$C_6H_5CH_2Si(CH_3)_3$	RCOCl, $AlCl_3$	4-$RCOC_6H_4CH_2Si(CH_3)_3$, 33–55% (R = n-C_3H_7, n-C_5H_{11}, n-C_7H_{15})	*(141B)*
4-ClC_6H_4OH	n-$C_3H_7CO_2H$, BF_3	2-HO-5-Cl-C_6H_3CO-(n-C_3H_7), 86%	*(93B)*
4-FC_6H_4OH	n-$C_3H_7CO_2H$, BF_3	2-HO-5-F-C_6H_3CO-(n-C_3H_7), 80%	*(93B)*
3-CH_3O-biphenyl	n-C_3H_7COCl, $AlCl_3$, $(CH_2Cl)_2$	2-HO-4-C_6H_5-C_6H_3CO-(n-C_3H_7), 60%	*(14B)*
1,3-$(HO)_2C_6H_4$	n-$C_3H_7CO_2H$, PPA	2,4-$(HO)_2C_6H_3CO$-(n-C_3H_7)	*(129B)*
3-CH_3-4-Cl-C_6H_3OH	n-$C_3H_7CO_2H$, BF_3	2-HO-4-CH_3-5-Cl-C_6H_2CO-(n-C_3H_7)	*(93B)*
2,4,6-$(HO)_3C_6H_2CH_3$	n-C_3H_7COCl, $AlCl_3$	2,4,6-$(HO)_3$-3-CH_3-C_6HCO-(n-C_3H_7), 41%	*(151B)*
Filicinic acid (also for 3-CH_3)	n-C_3H_7COCl, $AlCl_3$	3-(n-C_3H_7CO)-filicinic acid	*(152B)*
2-$FC_6H_4OCH_3$	RCOCl	3-F-4-CH_3O-C_6H_3COR (R = n-C_4H_9, n-C_5H_{11}, n-C_9H_{19})	*(30B)*
3-CH_3-4-Cl-C_6H_3OH	n-$C_4H_9CO_2H$, BF_3	2-HO-4-CH_3-5-Cl-C_6H_2CO-(n-C_4H_9), 86%	*(93B)*
1,2,3-$(HO)_3C_6H_3$	RCO_2H, $ZnCl_2$	2,3,4-$(HO)_3C_6H_2COR$	*(23B)*

R	Yield, %
n-C_4H_9	70
n-C_5H_{11}	70
n-C_9H_{19}	75–80
n-$C_{12}H_{25}$	..
n-$C_{14}H_{29}$	..

Aromatic	*Reagent*	*Product*	*Reference*
Benzene	$CH_3(CH_2)_nCOCl$, $AlCl_3$	$CH_3(CH_2)_nCOC_6H_5$ (n = 4 to 18)	*(15B)*
4-CH_3O-biphenyl	$CH_3(CH_2)_nCOCl$, $AlCl_3$, $C_6H_5NO_2$	4-(4-$CH_3OC_6H_4$)$C_6H_4CO(CH_2)_nCH_3$ (n = 4, 5, 6)	*(32B)*
Diphenyl ether	RCOCl	4-$(C_6H_5O)C_6H_4COR$ (R = n-C_5H_{11}, n-C_7H_{15})	*(30B)*
Naphthalene	$CH_3(CH_2)_nCOCl$, $AlCl_3$, $C_6H_5NO_2$	2-$CH_3(CH_2)_nCO$-naphthalene (n = 4, 6, 8, 10, 12)	*(181B)*
Chrysene	n-$C_6H_{13}COCl$, $AlCl_3$, $C_6H_5NO_2$	2-(n-$C_6H_{13}CO$)-chrysene	*(37B)*
RC_6H_5	n-$C_9H_{19}COCl$, $AlCl_3$, CS_2	4-RC_6H_4CO-(n-C_9H_{19}) (R = H, HO, CH_3, Cl, or $NHCOCH_3$)	*(101B)*
$C_6H_5N(CH_3)_2$	n-$C_9H_{19}COCl$, $ZnCl_2$	4-(n-$C_9H_{19}CO$)$C_6H_4N(CH_3)_2$	*(101B)*
1,3-$(HO)_2C_6H_4$	n-$C_9H_{19}CO_2H$, $ZnCl_2$	2,4-$(HO)_2C_6H_3CO$-(n-C_9H_{19})	*(101B)*
2-$HOC_6H_4CO_2H$	n-$C_9H_{19}COCl$, $AlCl_3$, $C_6H_5NO_2$	2-HO-5-(n-$C_9H_{19}CO$)$C_6H_3CO_2H$	*(101B)*
2,4-$(HO)_2C_6H_3CO_2H$	n-$C_9H_{19}COCl$, $AlCl_3$, CS_2	2,4-$(HO)_2$-5-(n-$C_9H_{19}CO$)$C_6H_2CO_2H$	*(101B)*
1-HO-naphthalene	n-$C_9H_{19}CO_2H$, $ZnCl_2$	1-HO-4-(n-$C_9H_{19}CO$)-naphthalene	*(101B)*
1,4-$(HO)_2$-naphthalene	n-$C_9H_{19}CO_2H$, $ZnCl_2$	1,4-$(HO)_2$-4-(n-$C_9H_{19}CO$)-naphthalene	*(101B)*
3,5-$(CH_3)_2C_6H_3$-(t-C_4H_9)	RCOCl, $AlCl_3$, CS_2	2,6-$(CH_3)_2$-4-(t-C_4H_9)-C_6H_2COR (R = n-C_9H_{19}, n-$C_{17}H_{35}$)	*(159B)*
4-$(C_6H_5S)C_6H_4NO_2$	n-$C_{17}H_{35}COCl$, $AlCl_3$, $C_6H_5NO_2$	No ketone	*(167B)*
Benzene	Karite oil, $AlCl_3$	58% C_6H_5COR and some C_6H_5R'	*(124B)*
Benzene	Hydrogenated palm oil, $AlCl_3$	35–39% C_6H_5COR	*(124B)*

OPEN-CHAIN ACYLATION (Aromatics) *(Continued)*

Aromatic	*Reagent*	*Product*	*Reference*
Benzene	Hydrogenated olive oil, $AlCl_3$	Tar	*(124B)*
Biphenyl	$(i$-$C_3H_7)COCl$, $AlCl_3$, CS_2	4-$C_6H_5C_6H_4CO$-$(i$-$C_3H_7)$, 92%	*(164B)*
Diphenyl ether	$(i$-$C_3H_7)COCl$	4-$(C_6H_5O)C_6H_4CO$-$(i$-$C_3H_7)$	*(30B)*
Mesitylene	$(i$-$C_3H_7)COCl$	$2,4,6$-$(CH_3)_3C_6H_2CO$-$(i$-$C_3H_7)$, 75%	*(10B)*
$1,2,3$-$(HO)_3C_6H_3$	$(i$-$C_3H_7)CO_2H$, $ZnCl_2$	$2,3,4$-$(HO)_3C_6H_2CO$-$(i$-$C_3H_7)$, 40%	*(23B)*
$1,3,5$-$(HO)_3C_6H_3$	$(i$-$C_3H_7)COCl$, $AlCl_3$, $C_6H_5NO_2$	$2,4,6$-$(HO)_3C_6H_2CO$-$(i$-$C_3H_7)$, 20%	*(83B)*
Biphenyl	$C_2H_5CH(CH_3)COCl$, $AlCl_3$, CS_2	4-$C_6H_5C_6H_4COCH(CH_3)C_2H_5$, 86%	*(165B)*
$2,5$-$(CH_3O)_2C_6H_3$-$(n$-$C_7H_{15})$	$(i$-$C_4H_9)COCl$, $AlCl_3$, CS_2	$2,5$-$(HO)_2$-4-$(n$-$C_7H_{15})$-C_6H_2CO-$(i$-$C_4H_9)$, mono ether	*(139B)*
Benzene	Cyclopentyl-COCl	Cyclopentyl-COC_6H_5	*(40B)*
Toluene	Cyclohexyl-COCl, $AlCl_3$	4-$CH_3C_6H_4CO$-cyclohexyl	*(81B)*
$1,2$-$(CH_3O)_2C_6H_4$ (also for 1,4-)	Cyclohexyl-COCl, $AlCl_3$, $C_6H_5NO_2$	$3,4$-$(CH_3O)_2C_6H_3CO$-cyclohexyl	*(18B)*
Anisole	Cyclohexyl-CH_2COCl, $AlCl_3$, $C_6H_5NO_2$	4-$CH_3OC_6H_4COCH_2$-cyclohexyl	*(20B)*
$1,3$-$(HO)_2C_6H_4$	Cyclohexyl-$(CH_2)_4CO_2H$, $ZnCl_2$	$2,4$-$(HO)_2C_6H_3CO(CH_2)_4$-cyclohexyl	*(18B)*
Biphenyl	$CH_3CH{=}CHCOCl$, $AlCl_3$, $(CHCl_2)_2$	4-$C_6H_5COCH{=}CHCH_3$	*(47B)*
Phenol	$C_6H_5CH{=}CHCO_2H$, PPA	4-$HOC_6H_4COCH{=}CHC_6H_5$, 20%	*(134B)*
Anisole	$C_6H_5CH{=}CHCO_2H$, PPA	4-$CH_3OC_6H_4COCH{=}CHC_6H_5$, 45%	*(134B)*
Anisole	$C_6H_5CH{=}CHCOCl$, $AgClO_4$	4-$CH_3OC_6H_4COCH{=}CHC_6H_5$	*(21B)*
3-CH_3O-4-HO-C_6H_3CHO	$C_6H_5CH{=}CHCOCl$, C_6H_6	Cinnamoylvanillin	*(148B)*
3-CH_3O-4-HO-$C_6H_3CO_2H$	$C_6H_5CH{=}CHCOCl$, C_6H_6	Cinnamoylvanillic acid	*(148B)*
$3,4,5$-$(CH_3O)_3C_6H_2OH$	$C_6H_5CH{=}CHCO_2H$, BF_3	$2,3,4$-$(CH_3O)_3$-6-HO-$C_6HCOCH{=}CHC_6H_5$	*(119B)*
Toluene	$C_6H_5CH_2COCl$	4-$CH_3C_6H_4COCH_2C_6H_5$, 93%	*(48B)*
Anisole	$C_6H_5CH_2COCl$, $AlCl_3$, CS_2	4-$CH_3OC_6H_4COCH_2C_6H_5$	*(48B)*
C_6H_5Cl	$C_6H_5CH_2COCl$	4-$ClC_6H_4COCH_2C_6H_5$	*(48B)*
4-ClC_6H_4OH	$C_6H_5CH_2CO_2H$, BF_3	2-HO-5-Cl-$C_6H_3COCH_2C_6H_5$, 68%	*(93B)*
2-$FC_6H_4OCH_3$	$C_6H_5CH_2COCl$	3-F-4-CH_3O-$C_6H_3COCH_2C_6H_5$	*(30B, 31B)*
4-$FC_6H_4OCH_3$	$C_6H_5CH_2COCl$, $AlCl_3$, CS_2	2-CH_3O-5-F-$C_6H_3COCH_2C_6H_5$	*(27B)*
$3,4,5$-$(CH_3O)_3C_6H_2OH$	$C_6H_5CH_2COCl$, $AlCl_3$, ether	$2,3,4$-$(CH_3O)_3$-6-HO-C_6HCO-$CH_2C_6H_5$	*(105B)*
Carbazole	$C_6H_5CH_2COCl$, $AlCl_3$, C_6H_6	$3,6$-$(C_6H_5CH_2CO)$-carbazole	*(96B)*
N-(C_6H_5CO)-carbazole	$C_6H_5CH_2COCl$, $AlCl_3$, CS_2	2-$(C_6H_5CH_2CO)$-N-(C_6H_5CO)-carbazole and some 2-$(C_6H_5CH_2CO)$-carbazole	*(96B)*
Benzene	4-$CH_3C_6H_4CH_2COCl$	4-$CH_3C_6H_4CH_2COC_6H_5$, 60%	*(48B)*
Anisole	4-$CH_3C_6H_4CH_2COCl$	4-$(4$-$CH_3C_6H_4CH_2CO)C_6H_4OCH_3$, 67%	*(48B)*
Benzene	4-$ClC_6H_4CH_2COCl$	4-$ClC_6H_4CH_2COC_6H_5$, 89%	*(48B)*
Benzene	4-$(C_6H_5CH_2)C_6H_4CH_2COCl$, $AlCl_3$	4-$(C_6H_5CH_2)C_6H_4CH_2COC_6H_5$	*(67B)*
$C_6H_5OC_2H_5$	4-$CH_3OC_6H_4CH_2COCl$, $SnCl_4$	4-$(4$-$CH_3OC_6H_4CH_2CO)C_6H_4OC_2H_5$	*(169B)*
$3,4,5$-$(CH_3O)_3C_6H_2OH$	4-$CH_3OC_6H_4CH_2COCl$, $AlCl_3$, ether	$2,3,4$-$(CH_3O)_3$-6-HO-1-$(4$-$CH_3OC_6H_4CH_2CO)$-C_6H	*(105B)*
$3,5$-$(CH_3O)_2$-4-C_2H_5O-C_6H_2OH	4-$C_2H_5OC_6H_4CH_2COCl$, $AlCl_3$, ether	$2,4$-$(CH_3O)_2$-3-C_2H_5O-6-HO-1-$(4$-$C_2H_5OC_6H_4CH_2CO)$-C_6H	*(104B)*
$3,5$-(C_2H_5O)-4-CH_3O-C_6H_2OH	4-$C_2H_5OC_6H_4CH_2COCl$, $AlCl_3$	$2,4$-$(C_2H_5O)_2$-3-CH_3O-6-HO-1-$(4$-$C_2H_5OC_6H_4CH_2CO)$-C_6H	*(105B)*
$1,2$-$(CH_3O)_2C_6H_4$	$3,4$-$(CH_3O)_2C_6H_3CH_2COCl$	1-$[3,4$-$(CH_3O)_2C_6H_3CH_2CO]$-$3,4$-$(CH_3O)_2$, 31%	*(179B)*
$1,2$-$(CH_3O)_2C_6H_4$	$2,4,6$-$(CH_3O)_3C_6H_2CH_2CO_2H$	1-$[2,4,6$-$(CH_3O)_3C_6H_2CH_2CO]$-$3,4$-$(CH_3O)_2C_6H_3$	*(134B)*
Benzene	FCH_2COCl, $AlCl_3$, CH_2Cl_2	$FCH_2COC_6H_5$	*(12B)*
Diphenyl ether	$ClCH_2COCl$, $AlCl_3$, CS_2	$(4$-$ClCH_2COC_6H_4)_2O$	*(175B)*
Diphenyl sulfide	$ClCH_2COCl$, $AlCl_3$, CS_2	$(4$-$ClCH_2COC_6H_4)_2S$	*(175B)*
4-$FC_6H_4OCH_3$		2-CH_3O-5-F-$C_6H_3COCH_2Br$	*(27B)*
$1,3$-$(CH_3O)_2C_6H_4$	$ClCH_2COCl$, $AlCl_3$, CS_2	2-HO-4-CH_3O-$C_6H_3COCH_2Cl$, 55%	*(106B)*
2-Cl-$3,5$-$(CH_3O)_2C_6H_2OH$ (also for 2-Br)	$ClCH_2COCl$, $AlCl_3$, $C_6H_5NO_2$	2-HO-3-Cl-$4,6$-$(CH_3O)_2C_6HCOCH_2Cl$	*(117B, 118B)*
Biphenyl	$BrCH_2COBr$, $AlCl_3$, CS_2	$(4$-$BrCH_2COC_6H_4)_2$, 35%	*(113B)*
2-CH_3CO_2-fluorene	$ClCH_2COCl$, $AlCl_3$, CS_2	2-CH_3CO_2-7-$ClCH_2CO$-fluorene, 64%	*(116B)*
4-Cyclohexyl-$C_6H_4OCH_3$	$ClCH_2COCl$, $AlCl_3$, $(CHCl_2)_2$	2-CH_3O-5-cyclohexyl-$C_6H_3COCH_2Cl$	*(20B)*
Benzene	XCH_2CH_2COCl, $AlCl_3$, C_6H_6	$XCH_2CH_2COC_6H_5$ (X = Br, Cl, I)	*(136B)*
$C_6H_5NHCOCH_3$	XCH_2CH_2COCl, $AlCl_3$, CS_2	4-$(XCH_2CH_2CO)C_6H_4NHCOCH_3$ (X = Br, Cl, I)	*(136B)*
$C_6H_5CH_2NHCHO$	XCH_2CH_2COCl, $AlCl_3$, CS_2	4-$(XCH_2CH_2CO)C_6H_4CH_2NHCHO$ (X = Br, Cl, I)	*(136B)*
$C_6H_5NHCOCH_3$	$BrCH_2CHBrCOCl$, $AlCl_3$, CS_2	4-$(CH_3CONH)C_6H_4COCHBrCH_2Br$	*(84B)*
Benzene	Cl_3CCOCl	$C_6H_5COCCl_3$	*(90B)*
Benzene	$F_3C(CF_2)_nCOCl$, $AlCl_3$	$F_3C(CF_2)_nCOC_6H_5$, 33–44% (n = 0 to 4)	*(160B)*
Toluene	$F_3C(CF_2)_nCOCl$, $AlCl_3$	4-$CH_3C_6H_4CO(CF_2)_nCF_3$, 21–66% (n = 0 to 4)	*(160B)*
$1,3$-$(CH_3)_2C_6H_4$	n-$C_5F_{11}COCl$, $Al(Hg) + Br_2$	$2,4$-$(CH_3)_2C_6H_3CO$-$(n$-$C_5F_{11})$, 81%	*(160B)*
Benzene	$CH_3SCH_2CH_2COCl$, $AlCl_3$	$CH_3SCH_2CH_2COC_6H_5$	*(146B)*
Benzene	$HO_2CCH_2CO_2H$, $SiCl_4$, $AlCl_3$	$CH_3COC_6H_5$, 44%	*(185B)*
Benzene	$C_2H_5O_2CCH_2CO_2H$, $SiCl_4$, $AlCl_3$	33% $C_2H_5O_2CCH_2COC_6H_5$ and some $C_2H_5C_6H_5$	*(185B)*
1,5-(Cyclohexyl)$_2$-$2,4$-$(C_2H_5O)_2$-C_6H_2	$CH_3O_2CCH_2CH_2COCl$, $AlCl_3$, C_6H_6	$2,4$-$(C_2H_5O)_2$-5-cyclohexyl-$C_6H_2COCH_2CH_2CO_2CH_3$	*(18B)*
1,5-(Cyclohexyl)$_2$-$2,4$-$(C_2H_5O)_2$-C_6H_2	$CH_3O_2CCH_2CH_2CH_2COCl$, $AlCl_3$, C_6H_6	$2,4$-$(C_2H_5O)_2$-5-cyclohexyl-$C_6H_2COCH_2CH_2CH_2CO_2CH_3$	*(18B)*
Benzene	$HO_2C(CH_2)_nCO_2H$, $SiCl_4$, $AlCl_3$	$HO_2C(CH_2)_nCOC_6H_5$, 51–80% (n = 2, 3, 4, 8)	*(185B)*
$2,4$-$(C_2H_5O)_2C_6H_3$-cyclohexyl	$CH_3O_2CCH_2CH_2COCl$, $C_2H_2Cl_4$	$2,4$-$(C_2H_5O)_2$-5-cyclohexyl-$C_6H_2COCH_2CH_2CO_2H$	*(19B)*
$1,2,3$-$(CH_3O)_3C_6H_3$	$C_2H_5O_2C(CH_2)_3COCl$, $AlCl_3$	$2,3,4$-$(CH_3O)_3C_6H_2CO(CH_2)_3CO_2C_2H_5$	*(112B)*
2-Cyclohexyl-$C_6H_4OCH_3$ (also for 4-)	$CH_3O_2C(CH_2)_4COCl$, $AlCl_3$	3-Cyclohexyl-4-CH_3O-C_6H_3CO-$(CH_2)_4$-CO_2CH_3	*(19B, 20B)*

OPEN-CHAIN ACYLATION (Aromatics) *(Continued)*

Aromatic	*Reagent*	*Product*	*Reference*
Diphenylmethane	$CH_3O_2C(CH_2)_2COCl$, $AlCl_3$, $C_2H_2Cl_4$	$[4\text{-}CH_3O_2C(CH_2)_2COC_6H_4]_2CH_2$, 70%	(*1B*)
Anisole	$CH_3O_2CCH(CH_3)CO_2H$, PPA	4-$CH_3OC_6H_4COCH(CH_3)CO_2CH_3$	(*66B*)
1,2,3-$(CH_3O)_3C_6H_3$	$CH_3O_2CCH(CH_3)CO_2H$, PPA	2,3,4-$(CH_3O)_3C_6H_2COCH(CH_3)CO_2CH_3$	(*66B*)
4-Cyclohexyl-$C_6H_4OCH_3$	$CH_3O_2CCH(C_6H_5)CH_2COCl$, $AlCl_3$, C_6H_5	2-CH_3O-5-cyclohexyl-C_6H_3CO-$CH_2CH(C_6H_5)CO_2CH_3$	(*20B*)
Indan	1-HO_2C-1-HO_2CCH_2-2-CH_3-cyclopentane, $AlCl_3$, $C_6H_5NO_2$	1-HO_2C-1-(5-indanyl-$COCH_2$)-2-CH_3-cyclopentane	(*73B*)
Tetralin	1-HO_2C-1-HO_2CCH_2-2-CH_3-cyclopentane, $AlCl_3$, $C_6H_5NO_2$	1-HO_2C-1-(5,6,7,8-H_4-2-naphthyl-$COCH_2$)-2-CH_3-cyclopentane	(*73B*)
Benzene	Succinic anhydride, $AlCl_3$	$C_6H_5COCH_2CH_2CO_2H$	(*128B*)
Toluene	Succinic anhydride, $AlCl_3$	4-$CH_3C_6H_4COCH_2CH_2CO_2H$	(*128B*)
$C_2H_5CH(CH_3)C_6H_5$	Succinic anhydride, $AlCl_3$, $C_2H_2Cl_4$	4-$[C_2H_5CH(CH_3)]C_6H_4COCH_2CH_2CO_2H$, 67% (28 known compounds were prepared in 31–85% yields)	(*144B*)
$(C_2H_5)_2CHC_6H_5$	Succinic anhydride, $AlCl_3$, $C_2H_2Cl_4$	4-$[(C_2H_5)_2CH]C_6H_4COCH_2CH_2CO_2H$, 83%	(*149B*)
$C_6H_5(CH_2)_3CO_2C_2H_5$	Succinic anhydride, $AlCl_3$, $(CHCl_2)_2$	4-$[C_2H_5O_2C(CH_2)_3]C_6H_4COCH_2CH_2CO_2H$	(*45B*)
$C_6H_5COCH_3$	Succinic anhydride, $AlCl_3$	4-$CH_3COC_6H_4COCH_2CH_2CO_2H$	(*128B*)
Anisole	Succinic anhydride, $AlCl_3$	4-$CH_3OC_6H_4COCH_2CH_2CO_2H$	(*128B*)
C_6H_5Cl	Succinic anhydride, $AlCl_3$	4-$ClC_6H_4COCH_2CH_2CO_2H$	(*128B*)
1,3-$(CH_3)C_6H_4$ (also for 1,4-)	Succinic anhydride, $AlCl_3$	2,4-$(CH_3)_2C_3H_3COCH_2CH_2CO_2H$	(*58B, 87B, 128B*)
1,4-$(CH_3O)_2C_6H_4$	Succinic anhydride, $AlCl_3$	2,5-$(CH_3O)_2C_6H_3COCH_2CH_2CO_2H$	(*128B*)
4-$CH_3C_6H_4OCH_3$	Succinic anhydride	2-CH_3O-5-CH_3-$C_6H_3COCH_2CH_2CO_2H$, 84%	(*56B*)
1,3-$(CH_3O)_2C_6H_4$ (also for 1,4-)	Succinic anhydride	2,4-$(CH_3O)_2C_6H_3COCH_2CH_2CO_2H$	(*52B, 125B*)
4-Cyclobutyl-$C_6H_4OCH_3$	Succinic anhydride	2-CH_3O-5-cyclobutyl-C_6H_3CO-$CH_2CH_2CO_2H$	(*19B*)
4-Cyclopentyl-$C_6H_4OCH_3$	Succinic anhydride	2-CH_3O-5-cyclopentyl-C_6H_3CO-$CH_2CH_2CO_2H$	(*19B*)
2-Cyclohexyl-$C_6H_4OCH_3$	Succinic anhydride, $AlCl_3$, $C_6H_5NO_2$	3-Cyclohexyl-4-CH_3O-C_6H_3CO-$CH_2CH_2CO_2H$	(*19B, 20B*)
4-Cyclohexyl-C_6H_4OR	Succinic anhydride, $AlCl_3$, $C_6H_5NO_2$	2-RO-5-cyclohexyl-$C_6H_3COCH_2CH_2CO_2H$ (R = CH_3, *i*-C_3H_7)	(*19B*)
1,2,4-$(C_2H_5)_3C_6H_3$	Succinic anhydride, $AlCl_3$, $C_2H_2Cl_4$	2,4,5-$(C_2H_5)_3$-$C_6H_2COCH_2CH_2CO_2H$, 70%	(*149B*)
$(2\text{-}CH_3OC_6H_4CH_2)_2$	Succinic anhydride, $AlCl_3$, $C_6H_5NO_2$	3-(2-$CH_3OC_6H_4CH_2CH_2$)-4-CH_3O-C_6H_3CO-$CH_2CH_2CO_2H$ and [2-CH_3O-5-($HO_2CCH_2CH_2CO$)-$C_6H_3CH_2$]$_2$	(*20B*)
3-CH_3-4-cyclohexyl-$C_6H_3OCH_3$	Succinic anhydride	2-CH_3O-4-CH_3-5-cyclohexyl-$C_6H_2COCH_2CH_2CO_2H$	(*19B*)
2-Cyclohexyl-4-Cl-$C_6H_3OCH_3$	Succinic anhydride	2-CH_3O-3-cyclohexyl-5-Cl-$C_6H_2COCH_2CH_2CO_2H$	(*19B*)
1,3-$(CH_3O)_2$-4-cyclopentyl-C_6H_3	Succinic anhydride	2,4-$(CH_3O)_2$-5-cyclopentyl-$C_6H_2COCH_2CH_2CO_2H$	(*19B*)
1,3-$(CH_3O)_2$-4-cyclohexyl-C_6H_3	Succinic anhydride	2,4-$(CH_3O)_2$-5-cyclohexyl-$C_6H_2COCH_2CH_2CO_2H$	(*19B*)
1,3-$(CH_3O)_2$-2-cyclohexyl-C_6H_3	Succinic anhydride	2,4-$(CH_3O)_2$-3-cyclohexyl-$C_6H_2COCH_2CH_2CO_2H$	(*19B*)
$[2,4\text{-}(CH_3O)_2C_6H_3]_2$	Succinic anhydride, $AlCl_3$, $C_6H_5NO_2$	[2,4-$(CH_3O)_2$-5-($HO_2CCH_2CH_2CO$)-C_6H_2]$_2$	(*18B*)
Indan	Succinic anhydride, $AlCl_3$, $C_6H_5NO_2$	5-Indanyl-$COCH_2CH_2CO_2H$, ~100%	(*55B*)
Tetralin	Succinic anhydride, $AlCl_3$	5,6,7,8-H_4-2-naphthyl-$COCH_2CH_2CO_2H$	(*128B*)
Naphthalene	Succinic anhydride, $AlCl_3$	1- and 2-Naphthyl-$COCH_2CH_2CO_2H$	(*128B*)
1-CH_3O-naphthalene (also for 2-)	Succinic anhydride, $AlCl_3$	1-($HO_2CCH_2CH_2CO$)-4-CH_3O-naphthalene	(*68B, 128B*)
9,10-H_2-phenanthrene	Succinic anhydride, $AlCl_3$	2-($HO_2CCH_2CH_2CO$)-9,10-H_2-phenanthrene, 90%	(*144B*)
2-C_2H_5-9,10-H_2-phenanthrene	Succinic anhydride, $AlCl_3$, $C_6H_5NO_2$	3-C_2H_5-7-($HO_2CCH_2CH_2CO$)-9,10-H_2-phenanthrene	(*36B*)
4,5-Cyclopenteno-6,7,8,8a-H_4-acenaphthene	Succinic anhydride, $AlCl_3$, $C_6H_5NO_2$	3-($HO_2CCH_2CH_2CO$)-4,5-cyclopenteno-6,7,8,8a-H_4-acenaphthene	(*49B*)
Dehydroabietic acid, ester	Succinic anhydride, $AlCl_3$, $C_6H_5NO_2$	6-($HO_2CCH_2CH_2CO$)-dehydroabietic acid, methyl ester	(*174B*)
Cumene	2-CH_3-succinic anhydride, $AlCl_3$ $C_6H_5NO_2$	4-(*i*-C_3H_7)$C_6H_4COCH_2CH(CH_3)CO_2H$	(*77B*)
1,3-$(CH_3)_2C_6H_4$	2-CH_3-succinic anhydride, $AlCl_3$, $C_6H_5NO_2$	2,4-$(CH_3)_2C_6H_3COCH_2CH(CH_3)CO_2H$	(*79B*)
4-Cyclohexyl-$C_6H_4OCH_3$	2-CH_3-succinic anhydride	2-CH_3O-5-cyclohexyl-$C_6H_3COCH_2CH(CH_3)CO_2H$	(*19B*)
2,5-$(CH_3O)_2C_6H_3OCH_3$	2-CH_3-succinic anhydride, $AlCl_3$, $C_6H_5NO_2$ or $C_2H_2Cl_4$	2,5-$(CH_3O)_2$-4-CH_3O-C_6H_2CO-$CHR_1CHR_2CO_2H$ (R_1 or R_2 = CH_3)	(*4B*)
2-(*i*-C_3H_7)-5-CH_3-$C_6H_3OCH_3$	2-CH_3-succinic anhydride	2-CH_3-4-CH_3O-5-(*i*-C_3H_7)-C_6H_2CO-$CH_2CH(CH_3)CO_2H$	(*108B*)
1,5-$(C_2H_5O)_2$-2,4-(cyclohexyl)$_2$-C_6H_2	2-CH_3-succinic anhydride, $AlCl_3$, $C_6H_5NO_2$	2,4-$(C_2H_5O)_2$-5-cyclohexyl-$C_6H_2COCH_2CH(CH_3)CO_2H$	(*18B*)
1,3-$(CH_3O)_2C_6H_4$	2-C_2H_5-succinic anhydride, $AlCl_3$, *n*-$C_3H_7NO_2$	2,5-$(CH_3O)_2C_6H_3COCH_2CH(C_2H_5)CO_2H$, 85%	(*17B*)
Benzene	2-C_6H_5-succinic anhydride	$C_6H_5COCHR_1CHR_2CO_2H$ (R_1 or R_2 = CH_3)	(*16B*)
4-Cyclohexyl-$C_6H_4OCH_3$	2-C_6H_5-succinic anhydride	2-CH_3O-5-cyclohexyl-C_6H_3CO-$CH_2CH(C_6H_5)CO_2H$	(*19B*)
Cumene	2,3-$(CH_3)_2$-succinic anhydride, $AlCl_3$, $C_6H_5NO_2$	4-(*i*-C_3H_7)$C_6H_4CO[CH(CH_3)]_2CO_2H$	(*78B*)
1-CH_3-4-(*i*-C_3H_7)-C_6H_4	2,3-$(CH_3)_2$-succinic anhydride, $AlCl_3$, $C_6H_5NO_2$	2-CH_3-5-(*i*-C_3H_7)C_6H_3CO-$[CH(CH_3)]_2CO_2H$	(*76B*)
Anisole	H_6-phthalic anhydride, $AlCl_3$, $C_6H_5NO_2$	1-HO_2C-2-(4-$CH_3OC_6H_4CO$)-cyclohexane	(*126B*)
$C_6H_5OC_2H_5$	H_6-phthalic anhydride, $AlCl_3$, $C_6H_5NO_2$	1-HO_2C-2-(4-$C_2H_5OC_6H_4CO$)-cyclohexane	(*126B*)

OPEN-CHAIN ACYLATION (Aromatics) (*Continued*)

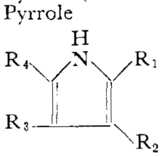
Aromatic	*Reagent*	*Product*	*Reference*
Benzene (also for toluene)	α,α-(2′-CH_3-cyclopentano)-succinic anhydride, $AlCl_3$	1-HO_2C-1-($C_6H_5COCH_2$)-2-CH_3-cyclopentane	*(72B)*
Benzene (also for toluene and tetralin)	α,α-(2′-C_2H_5-cyclopentano)-succinic anhydride, $AlCl_3$	1-HO_2C-1-($C_6H_5COCH_2$)-2-C_2H_5-cyclopentane	*(74B, 75B)*
4-$CH_3C_6H_4OH$	Maleic anhydride, $AlCl_3$, $(CH_2Cl)_2$	2-HO-5-CH_3-$C_6H_3COCH{=}CHCO_2H$	*(5B)*
4-$ClC_6H_4OCH_3$	Maleic anhydride	2-CH_3O-5-Cl-$C_6H_3COCH{=}CHCO_2H$	*(5B)*
1,2-$(HO)_2C_6H_4$	Maleic anhydride	3,4-$(HO)_2C_6H_3COCH{=}CHCO_2H$	*(5B)*
1,2-$(CH_3O)_2C_6H_4$ (also for 1,3- and 1,4-)	Maleic anhydride, $AlCl_3$, CH_2Cl_2	3,4-$(CH_3O)_2C_6H_3COCH{=}CHCO_2H$	*(5B)*
2,4-$(CH_3)_2C_6H_3OH$ (also for 3,4- and 3,5-)	Maleic anhydride	2-HO-3,5-$(CH_3)_2C_6H_2COCH{=}CHCO_2H$	*(5B)*
3,5-$(CH_3)_2C_6H_3OC_2H_5$	Maleic anhydride	2-C_2H_5O-4,6-$(CH_3)_2C_6H_2COCH{=}CHCO_2H$	*(5B)*
2-Cyclohexyl-$C_6H_4OCH_3$ (also for 4-)	Maleic anhydride, $AlCl_3$, $C_6H_5NO_2$	3-Cyclohexyl-4-CH_3O-$C_6H_3COCH{=}CHCO_2H$	*(19B)*
1-Cyclohexyl-2,4-$(CH_3O)_2$-C_6H_3	Maleic anhydride	2,4-$(CH_3O)_2$-5-cyclohexyl-$C_6H_2COCH{=}CHCO_2H$	*(19B)*
2-CH_3O-biphenyl	Maleic anhydride, $AlCl_3$, $C_6H_5NO_2$	3-C_6H_5-4-CH_3O-$C_6H_3COCH{=}CHCO_2H$	*(20B)*
1,5-$(C_2H_5O)_2$-2,4-(cyclohexyl)$_2$-C_6H_2	Maleic anhydride, $AlCl_3$, $C_6H_5NO_2$	2,4-$(C_2H_5O)_2$-5-cyclohexyl-$C_6H_2COCH{=}CHCO_2H$	*(18B)*
Benzene	2-C_6H_5-maleic anhydride, $AlCl_3$	$C_6H_5COC(C_6H_5){=}CHCO_2H$, 50%	*(114B)*
Benzene (also for C_6H_5Br)	Itaconic anhydride, $AlCl_3$, CS_2	$C_6H_5COCH_2C(CO_2H){=}CH_2$, 63%	*(115B)*
Benzene	Citraconic anhydride, $AlCl_3$, CS_2	46% $C_6H_5COCH(CH_3){=}CHCO_2H$ and 14% $C_6H_5COCH{=}CHCO_2H$	*(115B)*
Indan	1-Cyclopentene-1,2-dicarboxylic acid anhydride, $AlCl_3$, $C_6H_5NO_2$	2-(5-indanylcarbonyl)-1-cyclopentene-1-carboxylic acid	*(71B)*
Tetralin	1-Cyclopentene-1,2-dicarboxylic acid anhydride, $AlCl_3$, $C_6H_5NO_2$	1-(5,6,7,8-H_4-2-naphthylcarbonyl)-1-cyclopentene-2-carboxylic acid	*(71B)*
Benzene	Glutaric anhydride, $AlCl_3$	$C_6H_5CO(CH_2)_3CO_2H$	*(46B)*
$C_6H_5(CH_2)_4CO_2C_2H_5$	Glutaric anhydride, $AlCl_3$, $C_2H_2Cl_4$	4-$[C_2H_5O_2C(CH_2)_4]C_6H_4CO(CH_2)_3CO_2H$	*(46B)*
2-CH_3O-naphthalene	Glutaric anhydride, $AlCl_3$, $C_6H_5NO_2$	1- and 6-$[HO_2C(CH_2)_3CO]$-2-CH_3O-naphthalene	*(70B)*
Benzene	3-CH_3-glutaric anhydride	$C_6H_5COCH_2CH(CH_3)CH_2CO_2H$, 90%	*(158B)*
2-Cyclohexyl-$C_6H_4OC_2H_5$	Sebacic anhydride	3-Cyclohexyl-4-C_2H_5O-$C_6H_3CO(CH_2)_3CO_2H$	*(19B)*
1,2-$(CH_3O)_2C_6H_4$	Glutaric acid, BF_3; or *bis*-chloride, $AlCl_3$, CS_2	$[3,4\text{-}(CH_3O)_2C_6H_3COCH_2]_2CH_2$	*(138B)*
Benzene	$ClCOCH_2C(CH_3)_2CH_2COCl$, $AlCl_3$	$(C_6H_5COCH_2)_2C(CH_3)_2$, 70%	*(162B)*
$C_6H_5CH_2CH_2CO_2C_2H_5$	$ClCO(CH_2)_4COCl$, $AlCl_3$, CS_2	$[4\text{-}(C_2H_5O_2CH_2CH_2)C_6H_4COCH_2CH_2]_2$, 50%	*(1B)*
1,3-$(CH_3O)_2C_6H_4$ (also for *bis*-C_2H_5)	$COCl_2$, $AlCl_3$, $C_2H_2Cl_2$	$[2,4\text{-}(HO)_2C_6H_3]_2CO$, 35–40%, and mono ether	*(182B, 183B)*
Benzene	C_6H_5COCl, $AlCl_3$ or $SbCl_5$	$C_6H_5COC_6H_5$, 22 and 72%	*(142B)*
Toluene (also for benzene)	C_6H_5COCl, $AgClO_4$, MgO	4-$CH_3C_6H_4COC_6H_5$, 43% (0% for benzene)	*(39B)*
Toluene	C_6H_5COCl, $AlCl_3$	4-$CH_3C_6H_4COC_6H_5$, 40–90%	*(51B, 98B)*
Phenol	$C_6H_5CO_2H$	4-$HOC_6H_4COC_6H_5$	*(133B)*
Anisole	$C_6H_5CO_2H$, PPA; C_6H_5COCl, $AlCl_3$, CS_2; or $CF_3CO_2COC_6H_5$, CF_3CO_2H	4-$CH_3OC_6H_4COC_6H_5$, 64–100%	*(13B, 66B, 133B)*
$C_6H_5OC_2H_5$	C_6H_5COCl, I_2	4-$C_2H_5OC_6H_4COC_6H_5$, 83%	*(91B)*
C_6H_5Cl	C_6H_5COCl, $AlCl_3$	4-$ClC_6H_4COC_6H_5$, 9–72% (also some 3-Cl)	*(98B)*
$C_6H_5CH_2CH_2NHCOCH_3$	C_6H_5COCl, $AlCl_3$, $C_6H_5NO_2$	4-$C_6H_5COC_6H_4CH_2CH_2NHCOCH_3$	*(177B)*
$C_6H_5CH_2Si(CH_3)_3$	C_6H_5COCl, $AlCl_3$	4-$C_6H_5COC_6H_4CH_2Si(CH_3)_3$, 65%	*(141B)*
$C_6H_5Si(CH_3)_3$	C_6H_5COF, BF_3, $CHCl_3$	$C_6H_5COC_6H_4Si(CH_3)_3$	*(168B)*
Biphenyl	C_6H_5COCl, I_2	4-C_6H_5CO-biphenyl, 50%	*(91B)*
4-ClC_6H_4OH	$C_6H_5CO_2H$, BF_3	2-HO-5-Cl-$C_6H_3COC_6H_5$, 70%	*(93B)*
2-$FC_6H_4OCH_3$ (also for 4-)	C_6H_5COCl	3-F-4-CH_3O-$C_6H_3COC_6H_5$	*(27B, 30B)*
2-$ClC_6H_4SCH_3$	C_6H_5COCl	3-Cl-4-CH_3S-$C_6H_3COC_6H_5$	*(178B)*
4-(*t*-C_4H_9)$C_6H_4OCH_3$	C_6H_5COCl, $ZnCl_2$, $(CHCl_2)_2$	2-CH_3O-5-(*t*-C_4H_9)$C_6H_3COC_6H_5$	*(107B)*
1,2-$(CH_3O)_2C_6H_4$	C_6H_5COCl, $AlCl_3$, CS_2; $C_6H_5CO_2H$, PPA or I_2	3,4-$(CH_3O)_2C_6H_3COC_6H_5$, 68–81%, (some demethylation)	*(91B, 129B, 150B, 179B)*
1,3-$(CH_3O)_2C_6H_4$	$C_6H_5CO_2H$, PPA	2,4-$(CH_3O)_2C_6H_3COC_6H_5$	*(129B)*
$[4\text{-}CH_3OC_6H_4CH(C_2H_5)]_2$	C_6H_5COCl, $AlCl_3$, $C_6H_5NO_2$	2-CH_3O-5-$[4\text{-}CH_3OC_6H_4CH(C_2H_5)\text{-}CH(C_2H_5)]C_6H_3COC_6H_5$	*(30B)*
Mesitylene	C_6H_5COCl, I_2	2,4,6-$(CH_3)_3C_6H_2COC_6H_5$, 65%	*(91B)*
1,2,3-$(CH_3O)_3C_6H_3$	$C_6H_5CO_2H$, PPA	2,3,4-$(CH_3O)_3C_6H_2COC_6H_5$	*(66B)*
2,4,6-(*i*-C_3H_7)$_3C_6H_2N(CH_3)_2$	C_6H_5COCl, $AlCl_3$, CS_2	2,4,6-(*i*-C_3H_7)$_3$-3-H_2N-$C_6HCOC_6H_5$, 25%	*(173B)*
2,4,6-(*i*-C_3H_7)$_3C_6H_2NHC_2H_5$	C_6H_5COCl, $AlCl_3$, CS_2	2,4,6-(*i*-C_3H_7)$_3$-3-C_2H_5NH-$C_6HCOC_6H_5$, 69%	*(173B)*
Naphthalene	C_6H_5COCl	70% 1-C_6H_5CO-naphthalene and 30% 2-C_6H_5CO-naphthalene	*(97B)*
2-CH_3O-naphthalene	C_6H_5COCl, I_2	1-C_6H_5CO-2-CH_3O-naphthalene	*(91B)*
1-$C_6H_5CH_2$-naphthalene	C_6H_5COCl, $AlCl_3$	4-$C_6H_5CH_2$-1-C_6H_5CO-naphthalene, 79%	*(99B)*
1-HO-2-HO_2C-naphthalene (also for ester)		1-HO-2-HO_2C-4-C_6H_5CO-naphthalene	*(88B)*
2-HO-3-HO_2C-naphthalene (also for ester)		1-C_6H_5CO-2-HO-3-HO_2C-naphthalene	*(88B)*
7-HO-coumarin	C_6H_5COCl, $AlCl_3$	7-HO-8-C_6H_5CO-coumarin	*(120B)*
4-CH_3-5-HO-coumarin	C_6H_5COCl, $AlCl_3$	4-CH_3-5-HO-6-C_6H_5CO-coumarin	*(140B)*
4-CH_3-5,7-$(HO)_2$-coumarin	C_6H_5COCl, $AlCl_3$	4-CH_3-5,7-$(HO)_2$-6,8-$(C_6H_5CO)_2$-coumarin	*(140B)*
8-HO-quinoline	C_6H_5COCl	5-C_6H_5CO-8-HO-quinoline	*(172B)*
1,4-$(C_6H_5)_2C_6H_4$	C_6H_5COCl, $AlCl_3$, CS_2	1-C_6H_5-4-$[4\text{-}(C_6H_5CO)C_6H_4]C_6H_4$	*(25B)*
Phenanthrene	C_6H_5COCl, $AlCl_3$	3,6-$(C_6H_5CO)_2$-phenanthrene and isomers	*(42B)*
Dibenzofuran	C_6H_5COCl, $AlCl_3$, $C_6H_5NO_2$	2-C_6H_5CO-dibenzofuran and 1,7-$(C_6H_5CO)_2$-dibenzofuran	*(86B)*

OPEN-CHAIN ACYLATION (Aromatics) *(Continued)*

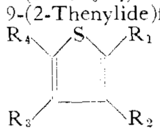
Aromatic	*Reagent*	*Product*	*Reference*
4,5-Cyclopenteno-6,7,8,8a-H_4-acenaphthene	C_6H_5COCl, $AlCl_3$, $C_6H_5NO_2$	3-C_6H_5CO-4,5-cyclopenteno-6,7,8,8a-H_4-acenaphthene	*(49B)*
4-(t-C_4H_9)$C_6H_4OCH_3$	R-C_6H_4COCl, $ZnCl_2$, $(CHCl_2)_2$	1-(RC_6H_4CO)-2-CH_3O-5-(t-C_4H_9)-C_6H_3	*(107B)*
		R — Yield, %	
		4-CH_3 — 76	
		2-Cl — 62	
		4-Cl — 60	
		2-Br — 68	
		3-Br — 61	
		2-CH_3O — 50	
		4-CH_3O — 60	
1,2,3,4,5-$(CH_3)_5C_6H$	4-$CH_3C_6H_4COCl$, $AlCl_3$, CS_2	1-(4-$CH_3C_6H_4CO$)-2,3,4,5,6-$(CH_3)_5$-C_6	*(161B)*
Phenanthrene	2-$CH_3C_6H_4COCl$, $AlCl_3$	3,6-(2-$CH_3C_6H_4CO)_2$-phenanthrene and isomers	*(42B)*
Biphenyl	4-C_6H_5-C_6H_4COCl, $AlCl_3$, CS_2	$[4\text{-}C_6H_5\text{-}C_6H_4]_2CO$	*(33B)*
Benzene	2-BrC_6H_4COCl, $AlCl_3$	2-Br-$C_6H_4COC_6H_5$	*(163B)*
Durene	4-BrC_6H_4COCl	1-(4-BrC_6H_4CO)-2,3,5,6-$(CH_3)_4$-C_6H	*(62B)*
Toluene	2-ClC_6H_4COCl	4-(2-ClC_6H_4CO)-$C_6H_4CH_3$	*(54B)*
Anisole	4-ClC_6H_4COCl, I_2	4-(4-ClC_6H_4CO)-$C_6H_4OCH_3$	*(91B)*
2-$ClC_6H_4OCH_3$ (also for 4-)	2-ClC_6H_4COCl (also 4-)	1-(2-ClC_6H_4CO)-3-Cl-4-CH_3O-C_6H_3	*(30B)*
Durene	2-ClC_6H_4COCl	1-(2-ClC_6H_4CO)-2,3,5,6-$(CH_3)_4$-C_6H	*(63B)*
Durene	2-FC_6H_4COCl, $AlCl_3$, CS_2 (also 4-)	1-(2-FC_6H_4CO)-2,3,5,6-$(CH_3)_4$-C_6H, 80%	*(61B)*
Anisole	4-$HOC_6H_4CO_2H$, PPA	4-(4-HOC_6H_4CO)$C_6H_4OCH_3$	*(133B)*
Phenol	4-$CH_3OC_6H_4CO_2H$, PPA	4-(4-HOC_6H_4CO)$C_6H_4OCH_3$	*(133B)*
Benzene (also for toluene)	2-$CH_3OC_6H_4COCl$	2-CH_3O-$C_6H_4COC_6H_5$, 40%	*(54B)*
Anisole	4-$CH_3OC_6H_4COCl$, $AlCl_3$, or I_2	$(4\text{-}CH_3OC_6H_4)_2CO$, 84%	*(91B, 133B)*
Durene	4-$CH_3OC_6H_4COCl$, $AlCl_3$, CS_2	1-(4-$CH_3OC_6H_4CO$)-2,3,5,6-$(CH_3)_4$-C_6H	*(60B)*
Tetralin	4-$CH_3OC_6H_4COCl$, $AlCl_3$, CS_2	2-(4-$CH_3OC_6H_4CO$)-5,6,7,8-H_4-naphthalene	*(38B)*
$[4\text{-}CH_3OC_6H_4CH(C_2H_5)]_2$	4-$CH_3OC_6H_4COCl$, $AlCl_3$, $C_6H_5NO_2$	2-CH_3O-4-[4-$CH_3OC_6H_4CH(C_2H_5)$-$CH(C_2H_5)$]$C_6H_3COC_6H_5$	*(30B)*
2-(i-C_3H_7)-5-CH_3-$C_6H_3OCH_3$	2-$CH_3OC_6H_4COCl$, $AlCl_3$, CS_2	2-(i-C_3H_7)-4-(2-$CH_3OC_6H_4CO$)-5-CH_3-$C_6H_2OCH_3$, 40%	*(156B)*
2-(i-C_3H_7)-5-CH_3-$C_6H_3OCH_3$	4-$CH_3OC_6H_4COCl$, $AlCl_3$, CS_2	2-(i-C_3H_7)-4-(4-$CH_3OC_6H_4CO$)-5-CH_3-$C_6H_2OCH_3$, 74%	*(156B)*
Anisole	4-$O_2NC_6H_4COCl$, I_2	4-(4-$CH_3OC_6H_4CO$)$C_6H_4NO_2$	*(91B)*

Aromatic	*Reagent*	*Product*	*Reference*
Benzene (also for toluene and anisole)	2-(4-$CH_3C_6H_4SO_2NH$)-C_6H_4COCl	2-$H_2NC_6H_4COC_6H_5$	*(54B)*
Toluene (also for anisole)	4-[$(CH_3)_3Si$]C_6H_4COCl	4-(4-$CH_3C_6H_4CO$)$C_6H_4Si(CH_3)_3$, 66%	*(11B)*
Toluene (also for anisole)	2-[$(CH_3)_3Si$]C_6H_4COCl	Resin	*(11B)*
Toluene	3-[$(CH_3)_3Si$]C_6H_4COCl, $AlCl_3$	3-(4-$CH_3C_6H_4CO$)$C_6H_4Si(CH_3)_3$, 43%	*(11B)*
1,2,3,4,5-$(CH_3)_5C_6H$	2,4,6-$(CH_3)_3C_6H_2COCl$, $AlCl_3$, CS_2	1-[2,4,6-$(CH_3)_3C_6H_2CO$]-2,3,4,5,6-$(CH_3)_5$-C_6, 82%	*(161B)*
Acenaphthene	2,4,6-$(CH_3)_3C_6H_2COCl$, $AlCl_3$, CS_2	5-[2,4,6-$(CH_3)_3C_6H_2CO$]-acenaphthene, 71%	*(64B)*
4-$CH_3C_6H_4OCH_3$	2-CH_3-4-CH_3O-5-(i-C_3H_7)-C_6H_2COCl, $AlCl_3$, CS_2	1-[2-CH_3-4-CH_3O-5-(i-C_3H_7)-C_6H_2CO]-2-CH_3O-5-CH_3-C_6H_3, 35%	*(156B)*
1,3-$(CH_3O)_2C_6H_4$	2-CH_3-4-CH_3O-5-(i-C_3H_7)-C_6H_2COCl, $AlCl_3$, CS_2	1-[2-CH_3-4-CH_3O-5-(i-C_3H_7)-C_6H_2CO]-2,4-$(CH_3O)_2$-C_6H_3, 60%	*(156B)*
2-(i-C_3H_7)-5-CH_3-$C_6H_3OCH_3$	2-CH_3-4-CH_3O-5-(i-C_3H_7)-C_6H_2COCl, $AlCl_3$, CS_2	[2-CH_3-4-CH_3O-5-(i-C_3H_7)-C_6H_2]$_2$CO, 69%	*(156B)*
1,4-$(CH_3O)_2C_6H_4$	2,3,6-$(CH_3O)_3C_6H_2COCl$	1-[2,5-$(CH_3)_2C_6H_3CO$]-2,3,6-$(CH_3O)_3$-C_6H_2	*(143B)*
Mesitylene (also for durene)	2-ClCO-furan, $AlCl_3$, CS_2	2-[2,4,6-$(CH_3)_3C_6H_2CO$]-furan, 83%	*(65B)*
4-$ClC_6H_4OCH_3$	2-ClCO-furan	2-(2-CH_3O-5-Cl-C_6H_3CO)-furan	*(30B)*
2-$BrC_6H_4OCH_3$ (also for 2-Cl)	2-ClCO-thiophene	2-(3-Br-4-CH_3O-C_6H_3CO)-furan	*(30B)*
2-$BrC_6H_4OCH_3$ (also for 2-Cl)	2-ClCO-5-CH_3-thiophene	2-(3-Br-4-CH_3O-C_6H_3CO)-5-CH_3-thiophene	*(30B)*
$C_6H_5CH_2CH_2N(CH_3)_2$	2-ClCO-pyridine, $AlCl_3$, $C_6H_5NO_2$	2-[4-$(CH_3)_2NCH_2CH_2C_6H_4CO$]-pyridine	*(177B)*
Benzene	Phthalic acid, $SiCl_4$, $AlCl_3$	2-$HO_2CC_6H_4COC_6H_5$, 96%	*(185B)*
1,4-$(CH_3)_2C_6H_4$ (also for 1,3-)	1,2-$(ClCO)_2C_6H_4$, $AlCl_3$	1,4-$(CH_3)_2$-2-(2-$HO_2CC_6H_4CO$)C_6H_3 and 74% 3,3-*bis*-[2,5-$(CH_3)_2$-C_6H_3]phthalide	*(43B)*
Toluene	Phthalic anhydride	1-HO_2C-2-(4-$CH_3C_6H_4CO$)C_6H_4	*(102B)*
Benzene and 24 homologs and isomers	Phthalic anhydride	1-HO_2C-2-ArCO-C_6H_4	*(110B)*
Phenanthrene	Phthalic anhydride, $AlCl_3$, $C_2H_2Cl_4$	3,6-(2-$HO_2CC_6H_4CO)_2$-phenanthrene and isomers	*(42B)*
Benzene and 27 homologs and isomers	3,4,5,6-Cl_4-phthalic anhydride	1-HO_2C-2-ArCO-3,4,5,6-Cl_4-C_6	*(111B)*
Anisole	9,10-$(ClCO)_2$-anthracene, $AlCl_3$	9,10-(4-$CH_3OC_6H_4CO)_2$-anthracene	*(153B)*
C_6H_5Cl	2,3-$(HO_2C)_2$-pyridine, $AlCl_3$	2-HO_2C-3-(4-ClC_6H_4CO)-pyridine	*(184B)*
Benzene	$ClCH_2CH(C_6H_5)COCl$	$ClCH_2CH(C_6H_5)COC_6H_5$ and $C_6H_5CH_2CH(C_6H_5)COC_6H_5$	*(123B)*
Benzene (also for toluene and biphenyl)	$C_6H_5COCH{=}C(C_6H_5)COCl$, $AlCl_3$	$C_6H_5COC(C_6H_5){=}CHCOC_6H_5$, 46%	*(114B)*
Anisole	8-(HO_2CCH_2)-5-HO-4′,7-$(CH_3O)_2$-flavone, $H_4P_2O_7$	8-[(4-$CH_3OC_6H_4$)CH_2]-5-HO-4′,7-$(CH_3O)_2$-flavone	*(130B)*
Anisole	8-(HO_2CCH_2)-4′,5,7-$(CH_3O)_3$-flavone, $H_4P_2O_7$	8-[(4-$CH_3OC_6H_4$)CH_2]-4′,5,7-$(CH_3O)_3$-flavone	*(130B)*

OPEN-CHAIN ACYLATION (Pseudoaromatics)

Pseudoaromatic	*Reagent*	*Product*	*Reference*
1,4-$(CH_3)_2$-7-(i-C_3H_7)-azulene	CH_3COCl, $AlCl_3$, CS_2	1,4-$(CH_3)_2$-3-CH_3CO-7-(i-C_3H_7)-azulene, 18%	*(23C)*
Furan		2-CH_3CO-furan	*(12C)*
4-HO-coumarin	RCOCl	3-RCO-4-HO-coumarin (R = CH_3, n-C_5H_{11}, n-C_7H_{15}, n-C_9H_{19}, $ClCH_2$, $C_6H_5CH_2$, $C_6H_5CH_2$-CH_2, $C_6C_5CH{=}CH$, C_6H_5)	*(1C)*
Pyrrole (also for indole)	$HCON(CH_3)_2$, $POCl_3$	2-HCO-pyrrole, 83%	*(18C)*
Pyrrole	H_2NCOCl	2-H_2NCO-pyrrole	*(22C)*
	H_2NCOCl	Yields of 60–90%	*(22C)*

R_1	R_2	R_3	R_4
CH_3	H_2NCO	CH_3	H_2NCO
CH_3	$C_2H_5O_2C$	CH_3	H_2NCO
$C_2H_5O_2C$	CH_3	H_2NCO	CH_3
CH_3	H_2NCO	H	$C_2H_5O_2C$
CH_3	$C_2H_5O_2C$	H	H_2NCO

Pseudoaromatic	*Reagent*	*Product*	*Reference*
1,2-$(C_6H_5)_2$-3-CH_3-pyrrole	H_2NCOCl	1,2-$(C_6H_5)_2$-3-CH_3-5-H_2NCO-pyrrole	*(22C)*
Pyridine	$HCON(CH_3)_2$, $POCl_3$	2-HCO-pyridine, low yield	*(14C)*
Pyridine	$C_6H_5N(CH_3)CHO$, $POCl_3$	2-HCO-pyridine, low yield	*(14C)*
Indole (similarly for 2-CH_3, 2-C_6H_5, 5-CH_3CO_2, 5-$C_6H_5CH_2O$, 5,6-$(CH_3O)_2$, 6-CH_3CO_2-7-CH_3O, and 1-benz[g])	$(COCl)_2$	3-ClCOCO-indole	*(19C)*
2-CH_3-pyrrocoline	$C_6H_5N(CH_3)CHO$, $POCl_3$, $(CH_2Cl)_2$	2-CH_3-3-HCO-pyrrocoline	*(17C)*
2,3-(CH_3)-pyrrocoline	$C_6H_5N(CH_3)CHO$, $POCl_3$, $(CH_2Cl)_2$	1-HCO-2,3-$(CH_3)_2$-pyrrocoline	*(17C)*
2-CH_3-4-HO-quinoline	CH_3COCl or $(CH_3CO)_2O$, $AlCl_3$	2-CH_3-3-CH_3CO-4-HO-quinoline	*(21C)*
Thiophene (also for 2-Cl, 2-CH_3, 3-CH_3, 2-(t-C_4H_9), 2-CH_3CONH)	$HCON(CH_3)_2$ or $C_6H_5N(CH_3)CHO$, $POCl_3$	2-HCO-thiophene, 72–77%	*(7C)*
2-(t-C_4H_9)-thiophene	$C_6H_5N(CH_3)CHO$, $POCl_3$	2-HCO-5-(t-C_4H_9)-thiophene, 80%	*(20C)*
2-C_6H_5-thiophene	$C_6H_5N(CH_3)CHO$, $POCl_3$, $C_6H_5CH_3$	2-HCO-5-C_6H_5-thiophene	*(8C)*
2-(3-ClC_6H_4)-thiophene		2-HCO-5-(3-ClC_6H_4)-thiophene	*(8C)*
2-($C_6H_5CH{=}CH$)-thiophene	$HCON(CH_3)_2$, $POCl_3$, 1,2-$Cl_2C_6H_4$	2-HCO-5-($C_6H_5CH{=}CH$)-thiophene	*(15C)*
2,4-$(C_6H_5)_2$-thiophene	$HCON(CH_3)_2$, $POCl_3$	2-HCO-3,5-$(C_6H_5)_2$-thiophene, 88%	*(8C, 16C)*
2,4-(4-$CH_3C_6H_4$)$_2$-thiophene		2-HCO-3,5-(4-$CH_3C_6H_4$)$_2$-thiophene	*(8C)*
2,5-$(C_6H_5)_2$-1,4-dithiadiene	$HCON(CH_3)_2$, $POCl_3$	2-HCO-3,5-$(C_6H_5)_2$-thiophene, above 32%	*(16C)*
2,4-$(C_6H_5)_2$-selenophene (also for ditolyl and dianisyl)		2-HCO-3,5-$(C_6H_5)_2$-selenophene	*(8C)*
Thiophene	$CF_3CO_2COCH_3$	2-CH_3CO-thiophene, 88%	*(4C)*
2-(t-C_4H_9)-thiophene	RCOCl, $SnCl_4$, CS_2	2-RCO-5-(t-C_4H_9)-thiophene (R = CH_3, C_2H_5, n-C_3H_7)	*(20C)*
2-($C_6H_5CH{=}CH$)-thiophene	RCOCl, $SnCl_4$, C_6H_6	2-RCO-5-($C_6H_5CH{=}CH$)-thiophene (R = CH_3, C_2H_5, C_6H_5)	*(15C)*
2-(3-ClC_6H_4)-thiophene	CH_3COCl, $SnCl_4$, CS_2	2-CH_3CO-5-(3-ClC_6H_5)-thiophene	*(8C)*
9-(2-Thenylide)fluorene	CH_3COCl	9-(5-CH_3CO-2-thenylidene)-fluorene	*(15C)*
	CH_3COCl, $SnCl_4$, C_6H_6	Yields of 45–99%	*(9C)*

R_1	R_2	R_3	R_4
CH_3	CH_3CO	H	CH_3
C_2H_5	CH_3CO	H	C_2H_5
CH_3	CH_3CO	H	t-C_4H_9
C_2H_5	CH_3CO	H	t-C_4H_9

(some replacement of t-C_4H_9)

Pseudoaromatic	*Reagent*	*Product*	*Reference*
2,5-$(CH_3)_2$-thiophene	CH_3COCl, $AlCl_3$, CS_2	2,5-$(CH_3)_2$-3-CH_3CO-thiophene, 75%	*(3C)*
2,5-(t-C_4H_9)$_2$-thiophene	CH_3COCl	2,5-(t-C_4H_9)$_2$-3-CH_3CO-thiophene	*(20C)*
2,5-$(C_2H_5)_2$-3-(n-C_3H_7)-thiophene (also for n-C_4H_9 and n-C_5H_{11})	CH_3COCl, $AlCl_3$	2,5-$(C_2H_5)_2$-3-CH_3CO-4-(n-C_3H_7)-thiophene, 40–5%	*(5C)*
2,4-$(C_6H_5)_2$-thiophene (also for ditolyl)		2-CH_3CO-3,5-$(C_6H_5)_2$-thiophene	*(8C)*
2,4-$(C_6H_5)_2$-selenophene (also for ditolyl and dianisyl)		2-CH_3CO-3,5-$(C_6H_5)_2$-selenophene	*(8C)*
2,4-$(C_6H_5)_2$-thiophene (also for ditolyl)		2-C_2H_5CO-3,5-$(C_6H_5)_2$-thiophene	*(8C)*
2,4-(4-$CH_3C_6H_4$)$_2$-selenophene		2-C_2H_5CO-3,5-(4-$CH_3C_6H_4$)$_2$-selenophene	*(8C)*
2,4-$(C_6H_5)_2$-selenophene		2-(n-C_3H_7)-3,5-$(C_6H_5)_2$-selenophene	*(8C)*
2,5-$(C_2H_5)_2$-thiophene	RCOCl, $AlCl_3$, CS_2	2,5-$(C_2H_5)_2$-3-RCO-thiophene, yields from 78–92% (R = C_2H_5, n-C_3H_7, n-C_4H_9, n-C_5H_{11}, n-C_6H_{13}, n-C_7H_{15}, n-C_9H_{19}, n-$C_{15}H_{31}$, C_6H_5, and $C_6H_5CH_2$)	*(5C)*
2-C_2H_5-thiophene	n-$C_6H_{13}COCl$	2-(n-$C_6H_{13}CO$)-5-C_2H_5-thiophene, 90%	*(3C)*
2,5-$(CH_3)_2$-thiophene	n-$C_6H_{13}COCl$, $SnCl_4$, C_6H_6; or n-$C_6H_{13}CO_2H$, P_2O_5	2,5-$(CH_3)_2$-3-(n-$C_6H_{13}CO$)-thiophene, 60–84%	*(3C)*
Thiophene	n-$C_{10}H_{21}COCl$	2-(n-$C_{10}H_{21}CO$)-thiophene, 80%	*(3C)*
Thiophene	(n-C_3H_7)$CH(C_2H_5)(CH_2)_3COCl$	2-[(n-C_3H_7)$CH(C_2H_5)(CH_2)_3CO$]-thiophene, 87%	*(3C)*
Thiophene	$CH_3CH{=}CHCOCl$, $AlCl_3$, CS_2	2-($CH_3CH{=}CHCO$)-thiophene, 71%	*(11C)*
2,5-$(C_2H_5)_2$-thiophene	$CH_3O_2C(CH_2)_2COCl$, $AlCl_3$, CS_2	2,5-$(C_2H_5)_2$-3-[$CH_3O_2C(CH_2)_2CO$]-thiophene	*(5C)*
2,5-$(C_2H_5)_2$-thiophene	$C_2H_5O_2C(CH_2)_3COCl$	2,5-$(C_2H_5)_2$-3-[$C_2H_5O_2C(CH_2)_3CO$]-thiophene, 67%	*(5C)*
4,5,6,7-H_4-thianaphthene	$C_2H_5O_2C(CH_2)_3COCl$, $AlCl_3$, CS_2	2-($C_2H_5O_2C(CH_2)_3CO$)-4,5,6,7-H_4-thianaphthene	*(6C)*
Thiophene (also for 2-C_2H_5, 2,5-$(CH_3)_2$, 2,5-$(CH_3)_2$-3-C_2H_5)	Succinic anhydride, $AlCl_3$, $C_6H_5NO_2$	2-($HO_2CCH_2CH_2CO$)-thiophene	*(3C)*
2-(n-C_7H_{15})-thiophene [also for n-$C_{11}H_{23}$, (n-C_3H_7)$CH(C_2H_5)$-$(CH_2)_4$]	Succinic anhydride, $AlCl_3$, $C_6H_5NO_2$	2-($HO_2CCH_2CH_2CO$)-5-(n-C_7H_{15})-thiophene	*(3C)*

OPEN-CHAIN ACYLATION (Pseudoaromatics) (*Continued*)

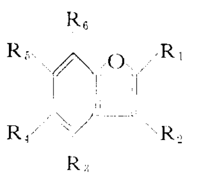
Pseudoaromatic	*Reagent*	*Product*	*Reference*
2-Br-thiophene	Succinic anhydride, $AlCl_3$, $C_6H_5NO_2$	2-($HO_2CCH_2CH_2CO$)-5-Br-thiophene	*(3C)*
2,5-(CH_3)$_2$-thiophene (also for diethyl)	Succinic anhydride	2,5-(C_2H_5)$_2$-3-($HO_2CCH_2CH_2CO$)-thiophene, 60%	*(2C, 5C)*
2,5-(C_2H_5)$_2$-thiophene	Glutaric anhydride, $AlCl_3$, $C_6H_5NO_2$	2,5-(C_2H_5)$_2$-3-[$HO_2C(CH_2)_3CO$]-thiophene, 75%	*(5C)*
4,5,6,7-H_4-thianaphthene	Glutaric anhydride, $AlCl_3$, $C_6H_5NO_2$	2-[$HO_2C(CH_2)_3CO$]-4,5,6,7-H_4-thianaphthene, 78%	*(6C)*
2-Cl-thiophene	C_6H_5COCl, I_2 (also 4-Cl)	2-C_6H_5CO-5-Cl-thiophene, 34%	*(13C)*
2-CH_3-5-C_6H_5-thiophene	C_6H_5COCl, $AlCl_3$	2-CH_3-3-C_6H_5CO-5-C_6H_5-thiophene	*(8C)*
Thiophene	4-XC_6H_5COCl	2-(4-XC_6H_4CO)-thiophene (X = CH_3, CH_3O, and Cl)	*(13C, 15C)*
Thiophene	1-$C_2H_5O_2C$-2-ClCO-3-O_2N-C_6H_3, $SnCl_4$, C_6H_6	1-$C_2H_5O_2C$-2-thenoyl-3-O_2N-C_6H_3, 51%	*(10C)*
Thiophene	1-ClCO-2-$C_2H_5O_2C$-3-O_2N-C_6H_3, $SnCl_4$, C_6H_6	1-Thenoyl-2-$C_2H_5O_2C$-3-O_2N-C_6H_3, 45%	*(10C)*
Thiophene	2-ClCO-naphthalene, $SnCl_4$	2-Thenoylnaphthalene	*(15C)*

OPEN-CHAIN ACYLATION (Aromatics, Gattermann-Koch-Hoesch)

Aromatic	*Reagent*	*Product*	*Reference*
Tetralin	CO, HCl, $AlCl_3$, CuCl, C_6H_6	2-HCO-5,6,7,8-H_4-naphthalene	*(9D)*
2-C_6H_5-6-HO-chroman	CO, HCl, $AlCl_3$	2-C_6H_5-6-HO-8-HCO-chroman	*(14D)*
2-C_6H_5-5-CH_3-7-HO-chroman	CO, HCl, $AlCl_3$	2-C_6H_5-5-CH_3-7-HO-8-HCO-chroman	*(14D)*
2-C_6H_5-6-CH_3-7-HO-chroman	CO, HCl, $AlCl_3$	2-C_6H_5-6-CH_3-7-HO-8-HCO-chroman	*(14D)*
2-C_6H_5-5-CH_3O-7-($C_6H_5CH_2O$)-chroman	CO, HCl, $AlCl_3$	2-C_6H_5-5-CH_3O-7-($C_6H_5CH_2O$)-8-HCO-chroman	*(14D)*
2-C_6H_5-5-CH_3O-7-HO-8-CH_3-chroman	CO, HCl, $AlCl_3$	2-C_6H_5-5-CH_3O-6-HCO-7-HO-8-CH_3-chroman	*(14D)*
2-(Cyclohexyl)-$C_6H_4OCH_3$	$Zn(CN)_2$, HCl, $AlCl_3$	3-(Cyclohexyl)-4-CH_3O-C_6H_3CHO	*(1D)*
2-CH_3O-biphenyl	$Zn(CN)_2$, HCl, $AlCl_3$	3-C_6H_5-4-CH_3O-C_6H_3CHO	*(1D)*
2-$C_6H_5CH_2$-$C_6H_4OCH_3$	$Zn(CN)_2$, HCl, $AlCl_3$	3-$C_6H_5CH_2$-4-CH_3O-C_6H_3CHO	*(1D)*
3,5-(CH_3)$_2C_6H_3OH$	HCN, HCl, $AlCl_3$	2,6-(CH_3)$_2$-4-HO-C_6H_2CHO, 45%	*(2D)*
3,4-(CH_3O)$_2C_6H_3C_2H_5$	$Zn(CN)_2$, HCl, $AlCl_3$, C_6H_6	2-C_2H_5-4,5-(CH_3O)$_2$-C_6H_2CHO	*(16D)*
2,6-$(HO)_2C_6H_3Br$	$Zn(CN)_2$, HCl, $(C_2H_5)_2O$	2,4-$(HO)_2$-3-Br-C_6H_2CHO	*(8D)*
2,4-$(HO)_2C_6H_3CO_2H$	$Zn(CN)_2$	2,4-$(HO)_2$-3-HCO-$C_6H_2CO_2H$	*(6D)*
2-C_6H_5-5-HO-7-CH_3O-chroman	HCN, HCl, $ZnCl_2$, $(C_2H_5)_2O$	2-C_6H_5-5-HO-6-HCO-7-CH_3O-chroman	*(14D)*
2-C_6H_5-7-HO-4-chromanone	HCN, HCl, $ZnCl_2$, $(C_2H_5)_2O$	2-C_6H_5-7-HO-8-HCO-4-chromanone	*(14D)*
1,2,3-$(HO)_3C_6H_3$	CH_3CN, HCl, $ZnCl_2$, $(C_2H_5)_2O$	2,3,4-$(HO)_3C_6H_2COCH_3$	*(13D)*
2-C_2H_5-3,5-(CH_3O)$_2$-C_6H_2OH	CH_3CN	2-HO-3-C_2H_5-4,6-(CH_3O)$_2$-C_6HCOCH_3	*(3D)*
2-C_6H_5-7-HO-4-chromanone	CH_3CN, HCl, $ZnCl_2$, $(C_2H_5)_2O$	2-C_6H_5-7-HO-8-CH_3CO-4-chromanone	*(14D)*
2-C_6H_5-5-HO-7-CH_3O-chroman	CH_3CN, HCl, $ZnCl_2$, $(C_2H_5)_2O$	2-C_6H_5-5-HO-7-CH_3O-8-CH_3CO-chroman	*(14D)*
2-C_6H_5-5-CH_3O-7-HO-chroman	CH_3CN, HCl, $ZnCl_2$, $(C_2H_5)_2O$	2-C_6H_5-5-CH_3O-7-HO-8-CH_3CO-chroman	*(14D)*
1,3-$(HO)_2$-2,4-$(CH_3)_2$-C_6H_2	n-$C_5H_{11}CN$, HCl, $ZnCl_2$, $(C_2H_5)_2O$	2,4-$(HO)_2$-3,5-$(CH_3)_2$-C_6HCO-(n-C_5H_{11}), 33%	*(7D)*
2,4,6-$(HO)_3C_6H_2CH_2CH_2CH$-$(CH_3)_2$	$(CH_3)_2CHCH_2CN$, HCl, $ZnCl_2$	2,4,6-$(HO)_3$-3-[$(CH_3)_2CHCH_2CH_2$]-$C_6HCOCH_2CH(CH_3)_2$, 68%	*(15D)*
2,4,6-$(HO)_3C_6H_2CH_3$	$C_6H_5CH_2CN$, HCl, $ZnCl_2$	2,4,6-$(HO)_3$-3-CH_3-$C_6HCOCH_2C_6H_5$	*(5D)*
1,3-$(HO)_2C_6H_4$	4-$HOC_6H_4CH_2CN$ (also for 4-CH_3O)	4-[2,4-$(HO)_2C_6H_3COCH_2$]C_6H_4OH	*(18D)*
1,3,5-$(HO)_3C_6H_3$	4-$HOC_6H_4CH_2CN$ (also for 4-CH_3O)	4-[2,4,6-$(HO)_3C_6H_2COCH_2$]C_6H_4OH	*(18D)*
1,3-$(HO)_2C_6H_4$	2-$CH_3OC_6H_4CH_2CN$, HCl, $ZnCl_2$	2-[2,4-$(HO)_2C_6H_3COCH_2$]$C_6H_4OCH_3$	*(17D)*
2,4,6-$(HO)_3C_6H_2CH_3$ (also for 4-C_2H_5O)	2-$CH_3OC_6H_4CH_2CN$, HCl, $ZnCl_2$ (also for 2-C_2H_5O)	2-[2,4,6-$(HO)_3$-3-CH_3-C_6HCOCH_2]-$C_6H_4OCH_3$	*(10D, 17D)*
1,3,5-$(HO)_3C_6H_3$ (also for 2-CH_3)	2,3-$(CH_3O)_2C_6H_3CH_2CN$, HCl, $ZnCl_2$	1-[2,4,6-$(HO)_3C_6H_2COCH_2$]-2,3-$(CH_3O)_2$-C_6H_3	*(17D)*
2,4-$(HO)_2C_6H_3C_2H_5$	$ClCH_2CN$, HCl, $ZnCl_2$, $(C_2H_5)_2O$	2,4-$(HO)_2$-5-C_2H_5-$C_6H_2COCH_2Cl$, 88%	*(13D)*
2,4-$(CH_3O)_2C_6H_3C_2H_5$	$ClCH_2CN$, HCl, $ZnCl_2$, $(C_2H_5)_2O$	2,4-$(CH_3O)_2$-5-C_2H_5-$C_6H_2COCH_2Cl$, 83%	*(13D)*
2,3,4-$(HO)_3C_6H_2C_2H_5$	$ClCH_2CN$, HCl, $ZnCl_2$, $(C_2H_5)_2O$	2,3,4-$(HO)_3$-5-C_2H_5-C_6H_5-C_6HCOCH_2Cl, 60%	*(13D)*
1,3-$(HO)_2$-2,4-$(CH_3)_2C_6H_2$	$ClCH_2CN$, HCl, $ZnCl_2$, $(C_2H_5)_2O$, (also for Cl_2CHCN)	2,4-$(HO)_2$-3,5-$(CH_3)_2$-C_6HCOCH_2Cl, 93%	*(7D)*
Phenol and 28 derivatives	$R_1R_2NCH_2CN$, HCl, $AlCl_3$, $C_6H_5NO_2$	Phenolic amino ketones, yields range from 14–90%	*(11D, 12D)*
Anisole	$(CH_3SO_2)_2C{=}C{=}N$-CH_3, HCl, $AlCl_3$, $C_6H_5NO_2$	4-$CH_3OC_6H_4COCH(SO_2CH_3)_2$, poor yield	*(4D)*
1,3-$(HO)_2C_6H_4$ [also for 1,2-$(CH_3O)_2$ and 1,4-$(CH_3O)_2$]	$(CH_3SO_2)_2C{=}C{=}N$-CH_3, HCl, $AlCl_3$, $C_6H_5NO_2$	2,4-$(HO)_2C_6H_3COCH(SO_2CH_3)_2$, 27%	*(4D)*

OPEN-CHAIN ACYLATION (Pseudoaromatics, Gattermann-Koch-Hoesch)

Pseudoaromatic



Reagent: CF_3CN, HCl, $ZnCl_2$, $(C_2H_5)_2O$ (similarly for CCl_3CN with 7 compounds)

Product

Reference: *(5E)*

R_1	R_2	R_3	R_4	R_5	R_6
CF_3CO	CH_3				
CF_3CO				HO	
CF_3CO	CH_3			HO	
CF_3CO	CH_3	CH_3O		CH_3O	
CF_3CO			CH_3O	CH_3O	
CF_3CO	CH_3		HO		
CF_3CO	CH_3		CH_3O		
CF_3CO			CH_3O		
		CH_3O		CH_3O	CF_3CO
CF_3CO	CH_3				CH_3O

OPEN-CHAIN ACYLATION (Pseudoaromatics, Gattermann-Koch-Hoesch) (Continued)

Pseudoaromatic	*Reagent*	*Product*	*Reference*
2,3-$(CH_3)_2$-4-$C_2H_5O_2C$-pyrrole	$Zn(CN)_2$	2-HCO-3-$C_2H_5O_2C$-4,5-$(CH_3)_2$-pyrrole	(*2E*)
Indole		3-CF_3CO-indole (similarly for 3-CCl_3CO)	(*4E*)
2-CH_3-indole	$Zn(CN)_2$, HCl, $(C_2H_5)_2O$	2-CH_3-3-HCO-indole	(*3E*)
2-$C_2H_5O_2C$-5,6-$(CH_3O)_2$-indole	$Zn(CN)_2$, HCl, $CHCl_3$, $(C_2H_5)_2O$	2-$C_2H_5O_2C$-3-HCO-5,6-$(CH_3O)_2$-indole	(*1E*)

OPEN-CHAIN ACYLATION (Aromatic, Sulfonylation)

Aromatic	*Reagent*	*Product*	*Reference*
Benzene	CH_3SO_3H, CH_3SO_2Cl or $(CH_3SO_2)_2O$, several catalysts and solvents	$C_6H_5SO_2CH_3$, 6–77%	(*1F*, *4F*)
Toluene	CH_3SO_2Cl, $AlCl_3$	52% *x*-$CH_3C_6H_4SO_2CH_3$ *x* — % of total 2 — 49 3 — 15 4 — 36	(*4F*)
C_6H_5Br (also for Cl and F)	CH_3SO_2Cl, $AlCl_3$	4-$BrC_6H_4SO_2CH_3$, 56%	(*4F*)
Mesitylene	CH_3SO_2Cl, $AlCl_3$	2,4,6-$(CH_3)_3C_6H_2SO_2CH_3$	(*4F*)
Benzene (also toluene)	$C_6H_5CH{=}CHSO_2Cl$, $AlCl_3$	$C_6H_5CH{=}CHSO_2C_6H_5$, 55%	(*3F*)
1-CH_3O-naphthalene	$C_6H_5SO_2Cl$, $AlCl_3$	1-$C_6H_5SO_2$-4-CH_3O-naphthalene	(*2F*)

acetonitriles gave the best yields when the $AlCl_3$ phenol ratio was 2.25. A review discussion of this reaction was published by Ebine (*28A*).

Methanesulfonylations of toluene and chlorobenzene have been carefully studied (*103A*). Results indicate that a halogen is a more powerfully orienting substituent than a methyl group. In the case of toluene, the reaction is much less selective than with acetylation.

Cyclization of 1-benzyl-1,2,3,4-tetrahydronaphthalene-1-carboxylic acid or the corresponding chloride gives a number of elimination and rearrangement products in addition to the expected spiroketone (*106A*).

Ring-closure acylation with ω-phenyl carboxylic acid chlorides shifts from the ortho to the para position as soon as sterically permitted (*44A*). The yield for the octamethylene chain derivative is very low because the carbonyl group is constrained to a position perpendicular to the plane of the ring and thus prevented from participating in resonance. High dilution techniques have given excellent yields of benzocyclooctanones (*83A*). Longer methylene chains gave dimeric and trimeric (large ring) products.

Fries rearrangements of salicylic acid derivatives indicate that the reaction is not hindered by ortho substituents (*1A*). Brändström (*9A*) has discussed the Fries rearrangement on the premise that O-acylation is fast and reversible while C-acylation is slow and irreversible. Nucleophilic solvents such as *m*-xylene and anisole can effectively compete for migrating acyl groups (*58A*). Maximum yields of ortho isomers are obtained at temperatures near 120° C.

RING-CLOSURE ACYLATION (Aromatics)

Product and Reagent	*Reference*
3-CH_3-1-indanone, H_3PO_4, 87%	(*42G*)
3-C_6H_5-1-indanone, $AlCl_3$, 74%	(*19G*)
3-CH_3O-1-indanone, PPA, 85–95% [also for 5-CH_3O, 6-CH_3O, and 4,5-$(CH_3O)_2$]	(*75G*)
(3-HO_2C-1-indanone), HF, little reaction	(*7G*)
3-[4-$(CH_3)_2NC_6H_4$]-1-indanone, $AlCl_3$	(*26G*)
3-$(C_6H_5CONHCH_2CH_2)$-1-indanone, $AlCl_3$	(*53G*)
2-C_6H_5-3-CH_3-1-indanone, H_2SO_4	(*47G*)
2-C_6H_5-3-benzylidine-1-indanone, H_2SO_4	(*47G*)
2,2-$(C_6H_5)_2$-1-indanone, 70%	(*78G*)
3-HO_2C-5-CH_3O-1-indanone, HF or $AlCl_3$ (also 7-CH_3O)	(*7G*)
3-HO_2C-6-C_2H_5-1-indanone, HF or $AlCl_3$	(*7G*)
3-HO_2CCH_2-4-O_2N-1-indanone, $AlCl_3$	(*30G*)
4,5-$(CH_3O)_2$-1-indanone, $SnCl_4$	(*43G*)
2-R_1-*x*-R_2-1-indanone, PPA	(*48G*)

R_1	*x*-R_2	
C_6H_5	5-CH_3O	40%
C_6H_5	6-CH_3O	20%
C_6H_5	7-CH_3O	
C_6H_5	5,6-$(CH_3O)_2$	30%
3-$CH_3OC_6H_4$	H	
4-$CH_3OC_6H_4$	H	
3,4-$(CH_3O)_2C_6H_3$	H	
3,4-$(CH_3O)_2C_6H_3$	5,6-$(CH_3O)_2$	

Spiro[fluorene-9,2′-indan-1′-one], 60%	(*78G*, *79G*)
2,2,3-$(C_6H_5)_3$-1-indanone, 50%	(*78G*)
4-C_2H_5-6,7-$(CH_3O)_2$-1-indanone, H_2SO_4, 84%	(*71G*)
3-HO_2C-5,6-$(CH_3O)_2$-1-indanone, HF or $AlCl_3$, 38–100%	(*7G*)
3-HO-thianaphthene, HF (enol form) [also for 5-CH_3, 4,7-$(CH_3)_2$, and 5,6,7-Cl_3]	(*20G*)
3-HO-9-Cl-naphtho[1,2-b]thiophene, HF, 89%	(*20G*)
9-Fluorenone, H_2SO_4	(*1G*)
1-HO_2C-9a-CH_3-1,2,4a,9a-H_4-9-fluorenone, H_2SO_4	(*1G*)
cis-1,2,3,4,4a,9a-H_6-9-fluorenone	(*11G*)
2-CH_3O-8a-CH_3-4b,5,6,7,8,8a-H_6-9-fluorenone, $SnCl_4$, 15–81%	(*64G*)
3-HO_2C-6,7-$(CH_2)_4$-1-indanone	(*57G*)
2-R-4,5-benzindan-1-one, HF (R = CH_3, C_2H_5, *n*-C_3H_7, *n*-C_4H_9)	(*5G*)
3-R-4,5-benzindan-1-one, HF, low yield (R = CH_3, C_2H_5, *n*-C_3H_7, *n*-C_4H_9)	(*6G*)
3′-CH_3O-4,5-benzindan-1-one, PPA, $AlCl_3$ or $SnCl_4$	(*33G*)
3-HO_2C-6,7-benzindan-1-one, HF, FSO_3H or $AlCl_3$	(*57G*)
5-Br-1-acenaphthenone, $AlCl_3$, 55%	(*29G*)
6-CH_3O-1-acenaphthenone, PPA or $AlCl_3$	(*33G*)
8-CH_3O-1-acenaphthenone, PPA	(*33G*)
5-Aza-2a,3,4,5-H_4-1,4-dioxoacenaphthene	(*30G*)
1-Oxo-3,4-$(CH_2)_4$-indan, PPA, $AlCl_3$ or $SnCl_4$, 83–92%	(*4G*, *23G*)
1′-Oxo-4,5-cyclopentenoacenaphthene, $SnCl_4$	(*22G*)
1′-Oxo-4,5-cyclopenteno-6,7,8,8a-H_4-acenaphthene, $SnCl_4$	(*21G*)

RING-CLOSURE ACYLATION *(Aromatics) (Continued)*

Product and Reagent	*Reference*
15H-6,7,16,17-H_4-15-oxo-cyclopenta[a]phenanthrene	*(66G)*
11H-10a-CH_3-11-oxo-6b,7,8,9,10,10a-H_6-benzo[a]fluorene, $SnCl_4$, 87%	*(64G)*
13H-12-HO_2C-13-oxo-dibenzo[a,g]fluorene, $AlCl_3$	*(12G)*
9H-8-HO_2C-9-oxo-naphtho[2,1-c]fluorene	*(12G)*
7H-6-HO_2C-7-oxo-benzo[g]naphtho[1,2-c]fluorene, HF	*(12G)*
7H-6-HO_2C-7-oxo-benzo[i]naphtho[1,2-c]fluorene, HF	*(12G)*
9H-8-HO_2C-9-oxo-benzo[i]naphtho[2,1-c]fluorene, HF or $AlCl_3$	*(12G)*
1-Tetralone, PPA or $SnCl_4$, 80–90%	*(27G, 49G)*
4-CH_3-1-tetralone, $AlCl_3$, 87%	*(63G)*
7-CH_3-1-tetralone, PPA, 88%	*(27G)*
2-C_6H_5-1-tetralone, nearly quantitative	*(13G)*
4-C_6H_5-1-tetralone, $AlCl_3$, 93%	*(83G)*
4-HO_2C-1-tetralone, PPA, 80%	*(58G)*
2,7-$(CH_3)_2$-1-tetralone, $AlCl_3$	*(86G)*
4,6-$(CH_3)_2$-1-tetralone, 92%	*(63G)*
5,8-$(CH_3)_2$-1-tetralone, PPA, 93%	*(27G, 28G)*
3-HO_2C-4-CH_3-1-tetralone, H_2SO_4	*(77G)*
2-($CH_3CCl{=}CHCH_2$)-5-CH_3O-1-tetralone, PCl_5, 61%	*(73G)*
4-CH_3-7-CH_3O-1-tetralone, $AlCl_3$, 44%	*(80G)*
5,8-$(CH_3O)_2$-1-tetralone, H_2SO_4, 68%	*(60G)*
[2,5,7-$(CH_3)_3$-1-tetralone], H_3PO_4, I_2, P	*(40G)*
4,5,7-$(CH_3)_3$-1-tetralone, 88%	*(51G, 63G)*
4,6,7-$(CH_3)_3$-1-tetralone, 85%	*(81G)*
5,7,8-$(CH_3)_3$-1-tetralone, $SnCl_4$, 82%	*(10G)*
2,3-$(CH_3)_2$-7-(i-C_3H_7)-1-tetralone, $AlCl_3$	*(39G)*
2,4-$(CH_3)_2$-7-(i-C_3H_7)-1-tetralone, $AlCl_3$ or [H_3PO_4, I_2, P]	*(38G)*
3,8-$(CH_3)_2$-5-(i-C_3H_7)-1-tetralone, $AlCl_3$	*(56G)*
3-HO_2C-4,4-$(CH_3)_2$-1-tetralone, H_2SO_4	*(77G)*
2,5-$(CH_3)_2$-7-CH_3O-1-tetralone, $AlCl_3$	*(56G)*
4,7-$(CH_3)_2$-5-CH_3O-1-tetralone, $POCl_3$	*(56G)*
4,7-$(CH_3)_2$-6-CH_3O-1-tetralone, H_2SO_4	*(56G)*
2-C_2H_5-5,8-$(CH_3O)_2$-1-tetralone, $SnCl_4$, 94%	*(10G)*
5,8-$(HO)_2$-1,4-naphthoquinone, $AlCl_3$, NaCl	*(9G)*
5-HO-8-Cl-1,4-naphthoquinone	*(9G)*
2,4,5,7-$(CH_3)_4$-1-tetralone, $AlCl_3$ or HI, P	*(40G)*
2,3,5-$(CH_3)_3$-8-(i-C_3H_7)-1-tetralone, $AlCl_3$	*(41G)*
2,5,8-$(CH_3)_3$-7-CH_3O-1-tetralone, H_2SO_4	*(8G)*
3,5,8-$(CH_3)_3$-7-CH_3O-1-tetralone, H_2SO_4	*(8G)*
2,5-$(CH_3)_2$-7-CH_3O-8-(i-C_3H_7)-1-tetralone, $AlCl_3$	*(56G)*
2-CH_3-3-$C_2H_5O_2C$-6,7-$(CH_3O)_2$-1-tetralone, PPA	*(82G)*
3-$C_2H_5O_2C$-5-Br-7,8-$(CH_3O)_2$-1-tetralone, PPA	*(82G)*
[2,3,4,5-$(CH_3)_4$-8-(i-C_3H_7)-1-tetralone], H_3PO_4, I_2, P	*(37G)*
3-HO_2C-4-[3,4,5-$(CH_3O)_3C_6H_2$]-6,7-(CH_2O_2)-1-tetralone, $AlCl_3$	*(31G)*
4-Chromanone, PPA	*(59G)*
6-C_6H_5-4-chromanone, PPA	*(59G)*
7-CH_3O-4-chromanone, PPA	*(59G)*
6-Cl-4-chromanone, H_2SO_4	*(46G)*
6-O_2N-4-chromanone, H_2SO_4, PPA or $POCl_3$	*(46G)*
4-Oxo-1,4-H_2-quinoline	*(2G)*
1-C_6H_5-4-oxo-1,2,3,4-H_4-quinoline, PPA	*(46G)*
1-(4-$CH_3C_6H_4SO_2$)-4-oxo-6-Cl-1,2,3,4-H_4-quinoline, $POCl_3$, low yield (also for 6-Br)	*(46G)*
4-Oxo-thiachroman, PPA	*(46G)*
8-CH_3-4-oxo-thiachroman, H_2SO_4	*(46G)*
1-Oxo-*trans*-3,4-cyclopentano-1,2,3,4-H_4-naphthalene, $AlCl_3$	*(84G)*
1-C_6H_5CO-5-oxo-1,2,2a,3,4,5-H_6-benz[cd]indole, $AlCl_3$ (also for 1-CH_3CO)	*(54G)*
1-Oxo-1,2,3,4,5,6,7,8-H_8-anthracene, $SnCl_4$, 95%	*(75G)*
4-CH_3-1-oxo-1,2,3,4,5,6,7,8-H_8-anthracene, 80%	*(55G)*
1,4-$(CH_3)_2$-9-[2,5-$(CH_3)_2C_6H_3$]-10-oxo-9,10-H_2-anthracene, $ZnCl_2$, NaCl	*(17G)*
1,3-$(CH_3)_2$-9-[2,4-$(CH_3)_2C_6H_3$]-10-oxo-9,10-H_2-anthracene, $ZnCl_2$, NaCl	*(17G)*
1,5-Dioxo-4,8,10-$(CH_3)_3$-1,2,3,4,5,6,7,8-H_8-anthracene, PPA, 63%	*(62G)*
9,10-Anthraquinone-9-C^{14}, H_2SO_4	*(72G)*
1-Oxo-1,2,3,4,5,6,7,8-H_8-phenanthrene	*(75G)*
9-Oxo-1,2,3,4,4a,9,10,*trans*-10a-H_8-phenanthrene, HF or H_2SO_4	*(11G)*
8-CH_3-1-oxo-1,2,3,4-H_4-phenanthrene	*(85G)*
10a-HO_2C-9-oxo-1,2,4a,9,10,10a-H_6-phenanthrene, H_2SO_4, 100%	*(1G)*
9-CH_3O-1-oxo-1,2,3,4-H_4-phenanthrene, H_2SO_4	*(33G)*
2,8-$(CH_3O)_2$-1-oxo-1,2,3,4-H_4-phenanthrene	*(25G)*
3-($HO_2CCH_2CH_2$)-6-CH_3O-4-oxo-1,2,3,4-H_4-phenanthrene, H_2SO_4 (also for 7-CH_3O, 8-CH_3O and 9-CH_3O; using H_2SO_4, PPA or $SnCl_4$)	*(33G)*
2,8-$(CH_3)_2$-5-CH_3O-1-oxo-1,2,3,4-H_4-phenanthrene, $SnCl_4$	*(25G)*
2-CH_3-7-CH_3O-1,9-dioxo-1,2,3,4,4a,9,10,10a-H_8-phenanthrene, $AlCl_3$	*(35G)*
1-$CH_3O_2CCH_2$-2-CH_3-2-CH_3O_2C-7-CH_3O-9-oxo-1,2,3,4,4a,9,10,10a-H_8-phenanthrene, $AlCl_3$	*(50G)*
Perinaphthan-1-one, 83%	*(65G)*
2-R-perinaphthan-1-one, HF (R = CH_3, C_2H_5, n-C_3H_7, n-C_4H_9)	*(5G)*
3-R-perinaphthan-1-one, HF (R = CH_3, C_2H_5, n-C_3H_7, n-C_4H_9) (some dehydrogenation)	*(6G)*
7-CH_3O-perinaphthan-1-one, PPA, H_2SO_4 or $SnCl_4$ (also for 9-CH_3O)	*(33G)*

(85A). The same investigators found that the presence or absence of solvent made little difference. Gerecs and coworkers *(32A–34A)* have accumulated evidence that hydrochloric acid plays an important role in the Fries rearrangement.

In lubricating oils rich in aromatics, the more reactive aromatics can be removed or rendered harmless by pretreatment with a liquid alkylating catalyst *(62A)*. The remaining aromatics can be alkylated using a solid catalyst with an olefin or alkyl halide.

Hydrogen transfer reactions with alkanes and olefins permit direct utilization of petroleum fractions to produce alkylbenzenes derived from the alkanes *(50A, 60A, 70A, 81A)*.

Mixed cresols react with isobutylene to give di-*tert*-butyl derivatives *(21A)*. Benzyl chloride and alcohol undergo polycondensation to give resins *(52A)*. Dicarboxylic esters have been used as alkylating agents *(26A)*. Benzene is alkylated in good yield with a complex boron trifluoride–phosphoric acid–water catalyst to give a mixture of mono- and dialkylation *(100A)*. Dodecylbenzene is obtained from benzene and propylene tetramer in yields up to 73% *(86A)*. Excess tetramer leads to side reactions involving fragmentation, hydrogen transfer, polymerization, cyclization, and polyalkylation. Propylene polymer reacts similarly *(67A)*. An attempted Friedel-Crafts reaction of anisole with ethyl chloromaleate was unsuccessful *(93A)*.

A liquid-liquid countercurrent system was used to effect continuous reaction between benzene and dodecyl chloride *(75A)*. The alkylation mixture is passed upward through a column of liquid catalyst. The product is removed at the top. The catalyst is gravity separated and recycled.

Zinc chloride supported on alumina gives fair yields of alkylbenzenes at 200° to 300° C. *(88A, 89A)*. Silica-alumina catalysts at 200° to 500° C. have been used rather frequently *(28A, 57A, 64A, 92A, 105A)*.

Alkyl halides with aluminum metal or alkylaluminum halides seem to give fair results *(90A, 91A, 107A, 108A)*. Topchiev and associates have made extensive study of the catalyst system, aluminum dichloride hydrogen sulfate *(45A, 97A, 99A)*. This catalyst appears to be deactivated by impurities in the reactants. Its failure to isomerize n-propyl chloride is taken as evidence that the isomerization actually occurs during the alkylation step.

Good yields in alkylations have been obtained using titanium tetrachloride *(23A)*. Silicon tetrafluoride is relatively ineffective even at elevated temperatures with high pressures *(98A)*. Of a series of metal oxides in conjunction with phosphoric acid, only cupric oxide was an effective catalyst (*104A*). Molecular combinations of boron trifluoride with water and salts all show diminished catalytic activity (*101A*).

Octadecyl *p*-toluenesulfonate alkylates benzene without side-chain rearrangement (*87A*). 1-Dodecene gives a mixture of products with benzene with attachment of the phenyl group at the 2-, 3-, 4-, and 5-positions (*2A*). The last two are formed in smaller amounts than the others. Toluene can be alkylated with diisobutylene to give good yields without fragmentation of the side chain (*76A*). Schmerling and West (*78A*) have found that the major products from *tert*-alkyl chlorides are *sec*-alkylbenzenes which are presumed to be formed by isomerization of the initially formed *tert*-alkylbenzene.

Polyhalogenated ethylenes and ethanes react with benzene in the presence of aluminum chloride to form polymeric resins with dihydroanthracene links which break up on dry distillation (*48A*). The final products include anthracene, diphenylmethane, triphenylmethane and, in one case *p*-xylene.

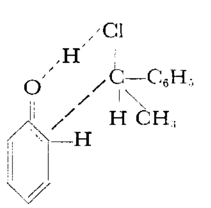
Styrene reacts with itself to form 1-methyl-3-phenylindene, 1,3-diphenyl-1-butene, a trimer and higher boiling material (*20A*). These products are also formed in reactions using styrene to alkylate benzene and ethylbenzene.

Toluene and xylenes react with acetylene to give diarylethanes from which can be prepared methyl- and dimethylstyrenes (*25A*). Acetaldehyde gives the same products but has a more desirable isomer distribution for polystyrene formation.

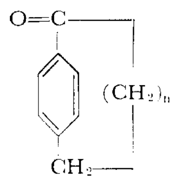
ω-Arylalkane sulfonic acids can be prepared in good yield from sultones (*102A*).

Condensation products from 1,3- or 1,4-butanediol or 1,3,5-hexanetriol include the expected alkylation and cyclization products but these have also been acetylated in the aryl rings (*51A*).

Stereochemical evidence in the alkylation of phenols with α-phenylethyl chloride indicates that both ortho and para substitutions involve displacement (*43A*). However, the retention of configuration for ortho substitution (in contrast to inversion for para substitution) suggests that a cyclic transition state with front-side displacement may be involved.



RING-CLOSURE ACYLATION (Aromatics) (Continued)

Product and Reagent	*Reference*
6-Oxo-5,6-H_2-benzo[c]quinoline, $AlCl_3$ (also for 2-Br)	(*61G*)
2,6-Dioxo-2,3,3a,4,5,6-H_6-naphtho[1,8-bc]pyran, P_2O_5, H_3PO_4	(*25G*)
5H-2′-CH_3-5-oxo-7,8-H_2-spiro{benz[f]indan-6-1′-cyclopentane}, H_2SO_4	(*36G*)
1H,6H-5-oxo-2,3,5,7,8,9-H_6-dicyclopenta[bg]naphthalene, H_2SO_4	(*34G*)
1H-4-oxo-2,3,4,6,7,8,9,11-H_8-cyclopent[b]anthracene	(*34G*)
5H-5-oxo-1,2,6,7-H_4-benz[fg]acenaphthylene, $SnCl_4$	(*22G*)
8H-4-oxo-1,2,2a,3,4,8,9,9b-H_8-benz[fg]acenaphthylene, $SnCl_4$	(*22G*)
6,11-Dioxo-6,11-H_2-benzo[b]naphtho[2,3-d]furan, $AlCl_3$	(*15G*)
8-C_2H_5-4-oxo-1,2,3,4,5,6-H_6-chrysene, $SnCl_4$	(*14G*)
5-HO-1,2,3,3a,4,5,9,10-H_8-pyrene, H_3PO_4, P_2O_5	(*68G*)
5,10,15,18-Tetraoxo-5,10,15,18-H_4-dinaphtho[2,3-b, 2′,3′-h]phenanthrene, H_2SO_4	(*16G*)
4H,8H-4,8-dioxo-6,10-$(HO_2C)_2$-dibenzo[cd,mn]pyrene, H_2SO_4	(*17G*)
4H,8H-4,8-dioxo-7,11-$(HO_2C)_2$-dibenzo[cd,mn]pyrene, H_2SO_4	(*17G*)
5H-5-oxo-6,7,8,9-H_4-cycloheptabenzene, $SOCl_2$, 81%	(*4G*)
5H-5-oxo-7-CH_3-6,7,8,9-H_4-cycloheptabenzene, $AlCl_3$, 72%	(*69G*)
5H-5-oxo-6-HO_2CCH_2-6,7,8,9-H_4-cycloheptabenzene, $AlCl_3$	(*44G*)
5H-5-oxo-7,8-$(CH_2)_3$-6,7,8,9-H_4-cycloheptabenzene, $AlCl_3$	(*32G*)
5H-5-oxo-*trans*-8,9-$(CH_2)_3$-6,7,8,9-H_4-cycloheptabenzene, $AlCl_3$, 75%	(*3G*)
1H-5-oxo-2,3,6,7,8,9-H_6-cyclohept[f]indene, $AlCl_3$, 72%	(*24G*)
5H-5-oxo-7,8-$(CH_2)_4$-6,7,8,9-H_4-cycloheptabenzene, $AlCl_3$	(*18G, 32G*)
10-Oxo-10,11-H_2-dibenz[b,f]oxepin, $AlCl_3$	(*52G*)
5-Oxo-5,6,7,8,9,10-H_6-cyclooöctabenzene, $AlCl_3$, 63–75%	(*45G, 67G, 70G*)
2,4-$(CH_3)_2$-5-oxo-5,6,7,8,9,10-H_6-cyclooöctabenzene, $AlCl_3$, 54%	(*70G*)
 (n = 6 to 11), $AlCl_3$, yields 1–36%	(*45G*)

RING-CLOSURE ACYLATION (Pseudoaromatics)

Product and Reagent	*Reference*
1,3-$(C_2H_5)_2$-4-oxo-4,5,6,7-H_4-benzo[c]thiophene, $SnCl_4$, 91%	(*1H*)
5H-5-oxo-6,7,8,9-H_4-cyclohepta[b]furan, $SnCl_4$, 60%	(*3H*)
4H-1,3-$(C_2H_5)_2$-4-oxo-5,6,7,8-H_4-cyclohepta[c]thiophene, $SnCl_4$, 71%	(*1H*)
5H-5-oxo-1,2,3,4,6,7,8,9-H_8-cyclohepta[b]thianaphthene, $SnCl_4$, 80%	(*2H*)

RING-CLOSURE ACYLATION (Aromatics, Gattermann-Koch-Hoesch)

Product and Reagent	*Reference*
2-Thiono-1,2-H_2-benz[cd]indole, $AlCl_3$, 26%	(*3i*)
4-Oxo-1,2,3,4-H_4-quinoline, $AlCl_3$, NaCl, 25%	(*1i*)
1-$(NCCH_2CH_2)$-4-oxo-1,2,3,4-H_4-quinoline, HCl, $AlCl_3$	(*4i*)
1-$(NCCH_2CH_2)$-4-oxo-7-CH_3-1,2,3,4-H_4-quinoline, HCl, $AlCl_3$, 29%	(*2i*)
1-$(NCCH_2CH_2)$-4-oxo-6-Cl-1,2,3,4-H_4-quinoline, HCl, $AlCl_3$, 74%	(*2i*)
1-$(NCCH_2CH_2)$-4-oxo-7-Cl-1,2,3,4-H_4-quinoline, HCl, $AlCl_3$, low yield	(*4i*)
1-$(NCCH_2CH_2)$-4-oxo-6,7-$(CH_3)_2$-1,2,3,4-H_4-quinoline, HCl, $AlCl_3$, 35%	(*2i*)
8-CH_3-1,7-dioxo-1,2,3,5,6,7-H_6-benz[ij]quinolizine, HCl, $AlCl_3$, 19%	(*2i*)
8-Cl-1,7-dioxo-1,2,3,5,6,7-H_6-benzo[ij]quinolizine, HCl, $AlCl_3$	(*4i*)
9-Cl-1,7-dioxo-1,2,3,5,6,7-H_6-benzo[ij]quinolizine, HCl, $AlCl_3$, 7–50%	(*2i*)

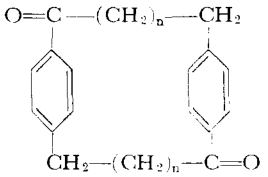
RING-CLOSURE ACYLATION (Aromatics, Sulfonylation)

Product and Reagent	*Reference*
2,3-H_2-benzo[e]thianaphthene-1,1-dioxide, $AlCl_3$, 54%	(*1J*)
Benzo[f]thiachroman-1,1-dioxide, $AlCl_3$, 65%	(*1J*)
Benzo[g]homothiachroman-1,1-dioxide, $AlCl_3$, 16%	(*1J*)

RING-CLOSURE ACYLATION (Complex)

Product and Reagent	*Reference*
4,5,8-$(CH_3)_3$-1-tetralone, $AlCl_3$	(*5K*)
4,6,7-$(CH_3)_3$-1-tetralone, $AlCl_3$, PPA	(*5K*)
9-Oxo-1,2,3,4,4a,9,10, *trans*-10a-H_8-phenanthrene, $AlCl_3$	(*8K*)
1,8-Dioxo-4,5,9,10-$(CH_3)_4$-1,2,3,4,5,6,7,8-H_8-phenanthrene, $AlCl_3$, PPA	(*5K*)
3-C_6H_5-2,4-dithiono-1,2,3,4-H_4-quinazoline, $AlCl_3$, NaCl	(*2K*)
2-C_2H_5-5-HO-6-CH_3O_2C-4-chromanone, $AlCl_3$	(*3K*)
2,2-$(CH_3)_2$-5-HO-6-CH_3O_2C-4-chromanone, $AlCl_3$	(*3K*)

RING-CLOSURE ACYLATION (Complex) (Continued)

Product and Reagent	Reference
1-HO-xanthone, $ZnCl_2$ (also for 3-HO; others mentioned)	(6K)
11H-6-oxo-6,7,8,9-H_4-benzo[b]fluorene	(1K)
5,8-$(HO)_2$-1,4-naphthoquinone, $AlCl_3$, NaCl	(4K)
2-C_2H_5-5,8-$(HO)_2$-1,4-naphthoquinone, $AlCl_3$, NaCl	(4K)
 $AlCl_3$, small yield (n = 6, 7, 10)	(7K)

The rate of *tert*-butylation of phenol is inversely proportional to the concentration of dioxane or tetrahydropyran (*40A*). This rate inhibition provides good evidence for the formation of phenol-ether complexes. The reaction of phenols with triphenylmethyl chloride is autocatalytically affected by hydrochloric acid (*39A*). The initial reaction in the absence of hydrochloric acid is second order. As the hydrochloric acid accumulates, a third-order term must be introduced into the kinetic expression.

OPEN-CHAIN ALKYLATION (Aromatics)

Aromatic	Reagent	Product	Reference
1-RO-naphthalene	BrCN, $AlCl_3$, CS_2	1-RO-4-NC-naphthalene, 80%, (R = C_2H_5, $n\text{-}C_5H_{11}$, $n\text{-}C_6H_{13}$, $n\text{-}C_7H_{15}$, $n\text{-}C_8H_{17}$, $n\text{-}C_9H_{19}$, $n\text{-}C_{10}H_{21}$, $n\text{-}C_{12}H_{25}$, $n\text{-}C_{16}H_{33}$, $n\text{-}C_{18}H_{37}$)	(26N)
Benzene (also for C_6H_5Cl)	$ClCH_2SiCl_3$, $AlCl_3$	$C_6H_5CH_2SiCl_3$, 62%	(60N)
3,5-$(CH_3)_2C_6H_3$-($t\text{-}C_4H_9$)	$H_2C{=}CH_2$, HF	3,5-$(CH_3)_2$-4-C_2H_5-C_6H_2-($t\text{-}C_4H_9$) with some ethylated m-xylenes	(68N)
Phenol	$HC{\equiv}CH$, $H_3PO_4\text{-}BF_3$, HgO, C_2H_5OH	$(4\text{-}HOC_6H_4)_2CHCH_3$ and polymer	(79N)
Toluene (similarly for xylene)	$HC{\equiv}CH$, $HgSO_4$, H_2SO_4	$(4\text{-}CH_3C_6H_4)_2CHCH_3$	(20N)
$(C_2H_5)_3C_6H_3$	C_2H_5Br, $AlCl_3$	$(C_2H_5)_4C_6H_2$	(64N)
Benzene	Ethylene oxide, $AlCl_3$	$C_6H_5CH_2CH_2OH$	(70N)
Benzene (also for toluene)	$ClCH_2CH_2SiCl_3$, $AlCl_3$	$C_6H_5CH_2CH_2SiCl_3$, 65%	(60N)
Benzene	$ClCH(CH_3)SiCl_3$, $AlCl_3$	$C_6H_5CH(CH_3)SiCl_3$, 65%	(60N)
Benzene (also for toluene)	$ClCH_2CH_2Cl$, $AlCl_3$	$C_6H_5CH_2CH_2C_6H_5$, 55%, and higher condensation	(21N)
Benzene	$CH_3CHClSCl$, $AlCl_3$	$CH_3CH(C_6H_5)SC_6H_5$	(5N)
C_6H_5Cl	C_3H_6, H_2SO_4 (also for C_4H_8)	ClC_6H_4-($i\text{-}C_3H_7$), 75–85%	(50N, 51N)
Anisole	$i\text{-}C_3H_7OH$	$(i\text{-}C_3H_7)C_6H_4OCH_3$	(25N)
Benzene	$(n\text{-}C_3H_7)_2O$, $AlCl_3$	$i\text{-}C_3H_7$, C_6H_5, $n\text{-}C_3H_7C_6H_5$, $C_2H_5C_6H_5$	(69N)
Benzene (also for mesitylene)	Trimethylene oxide, $AlCl_3$	$C_6H_5CH_2CH_2CH_2OH$, 52–71%	(70N)
Phenol	$CH_2{=}CHCH_2OH$, H_2SO_4 or H_3PO_4	2-$HOC_6H_4C(CH_3){=}CH_2$, 2-CH_3-coumaran, chroman, and usually a large proportion of resin	(48N)
Phenol	$CH_2{=}CHCH_2Br$, $ZnCl_2$ ($CH_2{=}CHCH_2Cl$ is better)	$HOC_6H_4CH_2CH{=}CH_2$	(10N)
Anisole	$CH_2{=}CHCN$, $AlCl_3$	4-$CH_3OC_6H_4CH_2CH_2CN$	(22N)
Phenol (also for anisole and phenetole)	CH_3COCH_2Cl, H_2SO_4 or $AlCl_3$	4-[4-$HOC_6H_4C(CH_3){=}CH$]C_6H_4OH, 67%	(88N)
Benzene	$ClCH{=}CHCH_2Cl$, $AlCl_3$	$C_6H_5CH_2CH{=}CHCl$, 47%	(69N)
3,4-$(CH_3)_2C_6H_3OH$	$CH_3CH_2CH{=}CH_2$, H_2SO_4	2-($t\text{-}C_4H_9$)-3,4-$(CH_3)_2$-C_6H_2OH	(2N)
Anisole (also for phenetole)	$CH_3CH{=}CHCH_3$, BF_3	$CH_3OC_6H_4$-($s\text{-}C_4H_9$), up to 83%	(85N, 87N)
Phenol (also for 2-CH_3, 2-Cl, and 2-C_6H_5)	$(CH_3)_2C{=}CH_2$, $POCl_3$ or $POBr_3$	$t\text{-}C_4H_9C_6H_4OH$, isomers in various proportions	(7N)
Phenol	$(CH_3)_2C{=}CH_2$, H_2SO_4, C_6H_6	2,4,6-$(t\text{-}C_4H_9)_3C_6H_2OH$, 72%	(16N, 74N)
Toluene	$C_4H_9ClO_4$	No reaction	(13N)
Benzene	$n\text{-}C_4H_9X$, $AlCl_3$ or $SbCl_5$	$n\text{-}C_4H_9C_6H_5$ and $i\text{-}C_4H_9C_6H_5$	(59N)
1,3-$(CH_3)_2C_6H_4$	$n\text{-}C_4H_9Cl$, $AlCl_3$ (also for $s\text{-}C_4H_9Cl$)	3,5-$(CH_3)_2C_6H_3$-($n\text{-}C_4H_9$) and 3,5-$(CH_3)_2C_6H_3$-($s\text{-}C_4H_9$)	(57N)
1,3-$(CH_3)_2C_6H_4$	$s\text{-}C_4H_9OH$, H_2SO_4 (also for $i\text{-}C_4H_9OH$)	3,5-$(CH_3)_2C_6H_3$-($s\text{-}C_4H_9$)	(57N, 65N)
Benzene	$i\text{-}C_4H_9OH$, H_2SO_4; or $i\text{-}C_4H_9Cl$, $AlCl_3$	$t\text{-}C_4H_9C_6H_5$	(65N)
$C_6H_5NHCOCH_3$	$i\text{-}C_4H_9Br$, $AlCl_3$	4-($t\text{-}C_4H_9$)$C_6H_4NHCOCH_3$	(41N)
$C_6H_5C_2H_5$	$t\text{-}C_4H_9OH$, H_2SO_4	4-($t\text{-}C_4H_9$)$C_6H_4C_2H_5$	(11N)
Naphthalene	$t\text{-}C_4H_9OH$, $AlCl_3$	2-($t\text{-}C_4H_9$)-naphthalene, also 2,6- and 2,7-$(t\text{-}C_4H_9)_2$-naphthalene	(18N)
Toluene	$t\text{-}C_4H_9Cl$, $AgClO_4$	$t\text{-}C_4H_9C_6H_4CH_3$, 56% para	(13N)
$C_6H_5C_2H_5$ (also for 3-CH_3 and 3-C_2H_5)	$t\text{-}C_4H_9Cl$, $FeCl_3$ or $AlCl_3$	$t\text{-}C_4H_9C_6H_4C_2H_5$	(11N)
Phenol	$t\text{-}C_4H_9Cl$, $AlCl_3$ or $POCl_3$	$t\text{-}C_4H_9C_6H_4OH$ and $(t\text{-}C_4H_9)_2C_6H_3OH$	(7N, 11N)
Indan [also for 1,1-$(CH_3)_2$-1,2,3,4-H_4-naphthalene]	$t\text{-}C_4H_9Cl$, $AlCl_3$	5-$t\text{-}C_4H_9$-indan	(11N)
1,4-$(t\text{-}C_4H_9)_2C_6H_4$	$t\text{-}C_4H_9Cl$, $AlCl_3$	1,3,5-$(t\text{-}C_4H_9)_3C_6H_3$	(4N)
1,2-$Cl_2C_6H_4$	$t\text{-}C_4H_9Cl$	3,4-$Cl_2C_6H_3(t\text{-}C_4H_9)$	(82N)
2,2′-$(HO)_2$-biphenyl	$t\text{-}C_4H_9Cl$, $AlCl_3$, CS_2	2,2′-$(HO)_2$-3,3′,5,5′-$(t\text{-}C_4H_9)_4$-biphenyl	(53N)
9,10-H_2-phenanthrene	$CH_2{=}CHCH_2CO_2C_2H_5$, $AlCl_3$, hexane	2-[$C_2H_5O_2CCH_2CH(CH_3)$]-9,10-H_2-phenanthrene	(61N)
ArH (12 examples)	$CH_2{=}C(CN)_2$, $AlCl_3$, $(CHCl_2)_2$	$ArCH_2CH(CN)_2$, up to 89%	(83N)
Toluene	$CH_3CO_2CCH_2CH_2CO_2CH_3$, $AlCl_3$	4-$CH_3C_6H_4(CH_2)_4O_2CCH_3$	(45N)
Benzene (also for toluene)	$CH_3CH(O_2CCH_3)CH_2CH_2O_2CCH_3$, $AlCl_3$	$C_6H_5CH(CH_3)CH_2CH_2O_2CCH_3$	(45N)

OPEN-CHAIN ALKYLATION *(Aromatics) (Continued)*

Aromatic	*Reagent*	*Product*	*Reference*
Phenol (also for 2-CH_3, 3-CH_3 and 2-CH_3O)	$CH_3COCH_2CH_2OH$, HCl or $AlCl_3$	4-$HOC_6H_4CH_2CH_2COCH_3$, 28–45%	(*49N*)
Phenol (also for anisole)	$CH_3COCHClCH_3$, $AlCl_3$ or H_2SO_4	4-[4-$HOC_6H_4C(CH_3){=}C(CH_3)$]$C_6H_4OH$	(*88N*)
Benzene	$CH_3CHBrCHBrCH_3$, $AlCl_3$	$C_6H_5CH(CH_3)CH(CH_3)C_6H_5$, 9%	(*76N*)
1,4-$(CH_3)_2C_6H_4$ (also for 1,4-Cl_2)	γ-Butyrolactone	2,5-$(CH_3)_2C_6H_3(CH_2)_3CO_2H$, 24%	(*77N*)
Benzene [also for C_6H_5Cl, toluene, 1,4-$(CH_3)_2C_6H_4$, 1,4-$Cl_2C_6H_4$ and anisole]	4-HO-butane sulfonic acid sultone, $AlCl_3$ or $FeCl_3$	$C_6H_5(CH_2)_4SO_3H$, 63%	(*77N*)
Anisole	$CH_3CH_2CH{=}CHCH_3$, BF_3, H_3PO_4	$CH_3OC_6H_4CH(C_2H_5)_2$, 62%	(*85N*)
2-ClC_6H_4OH (also for 4-)	$CH_3CH_2CH{=}CHCH_3$, BF_3	Mixture of ethers and phenols	(*86N*)
Phenol	$(CH_3)_2C{=}CHCH_3$, $POCl_3$	2- and 4-$HOC_6H_4C(CH_3)_2CH_2CH_3$ with some dialkylation	(*7N*)
Benzene [also for toluene, anisole, 1,2-$(CH_3)_2C_6H_4$, 1,3-$(CH_3)_2C_6H_4$, tetralin, and 9,10-H_2-phenanthrene]	$CH_2{=}CHCH_2CH_2CO_2C_2H_5$, $AlCl_3$	$C_6H_5CH(CH_3)CH_2CH_2CO_2C_2H_5$, 93.2%	(*43N*, *56N*, *80N*, *81N*)
Naphthalene	$(CH_3)_2CHCH_2CH_2Cl$, $ZnCl_2$, H_3PO_4, or BF_3	1- and 2-[$(CH_3)_2CHCH_2CH_2$]-naphthalene	(*66N*)
Toluene	$(CH_3)_3CCH_2Cl$, H_2SO_4	4-$CH_3C_6H_4CH_2C(CH_3)_3$	(*11N*)
$C_6H_5C_2H_5$	$(CH_3)_3CCH_2OH$	4-$CH_3C_6H_4CH_2C(CH_3)_3$	(*11N*)
Benzene [also for 1,4-$(CH_3)_2C_6H_4$ and 9,10-H_2-phenanthrene]	γ-Valerolactone	$C_6H_5CH(CH_3)CH_2CH_2CO_2H$, 70%	(*39N*, *54N*, *77N*)
Benzene	4-HO-pentane sulfonic acid sultone, $AlCl_3$	$C_6H_5CH(CH_3)CH_2CH_2CH_2SO_3H$, 88%	(*77N*)
1,2-$(CH_3)_2C_6H_4$ (also for anisole and tetralin)	$CH_3COCH_2CH_2CH{=}CH_2$, $AlCl_3$	3,4-$(CH_3)_2C_6H_3CH(CH_3)CH_2CH_2COCH_3$, 52%	(*43N*, *80N*, *81N*)
Benzene (similarly for toluene)	*n*-$C_6H_{13}CH{=}CH_2$, H_2SO_4	*n*-$C_6H_{13}CH(CH_3)C_6H_5$, 92%	(*19N*, *47N*)
4-$CH_3C_6H_4$(*i*-C_3H_7)	$C_8H_{17}OH$, $AlCl_3$, H_2SO_4 or H_3PO_4	2-C_8H_{17}-4-(*i*-C_3H_7)-$C_6H_3CH_3$	(*40N*)
Toluene [also for benzene and similarly for 3,4-$(CH_3)_2C_6H_3OH$]	Diisobutylene, $AlCl_3$, $C_6H_5NO_2$ or CH_3NO_2	4-$CH_3C_6H_4C(CH_3)_2CH_2C(CH_3)_3$, 85%	(*67N*)
Benzene	$RCH{=}CH_2$, H_2SO_4	$CH_3CHRC_6H_5$, 70–90% (R = *n*-C_8H_{17}, *n*-$C_{10}H_{21}$, *n*-$C_{12}H_{25}$, *n*-$C_{14}H_{29}$, and *n*-$C_{16}H_{33}$)	(*47N*)
Benzene	4-$CH_3C_6H_4SO_3$-(*n*-$C_{18}H_{37}$), $AlCl_3$	*n*-$C_{18}H_{37}C_6H_5$	(*71N*)
1,3-$(CH_3O)_2C_6H_4$	Cyclopentene, BF_3-$(C_2H_5)_2O$	1-Cyclopentyl-2,4-$(CH_3O)_2$-C_6H_3	(*9N*)
Phenol (also for 4-CH_3)	Cyclopentadiene, H_3PO_4	3-(4-HOC_6H_4)-cyclopentene, 67%	(*3N*)
Benzene	3-CH_3-cyclopentanol, $AlCl_3$	1-C_6H_5-3-CH_3-cyclopentane, 56%	(*73N*)
1,3-$(CH_3O)_2C_6H_4$ (also for diethyl)	Cyclohexene, $AlCl_3$, C_6H_5Cl	1-Cyclohexyl-2,4-$(CH_3O)_2$-C_6H_3 and 1,5-(cyclohexyl)$_2$-2,4-$(CH_3O)_2$-C_6H_2	(*9N*)
Indan	Cyclohexene, $AlCl_3$	5-Cyclohexyl-indan	(*63N*)
Phenol (also for anisole)	Cyclohexanol, PPA	2- and 4-cyclohexyl-C_6H_4OH	(*25N*)
1,3-$(HO)_2C_6H_4$	Cyclohexanol, $ZnCl_2$	1-Cyclohexyl-2,4-(HO_2)-C_6H_3	(*9N*)
4-Cl-C_6H_4OH	Cyclohexanol, H_2SO_4	Cyclohexylchlorophenol, 52%	(*1N*)
Toluene	Br-cyclohexane, $AgClO_4$	Cyclohexyl-$C_6H_4CH_3$, 93%	(*13N*)
Benzene	2-CH_3-cyclohexanol, $AlCl_3$	1-CH_3-1-C_6H_5-cyclohexane, 64% (also 1,2)	(*73N*)
Benzene	4-CH_3-cyclohexene, HF	1-CH_3-1-C_6H_5-cyclohexane, 75% (some dialkylation)	(*32N*)
Phenol	Dicyclopentadiene, H_3PO_4	1-Cyclopentyl-2-HO-C_6H_4	(*3N*)
Biphenyl	Cl-decalin, $AlCl_3$, CS_2	[(4-C_6H_5)C_6H_4]-decalin	(*30N*)
Benzene (also for toluene and C_6H_5Cl)	$C_6H_5CH_2Cl$, $AlCl_3$ or $SbCl_5$	$(C_6H_5)_2CH_2$, 35–55%	(*39N*, *59N*)
Toluene (also C_6H_5Cl)	$C_6H_5CH_2Cl$, $ZnCl_2$	4-$CH_3C_6H_4CH_2C_6H_5$, 4–60%	(*39N*)
Anisole	$C_6H_5CH_2Cl$, I_2	4-$CH_3OC_6H_4CH_2C_6H_5$ (some dialkylation)	(*36N*)
2-$CH_3C_6H_4SCH_3$ [similarly for mesitylene, 1-CH_3-naphthalene, 2-CH_3-naphthalene, 2-HOC_6H_4-CO_2CH_3, 2-$HOC_6H_4CO_2C_2H_5$, 4-$HOC_6H_4CO_2C_2H_5$, 1,4-$(C_6H_5)_2C_6H_4$, chrysene, and pyrene]	$C_6H_5CH_2Cl$, $ZnCl_2$, $CHCl_3$	2-CH_3-4-$C_6H_5CH_2$-$C_6H_3SCH_3$, 60%	(*10N*)
1,3-$(CH_3O)_2C_6H_4$	$C_6H_5CH_2Cl$, Cu, heat	2,4-$(CH_3O)_2C_6H_3CH_2C_6H_5$ (some dialkylation)	(*9N*)
Naphthalene	$C_6H_5CH_2Cl$, P_2O_5, $ZnCl_2$, $FeCl_3$ or $AlCl_3$	1- and 2-$C_6H_5CH_2$-naphthalene, yields from 20–80%	(*38N*)
2-$HOC_6H_4CO_2CH_3$	4-$ClC_6H_4CH_2Cl$, $ZnCl_2$	2-HO-5-(4-$ClC_6H_4CH_2$)-$C_6H_3CO_2CH_3$	(*10N*)
C_6H_5F	4-$FC_6H_5CH_2Cl$, $AlCl_3$, CS_2	$(4\text{-}FC_6H_4)_2CH_2$	(*58N*)
Benzene [also for toluene, C_6H_5Cl, and 1,3-$(CH_3)_2C_6H_4$]	3,4-$Cl_2C_6H_3CH_2Cl$, $AlCl_3$ (also for 4-$O_2NC_6H_4CH_2Cl$)	3,4-$Cl_2C_6H_3CH_2C_6H_5$, 64%	(*6N*)
ArOH (17 examples)	$Ar'CH_2OH$, HCl or 4-$CH_3C_6H_4SO_3H$	Phenolic resin intermediates	(*12N*, *62N*, *75N*)
ArOH (6 examples)	$Ar'CH_2Br$	Phenolic diphenylmethanes	(*23N*)
Toluene [also for 1,2-$(CH_3)_2C_6H_4$, 1,3-$(CH_3)_2C_6H_4$, 1,4-$(CH_3)_2C_6H_4$, and mesitylene]	$(C_6H_5)_2CHOH$, H_2SO_4, CH_3CO_2H	4-$CH_3C_6H_4CH(C_6H_5)_2$	(*44N*)
Phenol (also for 2-CH_3)	$(C_6H_5)_3CCl$, HCl, 1,2-$Cl_2C_6H_4$	4-$HOC_6H_4C(C_6H_5)_3$	(*28N*)
Benzene	Styrene, 71% H_2SO_4	$(C_6H_5)_2CHCH_3$ and more complex products	(*17N*)
Phenol [also for 4-CH_3, 4-Cl, and 2,6-$(CH_3)_2$]	$C_6H_5CHClCH_3$	$HOC_6H_4CH(CH_3)C_6H_5$	(*29N*)
3,4-$(CH_3)_2C_6H_3OH$	$C_6H_5C(CH_3){=}CH_2$, $SnCl_4$	2-[$C_6H_5C(CH_3)_2$]-4,5-$(CH_3)_2C_6H_2OH$, 74%	(*2N*)

OPEN-CHAIN ALKYLATION (Aromatics) (Continued)

Aromatic	Reagent	Product	Reference
1,2,3-$(HO)_3C_6H_3$	$C_6H_5C(CH_3){=}CH_2$, H_2SO_4, CH_3CO_2H [also for 4-$CH_3OC_6H_4$-$C(CH_3)_2OH$]	1,2,3-$(HO)_3$-4,5-$[C_6H_5C(CH_3)_2]_2C_6H$	(35N)
Benzene (also for toluene, anisole, C_6H_5Br, and C_6H_5Cl)	4-$CH_3C_6H_4SO_3CH(CN)C_6H_5$, $AlCl_3$ or H_2SO_4	$(C_6H_5)_2CHCN$, 60–82%	(72N)
C_6H_5Cl	4-$ClC_6H_4CH(OH)CCl_3$	$(4\text{-}ClC_6H_4)_2CHCCl_3$	(8N)
ArH	2-$HOC_6H_4CH_2CH_2SO_3H$ sultone, $AlCl_3$	No reaction	(77N)
Benzene	$C_6H_5CH{=}CHCO_2H$, $AlCl_3$	$(C_6H_5)_2CHCH_2CO_2H$, 87%	(17N)
Benzene (also for toluene)	$C_6H_5CH{=}CHSO_2CH_3$, H_2SO_4	$(C_6H_5)_2CHCH_2SO_2CH_3$, 76%	(78N)
Toluene	4-$CH_3C_6H_4SO_2CH{=}CHC_6H_5$, $AlCl_3$	4-[4-$CH_3C_6H_4CH(C_6H_5)CH_2SO_2]C_6H_4CH_3$	(78N)
Benzene	$C_6H_5COCH(C_6H_5)CH_2Cl$, $AlCl_3$	$C_6H_5COCH(C_6H_5)CH_2C_6H_5$	(52N)
Benzene	$C_6H_5CHBrCHBrCO_2H$, $AlBr_3$	$(C_6H_5)_2CHCH(C_6H_5)CO_2H$, 66–78%	(42N)
Benzene	*trans*-2-HO-cyclohexane-acetic acid lactone, $AlCl_3$	(2-C_6H_5)cyclohexane-acetic acid	(84N)
1,3-$(CH_3)_2C_6H_4$ (also for 1,4-)	1,2-$(ClCO)_2C_6H_4$, $AlCl_3$	3,3-[2,4-$(CH_3)_2C_6H_3$]phthalide, 74%	(14N, 15N)
Anisole	1-CH_3-1-$C_2H_5O_2C$-2-oxo-3-$C_2H_5O_2CCH_2$-cyclohexene-3, $AlCl_3$ (also for methyl ester)	1-CH_3-1-$C_2H_5O_2C$-2-oxo-3-$C_2H_5O_2CCH_2$-4-(4-$CH_3OC_6H_4$)-cyclohexane, 90%	(27N, 34N)
Benzene (also for toluene)	2-$(CH_2{=}CHCH_2)$-1-tetralone, $AlCl_3$	2-$[C_6H_5CH(CH_3)CH_2]$-1-tetralone, 82%	(55N)
Benzene [also for toluene and 1,3-$(CH_3)_2C_6H_4$]	2-$(CH_2{=}CHCH_2)$-4-CH_3-1-tetralone, $AlCl_3$	2-$[C_6H_5CH(CH_3)CH_2]$-4-CH_3-1-tetralone, 64%	(46N)
1,4-$(HO)_2$-2-CH_3-naphthalene	Phytol or isophytol, various catalysts	1,4-$(HO)_2$-2-CH_3-3-phytylnaphthalene (vitamin K_1), 42%	(31N, 33N)
Benzene	5-Mesitoylacenaphthylene, HCl, $AlCl_3$	1-C_6H_5-5-mesitoylacenaphthene, 80%	(24N)
Benzene	1-Br-5-mesitoylacenaphthene, $AlCl_3$	1-C_6H_5-5-mesitoylacenaphthene	(24N)
Anthracene	N-$(ClCH_2)$-phthalimide, $AlCl_3$, CS_2 or $ZnCl_2$, $C_6H_5NO_2$	9,10-bis(phthalimido-CH_2)-anthracene	(37N)

OPEN-CHAIN ALKYLATION (Pseudoaromatics)

Pseudoaromatic	Reagent	Product	Reference
Thiophene	$H_2C{=}CH_2$, SiO_2-Al_2O_3	2-C_2H_5-thiophene	(7Q)
2-CH_3-pyrrole [also for 2,4-$(CH_3)_2$, 2-CH_3-3-$C_2H_5O_2C$, 2,4-$(CH_3)_2$-3-$C_2H_5O_2C$, 2,4-$(CH_3)_2$-3-CH_3CO, and 2-$C_2H_5O_2CH_2$-3-$C_2H_5O_2C$-4-CH_3]	$CH_2{=}CHCO_2H$, BF_3-$(C_2H_5)_2O$ (similarly for corresponding lactone, nitrile, methyl and ethyl esters, and amide)	2-CH_3-5-$HO_2CCH_2CH_2$-pyrrole (corresponding nitrile was obtained only from 2,4-$(CH_3)_2$-pyrrole; several failures occurred with the methyl ester)	(6Q)
2-CH_3O_2C-furan	*s*-C_4H_9Br, $AlCl_3$, CS_2	2-CH_3-5-(*s*-C_4H_9)-furan (also some *t*-C_4H_9)	(3Q)
Thiophene	*t*-C_4H_9OH, $SnCl_4$, CS_2	2,5-(*t*-$C_4H_9)_2$-thiophene	(7Q)
2-CH_3O_2C-furan	*t*-C_4H_9Br, $AlCl_3$, CS_2	2-CH_3O_2C-5-*t*-C_4H_9-furan	(3Q)
Thiophene	*t*-C_4H_9Cl, $SnCl_4$, CS_2	2- and 3-*t*-C_4H_9-thiophene (also some dialkylation and formation of biaryl type products)	(5Q)
2-CH_3-thiophene [also for 2-C_6H_5, 2,5-$(CH_3)_2$, and 2,5-$(C_2H_5)_2$]	*t*-C_4H_9Cl, $FeCl_3$, CS_2	2-CH_3-5-*t*-C_4H_9-thiophene, 25%, and 2-CH_3-3,5-(*t*-$C_4H_9)_2$-thiophene, 60%	(2Q)
Thiophene	$CH_2{=}C(CN)_2$, $AlCl_3$, $(CHCl_2)_2$	2-$[(NC)_2CHCH_2]$-thiophene, 65%	(8Q)
Thiophene (also for 2-Cl)	$C_6H_5CH_2Cl$, I_2	No reaction	(4Q)
Thiophene	$C_6H_5C(CH_3)_2OH$, $SnCl_4$, CS_2 [also for $(C_6H_5)_2C(CH_3)OH$]	2,5-$[C_6H_5C(CH_3)_2]$-thiophene	(1Q)
Thiophene	$(C_6H_5)_3COH$	No reaction	(1Q)

OPEN-CHAIN PSEUDOALKYLATION (Aromatics)

Aromatic	Reagent	Product	Reference
t-$C_4H_9C_6H_5$	PCl_3, $AlCl_3$	4-*t*-$C_4H_9C_6H_4PCl_2$	(7R)
Tetralin (also for polystyrene)	PCl_3, $AlCl_3$	(Cl_2P)-tetralin	(1R)
Benzene	CH_3SCl, $AlCl_3$ (also for C_2H_5SCl)	$C_6H_5SCH_3$	(3R, 4R)
Benzene	$CH_3CHClSCl$, $AlCl_3$	$CH_3CH(C_6H_5)SC_6H_5$	(2R)
2-HO-naphthalene	C_6H_5SCl, CCl_4	1-C_6H_5S-2-HO-naphthalene	(5R)
Benzene [also for toluene, biphenyl, C_6H_5Br, C_6H_5Cl, $C_6H_5N(CH_3)_2$, and $C_6H_5N(C_2H_5)_2$]	2,4-$(O_2N)_2C_6H_3SCl$, $AlCl_3$, $C_2H_4Cl_2$	2,4-$(O_2N)_2C_6H_3SC_6H_5$, 91%	(6R)

If the phenol is previously saturated with hydrochloric acid, the reaction exhibits simple third-order kinetics.

The rate of reaction of cyclohexene with benzene in the presence of aluminum chloride is independent of time or concentration of cyclohexene, but is directly proportional to the concentration of hydrochloric acid (*53A*). This is taken to indicate that the actual alkylating agent is RCl and not olefin. The rate dependence on hydrochloric acid is thus related to the rate of formation of RCl.

The rate of reaction between phenol and styrene in glacial acetic acid containing perchloric acid is proportional to the concentration of perchloric acid and independent of initial styrene concentration, although there are batch variations in the effect of initial phenol concentration (*29A*). The acetoxonium ion is considered to be the effective catalyst.

The rates of reaction between 3,4-dichlorobenzyl chloride and benzene, chlorobenzene, toluene, and *m*-xylene are third order (*10A*). The substituents on the ring undergoing substitution have consistent but rather small influences on the relative rates. Dilution of the nitrobenzene solvent with methylcyclohexane has only a small diminishing effect on the rate. It is considered that the transition state involves a nucleophilic displacement by the aromatic on a complex between the benzyl halide and aluminum chloride.

Oda and Nomura (*63A*) have published a review which includes consideration of the Friedel-Crafts reactions of sulfenyl chlorides.

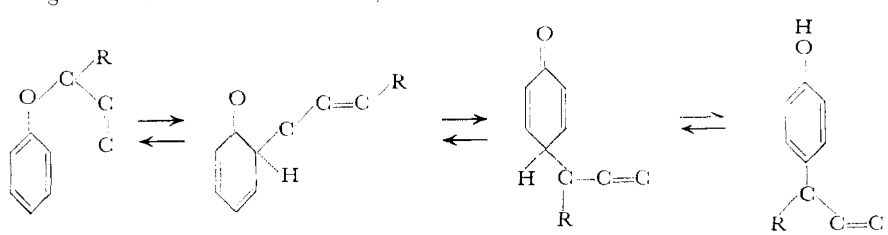
Chloromethylation followed by cyclization via amine displacement or, alternatively, formation of a Mannich base followed by ring-closure alkylation may be considered to be the intermediate steps in the synthesis of 3-aza-1-methyl-7-ethyl - 1,2,3,4 - tetrahydrophenanthrene (*6A*).

Added sulfur to inhibit polymerization and the use of aqueous formaldehyde and hydrochloric acid permitted the successful chloromethylation of the side-chain double bond in styrene without affecting the benzene ring (*109A*). Further evidence is advanced in support of the claim that FCH_2OH is the actual intermediate in fluoromethylation (*66A*). Previously existing kinetic data on chloromethylations have been shown to be in error (*11A*). Chloromethylation is a highly selective reaction and heavily dependent upon the nature of substituents on the ring undergoing substitution and reaction conditions.

Migration of optically active allyl groups indicates steric control of asymmetric induction in the ortho-Claisen rearrangement (*38A*). Kinetic and stereochemical evidence suggests that nuclear alkylation of phenols may occur by direct displacement to give C-alkylation rather than through O-alkylation followed by rearrangement (*41A, 42A*).

Conclusive evidence from several approaches (*19A, 22A, 24A, 59A, 71A, 79A, 80A*) has confirmed the view that the para-Claisen rearrangement is a two-step process involving an ortho-dienone intermediate with over-all retention of configuration and structure of the migrating group being due to two successive allylic rearrangements.

The literature covered by this period of review involves only a few reactions using C-14 (*14A, 37A, 79A, 93A*) in distinct contrast to the greatly expanded application of all other aspects of the Friedel-Crafts reactions.



RING-CLOSURE ALKYLATION (Aromatics)

Product and Reagent	*Reference*
2-Oxo-indoline, $AlCl_3$, NaCl	(*1S*)
1,7-$(CH_3)_2$-2-oxo-indoline, $AlCl_3$, NaCl	(*8S*)
1-Oxo-3-HO_2C-4-CH_3-7-HO-indan, $AlCl_3$, NaCl	(*2S*)
1-[4-$(CH_3)_2NC_6H_4$]-3-C_6H_5-indene, CH_3CO_2H, H_2SO_4 [similarly for 5-$(CH_3)_2N$]	(*9S*)
1,3-[4-$(CH_3)_2NC_6H_4$]$_2$-indene, CH_3CO_2H, H_2SO_4 [similarly for 5-$(CH_3)_2N$]	(*9S*)
Naphthalene, $SnCl_4$, 82%	(*10S*)
1,4-$(CH_3)_2$-6-CH_3O-1,2,3,4-H_4-naphthalene, H_2SO_4, 70%	(*18S*)
1,4,6,7-$(CH_3)_4$-1,2,3,4-H_4-naphthalene, H_2SO_4	(*19S*)
2-CH_3-6-CH_3O-4-chromanone, $AlCl_3$	(*5S*)
2-HO_2C-5,7-$(CH_3)_2$-4-chromanone, H_2SO_4	(*2S*)
Chroman, $SnCl_4$, 85% (also for 6-CH_3, 6-Br, and 6-Cl)	(*15S*)
Isoquinoline, PPA, $POCl_3$ (failed in 5 examples)	(*11S*)
2-Oxo-1,2,3,4-H_4-quinoline, $AlCl_3$	(*17S*)
1H-5-CH_3-2,3,3a,4,5,9b-H_6-benz[e]indene, P_2O_5, 60% [also for 5,8-$(CH_3)_2$, and 5,6,9-$(CH_3)_3$]	(*7S*)
2,9-$(CH_3)_2$-1,2,3,4,4a,9,10,10a-H_8-phenanthrene, P_2O_5, 60% [also for 2,6,9-$(CH_3)_3$ and 2,5,8,9-$(CH_3)_4$]	(*7S*)
4,9-$(CH_3)_2$-1,4-*endo*-isopropylidine-1,2,3,4,4a,9,10,10a-H_8-phenanthrene, P_2O_5, 62% [also for 4,6,9-$(CH_3)_3$]	(*7S*)
1,4-$(CH_3)_2$-1,2,3,4,5,6,7,8-H_8-anthracene, H_2SO_4	(*13S*)
9-*i*-C_4H_9-phenanthrene, CH_3CO_2H, HBr	(*3S*)
5-CH_3-5,6,6a,6b,7,8-H_6-benzo[c]phenanthrene, H_2SO_4, 70% [also for 2,5-$(CH_3)_2$, 5,8-$(CH_3)_2$, 2,5,8-$(CH_3)_3$, and 2,4,5,8-$(CH_3)_4$]	(*14S, 16S*)
Naphtho[e]pyrene, $AlCl_3$, NaCl	(*4S*)
5,8-Dioxo-dibenzo[a,i]pyrene, $AlCl_3$, NaCl, 68%	(*12S*)
Benzo[a]benzonaphtheno[1,2,3-cd]perylene, $AlCl_3$, NaCl	(*6S*)

RING-CLOSURE ALKYLATION (Pseudoaromatics)

Starting Compound and Reagent	*Reference*
2-[$(C_2H_5O)_2CHCH_2N{=}CH$]pyridine, no ring-closure with H_2SO_4-$POCl_3$, BF_3, HF, or PPA (similarly for 3- and 4-)	(*1T*)
2-[$(C_2H_5O)_2CHCH_2N{=}CH$]quinoline, no ring-closure with H_2SO_4-$POCl_3$, BF_3, HF, or PPA	

RING-CLOSURE ALKYLATION (Complex)

Product and Reagent	*Reference*
1-CH_3-3-C_6H_5-indene, silica gel	(*10U*)
1-CH_3-7-CH_3CO-indene, $AlCl_3$ [also for 6-CH_3 and 1,6-$(CH_3)_2$]	(*16U*)
7-HO-1-indanone, $AlCl_3$ (also for 4-C_6H_5 and 4-HO)	(*18U*)
2-CH_3-coumaran, H_3PO_4, 12%	(*17U*)

BIBLIOGRAPHY

General

(1A) Amin, J. H., Desai, R. D., *J. Sci. Ind. Research (India)* **13B**, 178–80 (1954).

(2A) Asahara, T., Takagi, Y., *J. Chem. Soc. Japan, Ind. Chem.* **58**, 147–53 (1955).

(3A) Ayer, W. A., Humber, L. G., Taylor, W. I., *J. Chem. Soc.*, **1954**, pp. 3505–8.

(4A) Baddeley, G., *Quart. Revs. (London)* **8**, 355–79 (1954).

(5A) Baddeley, G., Voss, D., *J. Chem. Soc.*, **1954**, pp. 418–22.

(6A) Bartlett, M. F., Wiesner, K., *Chemistry & Industry*, **1954**, p. 542.

(7A) Bassilios, H. F., Makar, S. M., Salem, A. Y., *Bull. soc. chim. France*, **1954**, pp. 72–9.

(8A) Benkeser, R. A., Krysiak, H. R., *J. Am. Chem. Soc.* **76**, 6353–7 (1954).

(9A) Brändström, A., *Arkiv Kemi* **7**, 29–31 (1954).

(10A) Brown, H. C., Grayson, M., *J. Am. Chem. Soc.* **75**, 6285–92 (1953).

(11A) Brown, H. C., Nelson, K. L., *Ibid.*, **75**, 6292–9 (1953).

(12A) Bryner, F., U. S. Patent **2,655,547** (Oct. 13, 1953).

(13A) Burkhard, C. A., Schmitz, J. V., Burnett, R. E., *J. Am. Chem. Soc.* **75**, 5957–8 (1953).

(14A) Burr, J. G., Jr., *Ibid.*, **75**, 1990–1 (1953).

(15A) Butler, J. C., Ferstandig, L. L., Clark, R. D., *Ibid.*, **76**, 1906–8 (1954).

(16A) Buu-Hoï, N. G., Eckert, B., Demerseman, P., *J. Org. Chem.* **19**, 726–32 (1954).

(17A) Cauquil, G., Barrera, H., Barrera, R., *Bull. soc. chim. France*, **1953**, pp. 1111–16.

(18A) Cauquil, G., Casadevall, A., *Compt. rend.* **238**, 908–11 (1954).

(19A) Conroy, H., Firestone, R. A., *J. Am. Chem. Soc.* **75**, 2530–1 (1953).

(20A) Corson, B. B., Dorsky, J., others, *J. Org. Chem.* **19**, 17–26 (1954).

(21A) Cowie, C. T. Y., Brit. Patent **701,438** (Dec. 23, 1953).
(22A) Crabbé, P., *Ing. chim.* **36**, 75–83 (1954).
(23A) Cullirane, N. M., Lyeshon, D. M., *J. Chem. Soc.* **1954**, pp. 2942–7.
(24A) Curtin, D. Y., Johnson, H. W., Jr., *J. Am. Chem. Soc.* **76**, 2276–7 (1954).
(25A) Dixon, J. K., Saunders, K. W., IND. ENG. CHEM. **46**, 652–60 (1954).
(26A) Dobryanskiĭ, A. F., Kornilova, Y. I., *Sbornik Stateĭ Obshcheĭ Khim., Akad. Nauk S.S.S.R.* **1**, 322–4 (1953).
(27A) Dolgov, B. N., Cherkasov, A. S., *Zhur. Obshcheĭ Khim.* **24**, 825–33 (1954).
(28A) Ebine, S., *Science Repts. Saitama Univ.* **1A**, 157–64 (1954).
(29A) Foster, G. L., *J. Chem. Soc.*. **1954**, pp. 2788–94.
(30A) Galloway, W. L., Reid, D. H., Stafford, W. H., *Chemistry & Industry*, **1954**, p. 724.
(31A) Gardner, P. D., *J. Am. Chem. Soc.* **76**, 4550–2 (1954).
(32A) Gerecs, Á., *Magyar Tudományos Akad. Kém Tudományok Osztályanok Közleményei* **3**, 77–82 (1953).
(33A) Gerecs, Á., Széll, T., Windholz, M., *Acta Chim. Acad. Sci. Hung.* **3**, 459–67 (1953).
(34A) Gerecs, Á., Windholz, M., Sipos, G., *Ibid.*, **4**, 123–7 (1954).
(35A) Ghosal, M., Bagchi, P., *Science and Culture (India)* **20**, 197–8 (1954).
(36A) Gore, P. H., *Chemistry & Industry* **1954**, pp. 1385–6.
(37A) Hadler, H. I., *J. Am. Chem. Soc.* **77**, 1052–3 (1955).
(38A) Hart, H., *Ibid.*, **76**, 4033–4 (1954).
(39A) Hart, H., Cassis, F. A., *Ibid.*, **76**, 1634–9 (1954).
(40A) Hart, H., Cassis, F. A., Bordeaux, J. J., *Ibid.*, **76**, 1639–41 (1954).
(41A) Hart, H., Eleuterio, H. S., *Ibid.*, **76**, 516–19 (1954).
(42A) *Ibid.*, pp. 519–22.
(43A) Hart, H., Spliethoff, W. L., Eleuterio, H. S., *J. Am. Chem. Soc.* **76**, 4547–50 (1954).
(44A) Huisgen, R., Rapp, W., others, *Ann.* **586**, 52–69 (1954).
(45A) Krentsel, B. A., Topchiev, A. V., Andreev, L. N., *Doklady Akad. Nauk S.S.S.R.* **98**, 75–8 (1954).
(46A) Koike, E., Okawa, M., *J. Chem. Soc. Japan, Pure Chem.* **74**, 971–4 (1953).
(47A) *Ibid.*, pp. 83–6 (1954).
(48A) Korshak, V. V., Samplavskaya, K. K., *Sbornik Stateĭ Obshcheĭ Khim.* **2**, 1020–6 (1953).
(49A) Kulka, M., *J. Am. Chem. Soc.* **76**, 5469–71 (1954).
(50A) Kunz, W., Brit. Patent **701,264** (Dec. 23, 1953).
(51A) Lagidze, R. M., Potskhverashvili, B. S., *Soobshcheniya Akad. Nauk Gruzinskoĭ S.S.R.* **14**, 473–80 (1953).
(52A) Lavrushin, V. F., Andriyanova, K. I., *Doklady Akad. Nauk S.S.S.R* **97**, 839–42 (1954).
(53A) Levedev, N. N., *Zhur. Obshcheĭ Khim.* **24**, 1782–7 (1954).
(54A) Lewenz, G. F., Serijan, K. T., *J. Am. Chem. Soc.* **75**, 4087–9 (1953).
(55A) *Ibid.*, pp. 5753–5.
(56A) Mamedaliev, Y. G., Veliev, S. V., *Doklady Akad. Nauk S.S.S.R.* **92**, 325–8 (1953).
(57A) *Ibid.*, pp. 573–5.
(58A) Marey, A. F., Baddar, F. G., Awad, W. I., *Nature* **172**, 1186–7 (1953).
(59A) Marvell, E. N., Teranishi, R., *J. Am. Chem. Soc.* **76**, 6165–8 (1954).
(60A) Medcalf, E. C., Vriens, G. N., U. S. Patent **2,694,095** (Nov. 9, 1954).
(61A) Moed, H. D., Asscher, M., others. *Rec. trav. chim.* **71**, 933–44 (1952).
(62A) N. V. de Bataafsche Petroleum Maatschappij, Dutch Patent **77,119** (Jan. 15, 1955).
(63A) Oda, R., Nomura, M., Kagaku, **8**, 70–9 (1953).
(64A) Offutt, W. C., U. S. Patent **2,684,389** (July 20, 1954).
(65A) Ogata, Y., *Chemistry and Chem. Ind. (Japan)* **8**, 204–7 (1955).
(66A) Oláh, G., Pavláth, A., *Acta Chim. Acad. Sci. Hung.* **3**, 425–9 (1953).
(67A) Paltz, W. J., Tegge, B. R., U. S. Patent **2,667,519** (Jan. 26, 1954).
(68A) Parham, W. E., Traynelis, V. J., *J. Am. Chem. Soc.* **76**, 4960–2 (1954).
(69A) Petrova, A. M., *Zhur. Obshcheĭ Khim.* **24**, 491–3 (1954).
(70A) Pines, H., Ipatieff, V. N., U. S. Patent **2,671,815** (March 9, 1954).
(71A) Rhoads, S. J., Raulins, R., Reynolds, R. D., *J. Am. Chem. Soc.* **75**, 2531–2 (1953).
(72A) Romadane, I., Rodinš, E., *Latvijas PSR Zinātnu Akad. Vēstis*, **1954**, pp. 115–18.

RING-CLOSURE ALKYLATION (Complex) (Continued)

Product and Reagent	*Reference*
1,2,3-$(C_6H_5)_3$-azulene, $AlCl_3$, 25%	(*2U*)
1-CH_3-6-CH_3O-1,2,3,4-H_4-naphthalene, HCl, Zn(Hg), 78%	(*25U*)
1,4-$(CH_3)_2$-6-CH_3O-1,2-H_2-naphthalene, $AlCl_3$, 52%	(*25U*)
Chroman, H_3PO_4, 11%	(*17U*)
6-C_2H_5-7-HO-coumarin, H_2SO_4	(*22U*)
6-Br-7-HO-coumarin, H_2SO_4	(*22U*)
5-HO-6-RNHCO-coumarin, $AlCl_3$, 30–60% (6 examples)	(*7U*)
4,7-$(CH_3)_2$-5-HO-coumarin, H_2SO_4	(*14U*)
4-CH_3-6-C_2H_5-7-CH_3O-coumarin, $AlCl_3$ or H_2SO_4 (also for 6-*n*-C_3H_7)	(*24U*)
4-CH_3-6-RNHCO-7-HO-coumarin, H_2SO_4, 2–50% (5 examples)	(*7U*)
4-CH_3-5-CH_3O-8-C_2H_5-coumarin, P_2O_5	(*24U*)
4H-2-Oxo-4-imino-5-CH_3-7-HO-2,3-H_2-1-benzopyran, HCl, $ZnCl_2$	(*14U*)
4,8-$(CH_3)_2$-5,7-$(HO)_2$-coumarin, HCl, CH_3CO_2H (similarly for 15 examples)	(*11U*)
4,5-$(CH_3)_2$-7-HO-8-C_2H_5-coumarin, $AlCl_3$, H_2SO_4 or P_2O_5	(*24U*)
2-CH_3-6-CH_3O-quinoline, HCl	(*4U*)
1H-1-CH_3-7-CH_3CO-2,2a,3,4-H_4-cyclopent[cd]indene	(*16U*)
2,3-Cyclopentano-2,3-H_2-benzo[b]furan	(*3U*)
9-HO_2C-fluorene, $AlCl_3$, 71–81%	(*21U*)
3-HO-2-acenaphthenone	(*18U*)
2-C_6H_5-naphtho[b]thiophene, $AlCl_3$	(*12U*)
Anthracene, $AlCl_3$	(*5U, 23U*)
9,10-$(CH_3)_2$-anthracene, $AlCl_3$	(*1U*)
9,9,10,10-$(CH_3)_4$-9,10-H_2-anthracene, $AlCl_3$	(*5U*)
2,3,6,7-$(CH_3O)_4$-9,10-H_2-anthracene, HCl	(*20U*)
9-H_2N-10-R-phenanthrene, H_2SO_4 (5 examples)	(*6U*)
9-HO-2,3-H_2-1-benzonaphthenone, $AlCl_3$	(*18U*)
7,8-benzocoumarin, H_2SO_4	(*15U*)
4-Cl-benzanthrone, H_2SO_4 (also for 9- and 10-)	(*19U*)
Naphtho[2,3-e]pyrene, $AlCl_3$, NaCl	(*8U*)
4,5,6,6a,6b,7,8,12b-H_8-benzo[j]fluoranthene, PPA	(*13U*)
Heptaphene, 400 °C, (other products are dibenzo[b,kl]picene and anthraceno-[2,1-a]naphthacene)	(*9U*)

MISCELLANEOUS

Aromatic	*Reagent*	*Product*	*Reference*
Ar_4Sn (3 examples)	CH_3COCl, $AlCl_3$	$ArCOCH_3$,	(*1Y*)
$(C_6H_5CH_2)_4Sn$	CH_3COCl, $AlCl_3$ (similarly for C_6H_5COCl)	$C_6H_5CH_2COCH_3$, 78%	(*1Y*)
Ar_4Sn	$C_6H_5CH_2Cl$, $AlCl_3$	$ArCH_2C_6H_5$	(*1Y*)
4-$CH_3C_6H_4OH$ (similarly for 3 analogs)	CCl_4, $AlCl_3$, CS_2 (unsuccessful for a number of similar reagents)	1-Oxo-4-CH_3-4-Cl_3C-2,5-cyclohexadiene, 60%	(*2Y*)
Phenol	$C_6H_5CCl_3$, $AlCl_3$, CS_2	4-$HOC_6H_4COC_6H_5$, 92%	(*3Y*)
4-$CH_3C_6H_4OH$ (similarly for many examples)	$ArCCl_3$, $AlCl_3$	2-ArCO-4-CH_3-C_6H_3OH and 2,6-$(ArCO)_2$-4-CH_3-C_6H_2OH	(*3Y, 4Y, 5Y*)
4-$CH_3C_6H_4OH$ (similarly for several examples)	$C_6H_5CCl_3$, $AlCl_3$, CS_2	6,12-$(C_6H_5)_2$-2,8-$(CH_3)_2$-6,12-epoxy-6H,12H-dibenzo[b,f][1,5]dioxocin, 29%	(*3Y*)

(73A) Rondestvedt, C. S., Jr., Filbey, A. H., *J. Org. Chem.* **19**, 119–28 (1954).
(74A) Rothstein, E., *Chemistry & Industry* **1954**, p. 403.
(75A) Ruhrchemie A. G., Brit. Patent **711,793** (July 14, 1954).
(76A) Sanford, R. A., Kovach, S. M., Friedman, B. S., *J. Am. Chem. Soc.* **75**, 6326–7 (1953).
(77A) Schlatter, M. J., *Ibid.*, **76**, 4952–7 (1954).
(78A) Schmerling, L., West, J. P., *Ibid.*, **76**, 1917–21 (1954).
(79A) Schmid, K., Haegele, W., Schmid, H., *Experientia* **9**, 414–15 (1953).
(80A) Schmid, K., Haegele, W., Schmid, H., *Helv. Chim. Acta* **37**, 1080–93 (1954).
(81A) Schneider, A., U. S. Patent **2,712,-033** (June 28, 1955).
(82A) Schubert, W. M., Donohue, J., Gardner, J. D., *J. Am. Chem. Soc.* **76**, 9–14 (1954).
(83A) Schubert, W. M., Sweeney, W. A., Latourette, H. K., *Ibid.*, **76**, 5462–6 (1954).
(84A) Schubert, W. M., Zahler, R. E., *Ibid.*, **76**, 1–9 (1954).
(85A) Sen, A. B., Parmar, S. S., *J. Indian Chem. Soc.* **30**, 720–2 (1953).
(86A) Sharrah, M. L., Feighner, G. C., IND. ENG. CHEM. **46**, 248–54 (1954).
(87A) Shirley, D. A., Zietz, J. R., Jr., *J. Am. Chem. Soc.* **75**, 6333–4 (1953).
(88A) Shuĭkin, N. I., Kuchkarev, A. B., Pozdnyak, N. A., *Doklady Akad. Nauk S.S.S.R.* **92**, 785–8 (1953).
(89A) Shuĭkin, N. I., Kuchkarev, A. B., Pozdnyak, N. A., *Izvest. Akad. Nauk S.S.S.R.*, Otdel. Khim. Nauk, **1954**, pp. 904–10.
(90A) Sidorova, N. G., Tsukervanik, I. P., Abidova, Z. K., *Doklady Akad. Nauk. Uzbek. S.S.R.*, **1953**, pp. 33–7.
(91A) Sidorova, N. G., Tsukervanik, I. P., Pak, E., *Zhur. Obshcheĭ Khim.* **24**, 94–6 (1954).
(92A) Smith, W. C., Masterton, B., U. S. Patent **2,678,951** (May 18, 1954).
(93A) Stevens, W. H., Crowder, D. A., *Can. J. Chem.* **32**, 792–80 (1954).
(94A) Takegami, Y., Azuma, K., Shingu, H., *J. Chem. Japan, Ind. Chem.* **55**, 630–1 (1952).
(95A) Takegami, Y., Shingu, H., *Ibid.*, **55**, 717–18 (1952).
(96A) Tedder, J. M., *Chemistry & Industry* **1954**, p. 630.
(97A) Topchiev, A. V., Andreev, L. N., Krentsel, B. A., *Doklady Akad. Nauk S.S.S.R.* **98**, 411–14 (1954).
(98A) Topchiev, A. V., Bogomolova, N. F., *Ibid.*, **88**, 691–2 (1953).
(99A) Topchiev, A. V., Krentsel, B. A., Andreev, L. N., *Ibid.*, **92**, 781–4 (1953).
(100A) Topchiev, A. V., Kurashev, M. V., Paushkin, Y. M., *Ibid.*, **93**, 839–42 (1953).
(101A) Topchiev, A. V., Tumerman, B. M., others, *Neftyanoe Khoz.* **32**, 65–9 (1954).
(102A) Truce, W. E., Hoerger, F. D., *J. Am. Chem. Soc.* **76**, 5357–60 (1954).
(103A) Truce, W. E., Vriesen, C. W., *Ibid.*, **75**, 5032–6 (1953).
(104A) Tsutsumi, S., Yoshijima, T., Koyama, K., *J. Fuel Soc. Japan* **34**, 145–50 (1955).
(105A) Turova-Pollak, M. B., Danilova, N. V., Treshchova, E. G., *Zhur. Obshcheĭ Khim.* **24**, 1558–62 (1954).
(106A) Vejdělek, Z. J., Kakáč, B., *Chem. Listy* **49**, 82–95 (1955).
(107A) Vdovtsova, E. A., Tsukervanik, I. P., *Sbornik Stateĭ Khim.* **2**, 1027–34 (1953).
(108A) Vdovtsova, E. A., Tsukervanik, I. P., *Doklady Akad. Nauk S.S.S.R.* **80**, 61–4 (1951).
(109A) Wichterle, O., Černý, J., *Chem. Listy* **49**, 1038–40 (1955).
(110A) Zagorodniĭ, S. V., Gostev, M. M., *Zhur. Obshcheĭ Khim.* **24**, 2002–6 (1954).

Open-Chain Acylation (Aromatics)

(1B) Abell, J., Cram, D. J., *J. Am. Chem. Soc.* **76**, 4406–12 (1954).
(2B) Allinger, N. L., Cram, D. J., *Ibid.*, **76**, 2362–7 (1954).
(3B) Askam, V., Linnell, W. H., *J. Chem. Soc.* **1954**, pp. 4691–3.
(4B) Ayer, W. A., Humber, L. G., Taylor, W. I., *Ibid.*, **1954**, pp. 3505–8.
(5B) Baddeley, G., Makar, S. M., Ivinson, M. G., *Ibid.*, **1953**, pp. 3969–71.
(6B) Baker, W., Boarland, M. P. V., McOmie, J. F. W., *Ibid.*, **1954**, pp. 1476–82.
(7B) Bartlett, M. F., Wiesner, K., *Chemistry & Industry*. **1954**, p. 542.
(8B) Bassilios, H. F., Makar, S. M., Salem, A. Y., *Bull. soc. chim. France* **1954**, pp. 72–9.
(9B) Battersby, A. R., Binks, R., *Chemistry & Industry* **1954**, p. 1455.
(10B) Bayless, P. L., Hauser, C. R., *J. Am. Chem. Soc.* **76**, 2306–8 (1954).
(11B) Benkeser, R. A., Krysiak, H. R., *Ibid.*, **76**, 599–603 (1954).
(12B) Bergmann, F., Kalmus, A., *Ibid.*, **76**, 4137–40 (1954).
(13B) Bourne, E. J., Stacey, M., others, *J. Chem. Soc.*, **1954**, pp. 2006–12.
(14B) Bradsher, C. K., Brown, F. C., Porter, H. K., *J. Am. Chem. Soc.* **76**, 2357–62 (1954).
(15B) Breusch, F. L., Oguzer, M., *Chem. Ber.* **87**, 1225–8 (1954).
(16B) Browne, C. L., Lutz, R. E., *J. Org. Chem.* **18**, 1638–47 (1953).
(17B) Brunner, O., Hanke, P., *Monatsh.* **85**, 88–91 (1954).
(18B) Burtner, R. R., *J. Am. Chem. Soc.* **75**, 2334–40 (1953).
(19B) Burtner, R. R., U. S. Patent **2,663,728** (Dec. 22, 1953).
(20B) Burtner, R. R., Brown, J. M., *J. Am. Chem. Soc.* **75**, 2334–40 (1953).
(21B) Burton, H., Munday, D. A., *J. Chem. Soc.*, **1954**, pp. 1456–60.
(22B) Butler, J. C., Ferstandig, L. L., Clark, R. D., *J. Am. Chem. Soc.* **76**, 1906–8 (1954).
(23B) Buu-Hoï, N. P., *J. Org. Chem.* **18**, 1723–9 (1953).
(24B) *Ibid.*, **19**, 721–5 (1954).
(25B) Buu-Hoï, N. P., Eckert, B., Demerseman, P., *J. Org. Chem.* **19**, 726–32 (1954).
(26B) Buu-Hoï, N. P., Eckert, B., Royer, R., *Ibid.*, **19**, 1548–52 (1954).
(27B) Buu-Hoï, N. P., Lavit, D., Xuong, N. D., *Ibid.*, **19**, 1617–21 (1954).
(28B) Buu-Hoï, N. P., Royer, R., others, *J. Chem. Soc.* **1953**, pp. 3584–7.
(29B) Buu-Hoï, N. P., Royer, R., others, *J. Org. Chem.* **18**, 1209–24 (1953).
(30B) Buu-Hoï, N. P., Xuong, N. D., Lavit, D., *J. Chem. Soc.*, **1954**, pp. 1034–8.
(31B) Buu-Hoï, N. P., Xuong, N. D., Lavit, D., *J. Org. Chem.* **19**, 1562–6 (1954).
(32B) Buu-Hoï, N. P., Xuong, N. D., Thang, K. v., *Rec. trav. chim.* **72**, 774–80 (1953).
(33B) Calzolari, C., Furlani, C., *Ann. triest. cura univ. Trieste, Sez.* 2 **22-23**, 43–61 (1953).
(34B) Campaigne, E. E., Archer, W. L., *J. Am. Chem. Soc.* **75**, 989–91 (1953).
(35B) Carlo Erba Società per azioni, Ital. Patent **475,964** (Nov. 25, 1952).
(36B) Carruthers, W., *J. Chem. Soc.*, **1953**, pp. 3486–9.
(37B) Carruthers, W., Cook, J. W., *Ibid.*, **1954**, pp. 2047–52.
(38B) Castel, P., Orzalesi, H., *Trav. soc. pharm. Montpellier* **10**, 41–2 (1950).
(39B) Cauquil, G., Barrera, H., Barrera, R., *Bull. soc. chim. France* **1953**, pp. 1111–16.
(40B) Cauquil, G., Rouzaud, J., *Compt. rend.* **237**, 1720–2 (1953).
(41B) Charlton, J. C., Hughes, E. D., *J. Chem. Soc.*, **1954**, pp. 2939–42.
(42B) Clar, E., Kelly, W., *J. Am. Chem. Soc.* **76**, 3502–4 (1954).
(43B) Clar, E., Stewart, D. G., *Ibid.*, **76**, 3504–7 (1955).
(44B) Cram, D. J., Allinger, N. L., *Ibid.*, **76**, 726–31 (1954).
(45B) Cram, D. J., Allinger, N. L., Steinberg, H., *Ibid.*, **76**, 6132–41 (1954).
(46B) Cram, D. J., Daeniker, H. U., *Ibid.*, **76**, 2743–52 (1954).
(47B) Cromwell, N. H., and Mohrbacher, R. J., *Ibid.*, **75**, 6252–6 (1953).
(48B) Curtin, D. Y., Crew, M. C., *Ibid.*, **76**, 3719–22 (1954).
(49B) Dannenberg, H., Dannenberg, D., *Z. Naturforsch.* **8b**, 165–73 (1953).
(50B) Dauben, W. G., Jiu, J., *J. Am. Chem. Soc.* **76**, 4426–9 (1954).
(51B) Davies, A. G., Kenyon, J., others, *J. Chem. Soc.* **1954**, pp. 3474–9.
(52B) Davies, J. E., King, F. E., Roberts, J. C., *Chemistry & Industry* **1954**, pp. 1110–11.
(53B) Dean, F. M., Evans, E., Robertson, A., *J. Chem. Soc.*, **1954**, pp. 4565–72.
(54B) DeTar, D. F., Relyea, D. I., *J. Am. Chem. Soc.* **76**, 1680–5 (1954).
(55B) Dev, S., *J. Indian Chem. Soc.* **30**, 789–800 (1953).
(56B) Dreiding, A. S., Tomasewski, A. J., *J. Am. Chem. Soc.* **76**, 540–5 (1954).
(57B) Evans, D. D., Morris, D. S., others, *J. Chem. Soc.* **1954**, pp. 1687–90.
(58B) Evans, R. F., Smith, J. C., Strauss, F. B., *J. Inst. Petroleum* **40**, 7–13 (1954).
(59B) Fel'dman, I. K., Simeonov, A. A., *Zhur. Obshcheĭ Khim.* **23**, 2043–6 (1953).
(60B) Fuson, R. C., Emmons, W. D., Parshall, G. W., *J. Am. Chem. Soc.* **76**, 5466–9 (1954).
(61B) Fuson, R. C., Friedlander, W. S., *Ibid.*, **76**, 4989–91 (1954).
(62B) Fuson, R. C., Friedlander, W. S., Parshall, G. W., *Ibid.*, **76**, 5119–21 (1954).
(63B) Fuson, R. C., Hammann, W. C., Smith, W. E., *J. Org. Chem.* **19**, 674–7 (1954).
(64B) Fuson, R. C., Mange, F. E., *Ibid.*, **19**, 806–9 (1954).
(65B) Fuson, R. C., Wallingford, H. P., *J. Am. Chem. Soc.* **75**, 5950–2 (1953).

(66B) Gardner, P. D., *Ibid.*, **76**, 4550–2 (1954).
(67B) Gault, H., Selim, M., *Compt. rend.* **240**, 630–1 (1955).
(68B) Ghosal, M., Bagchi, P., *Science and Culture (India)* **20**, 197–8 (1954).
(69B) Gray, G. W., Jones, B., *J. Chem. Soc.* **1954**, pp. 678–83.
(70B) Green, A. L., Hey, D. H., *Ibid.*, **1954**, pp. 4306–18.
(71B) Gupta, S. C. S., Bhattacharjee, A., *J. Indian Chem. Soc.* **30**, 805–8 (1954).
(72B) Gupta, S. C. S., Chatterjee, D. N., *Ibid.*, **29**, 438–42 (1952).
(73B) Gupta, S. C. S., Chatterjee, D. N., *Ibid.*, **31**, 11–16 (1954).
(74B) *Ibid.*, **31**, 285–90 (1954).
(75B) Gupta, S. C. S., Chatterjee, D. N., *Science and Culture (India)* **19**, 47–8 (1953).
(76B) Gupta, R. C., Muthana, M. S., *J. Indian Inst. Sci.* **35A**, 259–62 (1953).
(77B) *Ibid.*, pp. 263–7.
(78B) *Ibid.*, pp. 307–9.
(79B) *Ibid.*, pp. 310–14.
(80B) Haksar, C. N., *Agra Univ. J. Research* **2**, 233–9 (1953).
(81B) Henze, H. R., Isbell, A. F., *J. Am. Chem. Soc.* **76**, 4152–6 (1954).
(82B) Hoán, N., *Compt. rend.* **238**, 1136–8 (1954).
(83B) Howard, G. A., Tatchell, A. R., *Chemistry & Industry* **1954**, p. 514.
(84B) Ishidate, M., Nambara, T., *Pharm. Bull.* **1**, 290–2 (1953).
(85B) Johnson, W. S., Graber, R. P., U. S. Patent **2,683,738** (July 13, 1954).
(86B) Johnson, R. G., Willis, H. B., Gilman, H., *J. Am. Chem. Soc.* **76**, 6407–8 (1954).
(87B) Johnston, W. T. G., Smith, J. C., Staveley, C. M., *Chemistry & Industry* **1954**, p. 607.
(88B) Joshi, G. G., Shah, N. M., *J. Indian Chem. Soc.* **31**, 223–30 (1954).
(89B) Joshi, S. S., Singh, H., *J. Am. Chem. Soc.* **76**, 4993–4 (1954).
(90B) Kaluszyner, A., Reuter, S., *Ibid.*, **75**, 5126–7 (1953).
(91B) Kaye, I. A., Klein, H. C., Burlant, W. J., *Ibid.*, **75**, 745–6 (1953).
(92B) Kimoto, S., Asaki, K., Kishi, S., *J. Pharm. Soc. Japan* **74**, 358–60 (1954).
(93B) Kindler, K., Oelschläger, H., *Chem. Ber.* **87**, 194–202 (1954).
(94B) King, F. E., King, T. J., Stokes, P. J., *J. Chem. Soc.*, **1954**, pp. 4587–94.
(95B) King, F. E., King, T. J., Topliss, J. G., *Chemistry & Industry* **1954**, pp. 108–9.
(96B) Kinsley, D. A., Plant, S. G. P., *J. Chem. Soc.*, **1954**, pp. 1341–3.
(97B) Koike, E., Okawa, M., *J. Chem. Soc. Japan, Pure Chem.* **74**, 971–4 (1953).
(98B) Koike, E., and Okawa, M., *Ibid.*, **75**, 83–6 (1954).
(99B) Koike, E., Okawa, M., Kaneko, T., *J. Chem. Soc. Japan, Ind. Chem.* **55**, 535–8 (1952).
(100B) Kost, A. N., *Vestnik Moskov. Univ.* **7**, *Ser. Fiz. Mat. i Estestven. Nauk* No. **8**, 35–7 (1952).
(101B) Kosuge, T., Sato, M., *J. Pharm. Soc. Japan, Pure Chem.* **74**, 1139–41 (1954).
(102B) Krimmel, C. P., U. S. Patent **2,629,737** (Feb. 24, 1953).
(103B) Krishnamurti, M., Seshadri, T. R., *Chemistry & Industry* **1954**, pp. 542–3.
(104B) Krishnamurti, M., Seshadri, T. R., *J. Sci. Ind. Research (India)* **13B**, 474–5 (1954).
(105B) Krishnamurti, M., Seshadri, T. R., *Proc. Indian Acad. Sci.* **39A**, 144–52 (1954).
(106B) Kuhn, R., Staab, H. A., *Chem. Ber.* **87**, 266–72 (1954).
(107B) Kulka, M., *J. Am. Chem. Soc.* **76**, 5469–71 (1954).
(108B) Lindahl, R. G., *Ann. Acad. Sci. Fennicae* **48**, 7–60 (1953).
(109B) Lespagnol, A., Hallot, J., *Bull. soc. pharm. Lille*, **1954**, pp. 45–6.
(110B) Lewenz, G. F., Serijan, K. T., *J. Am. Chem. Soc.* **75**, 4087–9 (1953).
(111B) *Ibid.*, pp. 5753–5.
(112B) Loewenthal, H. J. E., *J. Chem. Soc.* **1953**, pp. 3962–8.
(113B) Long, J. P., Schueler, F. W., *J. Am. Pharm. Assoc.* **43**, 79–86 (1954).
(114B) Lutz, R. E., Bauer, C. R., *J. Am. Chem. Soc.* **75**, 5997–6002 (1953).
(115B) Lutz, R. E., Bailey, P. S., others, *Ibid.*, **75**, 5039–44 (1953).
(116B) MacGregor, I. R., Neblett, R. F., Cook, C. H., *J. Org. Chem.* **19**, 626–30 (1954).
(117B) MacMillan, J., *J. Chem. Soc.*, **1954**, pp. 2585–7.
(118B) MacMillan, J., Mulholland, T. P. C., others, *Ibid.*, **1954**, 429–35.
(119B) Mani, R., Venkataraman, K., *Current Sci. (India)* **23**, 220–1 (1954).
(120B) Marathey, M. G., Athavale, J. M *J. Univ. Poona, Science an Technol.*, **1953**, pp. 90–3.
(121B) Martynoff, M., *Compt. rend.* **238**, 249–51 (1954).
(122B) Matsuda, S., Matsuda, H., Kikkawa, S., *J. Chem. Soc. Japan, Ind. Chem.* **57**, 845–7 (1954).
(123B) Matti, J., Perrier, M., *Bull. soc. chim. France*, **1955**, pp. 525–30.
(124B) Mellier, M. T., *Oléagineux* **9**, 167–8 (1954).
(125B) Merck & Co., Inc., Brit. Patent **702,012** (Jan. 6, 1954).
(126B) *Ibid.*, **713,696** (Aug. 18, 1954).
(127B) Morrison, R. T., Wishman, M., *J. Am. Chem. Soc.* **76**, 1059–61 (1954).
(128B) Motoyanagi, T., Yamashita, Y., Ishii, Y., *J. Chem. Soc. Japan, Ind. Chem.* **56**, 887–90 (1953).
(129B) Nakazawa, K., *J. Pharm. Soc. Japan* **74**, 836–9 (1954).
(130B) Nakazawa, K., Matsuura, S., *Ibid.*, **74**, 40–2 (1954).
(131B) *Ibid.*, pp. 69–72.
(132B) *Ibid.*, pp. 1254–5.
(133B) Nakazawa, K., Matsuura, S., Baba, S., *Ibid.*, **74**, 498–501 (1954).
(134B) Nakazawa, K., Matsuura, S., Kusuda, K., *Ibid.*, **74**, 495–7 (1954).
(135B) Nakazawa, K., Tsubouchi, S., *Ibid.*, **74**, 1254–5 (1954).
(136B) Nambara, T., *Ibid.*, **74**, 13–16 (1954).
(137B) Oki, M., *Bull. Chem. Soc. Japan* **26**, 331–6 (1953).
(138B) Pailer, M., Reifschneider, W., *Monatsh.* **84**, 585–91 (1953).
(139B) Panizzi, L., Nicolaus, R., *Gazz. chim. ital.* **83**, 774–81 (1953).
(140B) Parikh, R. J., Thakor, V. M., *J. Indian Chem. Soc.* **31**, 137–40 (1954).
(141B) Petrov, A. D., Chernyshev, E. A., Kulish, I. A., *Doklady Akad. Nauk S.S.S.R.* **100**, 929–32 (1955).
(142B) Petrova, A. M., *Zhur. Obshchei Khim.* **24**, 491–3 (1954).
(143B) Philbin, E. M., Swirski, J., Wheeler T. S., *Chemistry & Industry*, **1955**, pp. 445–6.
(144B) Phillips, D. D., McWhorter, E. J., *J. Am. Chem. Soc.* **76**, 4948–50 (1954).
(145B) Profft, E., *Chem. Tech. (Berlin)* **6**, 366–72 (1954).
(146B) Protiva, M., Exner, O., *Chem. Listy* **47**, 736–41 (1953).
(147B) Ramage, G. R., Stead, C. V., *J. Chem. Soc.*, **1953**, pp. 3602–6.
(148B) Rastogia, R. P., Sen, A. B., *J. Indian Chem. Soc.* **30**, 514–18 (1953).
(149B) Reinheimer, J. D., Taylor, S., *J. Org. Chem.* **19**, 802–5 (1954).
(150B) Richtzenhain, H., Alfredsson, B., *Acta Chem. Scand.* **8**, 1519–29 (1954).
(151B) Riedl, W., *Ann.* **585**, 32–7 (1954).
(152B) Riedl, W., Risse, K. H., *Chem. Ber.* **87**, 865–8 (1954).
(153B) Rigaudy, J., Farthouat, J. M., *Bull. soc. chim. France*, **1954**, 1261–5.
(154B) Robertson, A., Clarke, J. R., U. S. Patent **2,680,119** (June 1, 1954).
(155B) Rorig, K., *J. Am. Chem. Soc.* **75**, 5381–3 (1953).
(156B) Royer, R., Bisagni, É., *Bull soc. chim. France* **1954**, pp. 486–92.
(157B) Sallay, I., Fodor, G., *Acta Chim. Acad. Sci. Hung.* **2**, 57–60 (1952).
(158B) Sato, K., Miyamoto, O., *J. Chem. Soc. Japan, Pure Chem.* **75**, 225–7 (1954).
(159B) Schlatter, M. J., *J. Am. Chem. Soc.* **76**, 4952–7 (1954).
(160B) Simons, J. H., Black, W. T., Clark, R. F., *Ibid.*, **75**, 5621–2 (1953).
(161B) Smith, H. A., Thompson, R. G., *Ibid.*, **77**, 1778–83 (1955).
(162B) Stetter, H., Krause, H. J., *Chem. Ber.* **87**, 209–11 (1954).
(163B) Stevens, W. H., Crowder, D. A., *Can. J. Chem.* **32**, 792–801 (1954).
(164B) Stevens, C. L., Dykstra, S. J., *J. Am. Chem. Soc.* **75**, 5975–8 (1953).
(165B) *Ibid.*, **76**, 4402–5 (1954).
(166B) Subluskey, L. A., Sanderson, T. F., *J. Am. Chem. Soc.* **76**, 3512–15 (1954).
(167B) Szmant, H. H., Levitt, G., *Ibid.*, **76**, 5459–61 (1954).
(168B) Szmant, H. H., Skendrovich, S., *Ibid.*, **76**, 2282 (1954).
(169B) Tadros, W., Ekladius, L., Salka, A. B., *J. Chem. Soc.*, **1954**, pp. 2351–3.
(170B) Takegami, Y., Azuma, K., Shingu, H., *J. Chem. Soc. Japan, Ind. Chem.* **55**, 630–1 (1952).
(171B) Takegami, Y., Shingu, H., *Ibid.*, **55**, 717–8 (1952).
(172B) Thakor, V. M., Shah, R. C., *J. Indian Chem. Soc.* **31**, 597–9 (1954).
(173B) Thiec, J., *Ann. chim. (Paris)* **9**, 51–96 (1954).
(174B) Thoi, L. V., Belloc, A., *Compt. rend.* **239**, 500–2 (1954).
(175B) Tomita, M., Kumaoka, H., Takase, M., *J. Pharm. Soc. Japan* **74**, 850–3 (1954).
(176B) Trave, R., Biachetti, G., *Atti accad. nazl. Lincei, Rend., Classe sci. fis. mat. e nat.* **11**, 211–18 (1951).
(177B) Villani, F. J., King, M. S., others, *J. Am. Chem. Soc.* **76**, 5623–5 (1954).
(178B) Vo-thi, T.-T., Nguyên-Hoán, *Compt. rend.* **237**, 1016–18 (1953).
(179B) Walker, G. N., *J. Am. Chem. Soc.* **76**, 3999–4003 (1954).

(180B) Walker, H. G., Jr., Sanderson, J. J., Hauser, C. R., *Ibid.*, **75,** 4109–10 (1953).
(181B) Wibaut, J. P., van Nes, K., Stofberg, J., *Rec. trav. chim.* **73,** 501–12 (1954).
(182B) Wynn, R. W., Hoch, P. E., U. S. Patent **2,686,812** (Aug. 17, 1954)
(183B) *Ibid.*, **2,694,729** (Nov. 16, 1954).
(184B) Yokote, M., Inahata, S., *J. Chem. Soc. Japan, Ind. Chem.* **56,** 796–7 (1953).
(185B) Yur'ev, Y. K., Elyakov, G. B., Belyakova, Z. V., *Zhur. Obshcheĭ Khim.* **24,** 1568–71 (1954).

Open-Chain Acylation (Pseudoaromatics)

(1C) Arakawa, K., *Pharm. Bull.* **1,** 331–4 (1953).
(2C) Badger, G. M., Rodda, H. J., Sasse, W. H. F., *Chemistry & Industry* **1954,** p. 308.
(3C) Badger, G. M., Rodda, H. J., Sasse, W. H. F., *J. Chem. Soc.* **1954,** pp. 4162–8.
(4C) Bourne, E. J., Stacey, M., others, *Ibid.*, **1954,** pp. 2006–12.
(5C) Cagniant, P., Cagniant, P., *Bull. soc. chim. France*, **1953,** pp. 713–25.
(6C) *Ibid.*, **1953,** pp. 921–3.
(7C) Campaigne, E. E., Archer, W. L., *J. Am. Chem. Soc.* **75,** 989–91 (1953).
(8C) Demerseman, P., Buu-Hoï, N. P., Royer, R., *J. Chem. Soc.*, **1954,** pp. 4193–7.
(9C) Gol'dfarb, Y. L., Korsakova, I. S., *Izvest. Akad. Nauk S.S.S.R., Otdel. Khim. Nauk* **1954,** pp. 564–9.
(10C) Goncalves, R., Brown, E. V., *J. Org. Chem.* **19,** 4–10 (1954).
(11C) Hirao, I., Mizunuma, K., Hayashi, M., *J. Pharm. Soc. Japan* **74,** 105–6 (1954).
(12C) Hurd, C. D., Oliver, G. L., *J. Am. Chem. Soc.* **76,** 50–1 (1954).
(13C) Kaye, I. A., Klein, H. C., Burlant, W. J., *Ibid.*, **75,** 745–6 (1953).
(14C) Mingoia, Q., Ferreira, P. C., *Anais fac. farm. e odontol univ. São Paulo* **11,** 9–16 (1953).
(15C) Nam, N. H., Buu-Hoï, N. P., Xuong, N. D., *J. Chem. Soc.*, **1954,** pp. 1690–6.
(16C) Parham, W. E., Traynelis, V. J., *J. Am. Chem. Soc.* **76,** 4960–2 (1954).
(17C) Rossiter, E. D., Saxton, J. E., *J. Chem. Soc.*, **1953,** pp. 3654–9.
(18C) Smith, G. F., *Ibid.*, **1954,** pp. 3842–6.
(19C) Speeter, M. E., Anthony, W. C., *J. Am. Chem. Soc.* **76,** 6208–10 (1954).
(20C) Sy, M., Buu-Hoï, N. P., Xuong, N. D., *J. Chem. Soc.*, **1954,** pp. 1975–8.
(21C) Thakor, V. M., Shah, R. C., *J. Indian Chem. Soc.* **31,** 597–9 (1954).
(22C) Treibs, A., Derra, R., *Ann.* **589,** 174–5 (1955).
(23C) Ukita, C., Watanabe, H., Miyazaki, M., *J. Am. Chem. Soc.* **76,** 4584–7 (1954).

Open-Chain Acylation (Aromatics, Gattermann-Koch-Hoesch)

(1D) Burtner, R. R., Brown, J. M., *J. Am. Chem. Soc.* **75,** 2334–40 (1953).
(2D) Davis, C. T., Geissman, T. A., *Ibid.*, **76,** 3507–11 (1954).
(3D) Dean, F. M., Evans, E., Robertson, A. *J. Chem. Soc.*, **1954,** pp. 4565–72.
(4D) Dijkstra, R., Backer, H. J., *Rec. trav. chim.* **73,** 695–703 (1954).
(5D) Iengar, R., Mehta, A. C., others, *J. Sci. Ind. Research (India)* **13B,** 166–74 (1954).
(6D) Ishii, Y., *J. Agr. Chem. Soc. Japan* **26,** 510–13 (1952).
(7D) Kuhn, R., Staab, H. A., *Chem. Ber.* **87,** 266–72 (1954).
(8D) Lele, S. S., Sethna, S., *J. Sci. Ind. Research, (India)* **14B,** 101–4 (1955).
(9D) Linnell, W. H., Mathieson, D. W., Modi, D. T., *J. Chem. Soc.*, **1953,** pp. 3257–61.
(10D) Mehta, A. C., Seshadri, T. R., Varadarajan, S., *Proc. Indian Acad. Sci.* **38A,** 381–6 (1953).
(11D) Moed, H. D., Asscher, M., U. S. Patent **2,683,743** (July 13, 1954).
(12D) Moed, H. D., Asscher, M., others, *Rec. trav. chim.* **71,** 933–44 (1952).
(13D) Murai, J., *Science Repts., Saitama Univ.* **1,** 23–6 (1952).
(14D) Robertson, A., Venkateswarlu, V., Whalley, W. B., *J. Chem. Soc.* **1954,** pp. 3137–42.
(15D) Semonský, M., Kuňák, J., Černý, A., *Chem. Listy* **47,** 1412 (1953).
(16D) Šorm, F., Benešová, V., others, *Ibid.*, **48,** 1823–36 (1954).
(17D) Whalley, W. B., *J. Chem. Soc.* **1953,** pp. 3366–71.
(18D) Yoder, L., Cheng, E. W.-K., Burroughs, W., *Proc. Iowa Acad. Sci.* **61,** 271–7 (1954).

Open-Chain Acylation (Pseudoaromatics, Gattermann-Koch-Hoesch)

(1E) Harvey, D. G., *J. Chem. Soc.* **1955,** p. 2536.
(2E) Kleinspehn, G. G., Corwin, A. H., *J. Am. Chem. Soc.* **76,** 5641–6 (1954).
(3E) Plieninger, H., *Chem. Ber.* **86,** 404–12 (1953).
(4E) Whalley, W. B., *J. Chem. Soc.* **1954,** pp. 1651–3.
(5E) *Ibid.*, **1953,** pp. 3479–83.

Open-Chain Acylation (Aromatics, Sulfonylation)

(1F) Field, L., Settlage, P. H., *J. Am. Chem. Soc.* **76,** 1222–5 (1954).
(2F) Leandri, G., Maioli, L., *Ann. chim.* **45,** 3–13 (1955).
(3F) Truce, W. E., Simms, J. A., Hill, H. E., *J. Am. Chem. Soc.* **75,** 5411–13 (1953).
(4F) Truce, W. E., Vriesen, C. W., *Ibid.*, **75,** 5032–6 (1953).

Ring-Closure Acylation (Aromatics)

(1G) Alder, K., Haydn, J., Krüger, B., *Chem. Ber.* **86,** 1372–80 (1953).
(2G) Allison, J. A. C., Braunholtz, J. T., Mann, F. G., *J. Chem. Soc.* **1954,** 403–8.
(3G) Amiel, Y., Löffler, A., Ginsburg, D., *J. Am. Chem. Soc.* **76,** 3625–8 (1954).
(4G) Anderson, A. G., Jr., Wang, S. Y., *J. Org. Chem.* **19,** 277–83 (1954).
(5G) Ansell, M. F., *J. Chem. Soc.* **1954,** 575–7.
(6G) Ansell, M. F., Berman, A. M., *Ibid.*, **1954,** 1792–5.
(7G) Askam, V., Linnell, W. H., *Ibid.*, **1954,** 2435–8.
(8G) Ayer, W. A., Humber, L. G., Taylor, W. I., *Ibid.*, **1954,** 3505–8.
(9G) Baddeley, G., Makar, S. M., Ivinson, M. G., *Ibid.*, **1953,** 3969–71.
(10G) Brunner, O., Hanke, P., *Monatsh.* **85,** 88–91 (1954).
(11G) Buchanan, C., Ritchie, A. C., *J. Chem. Soc.* **1954,** 4523–8.
(12G) Campbell, A. D., *Ibid.*, **1954,** 3659–69.
(13G) Campbell, N., Kidd, D., *Ibid.*, **1954,** 2154–5.
(14G) Carruthers, W., *Ibid.*, **1953,** 3486–9.
(15G) Chatterjea, J. N., *J. Indian Chem. Soc.* **31,** 101–7 (1954).
(16G) Clar, E., Kelly, W., *J. Am. Chem. Soc.* **76,** 3502–4 (1954).
(17G) Clar, E., Stewart, D. G., *Ibid.*, **76,** 3504–7 (1955).
(18G) Colonge, J., Sibeud, J., Boisdé, P., *Bull. soc. chim. France* **1953,** 767–70.
(19G) Corson, B. B., Dorsky, J., others, *J. Org. Chem.* **19,** 17–26 (1954).
(20G) Dann, O., Kokorudz, M., *Chem. Ber.* **86,** 1449–53 (1953).
(21G) Dannenberg, H., Dannenberg-von Dresler, D., *Z. Naturforsch.* **8b,** 165–73 (1953).
(22G) Dannenberg, H., Dannenberg-von Dresler, D., *Ann.* **585,** 1–15 (1954)
(23G) Dev, S., *Chemistry & Industry* **1954,** 1021.
(24G) Dev, S., *J. Indian Chem. Soc.* **30,** 789–800 (1953).
(25G) Dreiding, A. S., Tomasewski, A. J., *J. Am. Chem. Soc.* **76,** 540–5 (1954).
(26G) Dufraisse, C., Etiénne, A., Goffinet, B., *Compt. rend.* **235,** 1349–52 (1952).
(27G) Evans, R. F., Smith, J. C., *J. Chem. Soc.* **1954,** 798–800.
(28G) Evans, R. F., Smith, J. C., Strauss, F. B., *J. Inst. Petroleum* **40,** 7–13 (1954).
(29G) Fuson, R. C., Frey, S. E., *J. Org. Chem.* **19,** 810–16 (1954).
(30G) Fuson, R. C., Veazey, T. M., *J. Am. Chem. Soc.* **76,** 1169–70 (1954).
(31G) Gensler, W. J., Samour, C. M., Wang, S. Y., *Ibid.*, **76,** 315–16 (1954).
(32G) Ginsburg, D., *J. Chem. Soc.* **1954,** 2361–4.
(33G) Green, A. L., Hey, D. H., *Ibid.*, **1954,** 4306–18.
(34G) Gupta, S. C. S., Bhattacharjee, A., *J. Indian Chem. Soc.* **30,** 805–8 (1954).
(35G) Gupta, P. S., Bhattacharyya, B. K., *Ibid.* **31,** 337–45 (1954).
(36G) Gupta, S. C. S., Chatterjee, D. N., *Ibid.*, **31,** 11–16 (1954).
(37G) Gupta, R. C., Muthana, M. S., *J. Indian Inst. Sci.* **35A,** 259–62 (1953).
(38G) *Ibid.*, pp. 263–7.
(39G) *Ibid.*, pp. 307–9.
(40G) *Ibid.*, pp. 310–14.
(41G) *Ibid.*, **36A,** 125–7 (1954).
(42G) Horii, Z., Tamura, Y., others, *J. Pharm. Soc. Japan* **74,** 150–3 (1954).
(43G) Horning, E. C., Walker, G. N., *J. Am. Chem. Soc.* **76,** 1700–2 (1954).
(44G) Horton, W. J., Johnson, H. W., Zollinger, J. L., *Ibid.*, **76,** 4587–9 (1954).
(45G) Huisgen, R., Rapp, W., others, *Ann.* **586,** 52–69 (1954).

(46G) Hurd, C. D., Hayao, S., *J. Am. Chem. Soc.* **76**, 5065–9 (1954).
(47G) Ivanov, C., Mladénova-Orlinova, L., *Compt. rend. acad. bulgare sci.* **6**, 33–6 (1953).
(48G) Jocelyn, P. C., *J. Chem. Soc.* **1954**, 1640–2.
(49G) Johnson, G. D., *Org. Syntheses* **33**, 90–2 (1953).
(50G) Johnson, W. S., Christiansen, R. G., U. S. Patent **2,663,716** (Dec. 22, 1953).
(51G) Johnston, W. T. G., Smith, J. C., Staveley, C. M., *Chemistry & Industry*, **1954**, p. 607.
(52G) Kimoto, S., Kimura, K., Muramatsu, S., *J. Pharm. Soc. Japan* **74**, 358–60 (1954).
(53G) Koelsch, C. F., DeNet, R. W., *J. Am. Chem. Soc.* **75**, 3271–2 (1953).
(54G) Kornfeld, E. C., U. S. Patent **2,663,714** (Dec. 22, 1953).
(55G) Kubba, V. P., Vig, O. P., Mukherji, S. M., *Current Sci. (India)* **23**, 158–9 (1954).
(56G) Lindahl, R. G., *Ann. Acad. Sci. Fennicae* **48**, 7–60 (1953).
(57G) Linnell, W. H., Mathieson, D. W., Modi, D. T., *J. Chem. Soc.* **1953**, 3257–61.
(58G) Lloyd, H. A., Horning, E. C., *J. Am. Chem. Soc.* **76**, 3651–3 (1954).
(59G) Loudon, J. D., Razdan, R. K., *J. Chem. Soc.* **1954**, 4299–4303.
(60G) Merck and Company, Inc., Brit. Patent **702,012** (Jan. 6, 1954).
(61G) Mosby, W. L., *J. Am. Chem. Soc.* **76**, 936–7 (1954).
(62G) Mosby, W. L., *J. Org. Chem.* **19**, 294–304 (1954).
(63G) Mukherji, S. M., Vig, O. P., others, *J. Org. Chem.* **18**, 1499–1505 (1953).
(64G) Novák, L., Protiva, M., *Chem. Listy* **48**, 70–6 (1953).
(65G) Patton, J. W., Daub, G. H., *J. Am. Chem. Soc.* **76**, 1954–5 (1954).
(66G) Phillips, D. D., McWhorter, E. J., *Ibid.*, **76**, 4948–50 (1954).
(67G) Ramirez, F., Kirby, A. F., *Ibid.*, **75**, 6026–30 (1953).
(68G) Saha, N. N., Bagchi, P., *Chemistry & Industry* **1954**, 1537–8.
(69G) Sato, K., Miyamoto, O., *J. Chem. Soc. Japan* **75**, 225–7 (1954).
(70G) Schubert, W. M., Sweeney, W. A., Latourette, H. K., *J. Am. Chem. Soc.* **76**, 5462–6 (1954).
(71G) Šorm, F., Benešová, V., others, *Chem. Listy* **48**, 1823–36 (1954).
(72G) Stevens, W. H., Crowder, D. A., *Can. J. Chem.* **32**, 792–801 (1954).
(73G) Tatevosyan, G. T., Vardanyan, A. G., *Zhur. Obshcheĭ Khim.* **24**, 1845–51 (1954).
(74G) Truce, W. E., Toren, G. A., *J. Am. Chem. Soc.* **76**, 695–8 (1954).
(75G) Turner, D. L., *Ibid.*, **76**, 5175–6 (1954).
(76G) Uhlig, F., *Angew. Chem.* **66**, 435–6 (1954).
(77G) Urban, R. S., Beavers, E. M., *J. Am. Chem. Soc.* **76**, 3042–3 (1954).
(78G) Vaillant, M., *Ann. chim.* **9**, 5–49 (1954).
(79G) Vaillant, M., *Compt. rend.* **234**, 534–6 (1952).
(80G) Vig, O. P., Maheshwary, N. K., Mukherji, S. M., *Research Bull. East Punjab Univ.* **34**, 107–15 (1953).
(81G) Vig, O. P., Sandhu, S. S., *Science and Culture (India)* **19**, 311–12 (1953).
(82G) Walker, G. N., *J. Am. Chem. Soc.* **75**, 4108–9 (1953).
(83G) Wawzonek, S., Kozikowski, J., *Ibid.*, **76**, 1641–3 (1954).
(84G) Winternitz, F., Mousseron, M., Rouzier, G., *Bull. soc. chim. France* **1954**, 316–20.
(85G) Woodward, R. B., Inhoffen, H. H., others, *Chem. Ber.* **86**, 594–600 (1953).
(86G) Yamaguchi, K., Shoji, H., *J. Pharm. Soc. Japan* **74**, 20–2 (1954).

Ring-Closure Acylation (Pseudoaromatics)

(1H) Cagniant, P., Cagniant, P., *Bull. soc. chim. France* **1953**, 713–25.
(2H) *Ibid.*, pp. 921–3.
(3H) Treibs, W., Heyer, W., *Chem. Ber.* **87**, 1197–1200 (1954).

Ring-Closure Acylation (Aromatics, Gattermann-Koch-Hoesch)

(1i) Allison, J. A. C., Braunholtz, J. T., Mann, F. G., *J. Chem. Soc.* **1954**, 403–8.
(2i) Braunholtz, J. T., Mann, F. G., *Ibid.*, **1954**, 651–8.
(3i) Dokunikhin, N. S., Gaeva, L. A., *Zhur. Obshcheĭ Khim.* **24**, 1871–3 (1954).
(4i) Johnson, W. S., DeAcetis, W., *J. Am. Chem. Soc.* **75**, 2766–8 (1953).

Ring-Closure Acylation (Aromatics, Sulfonylation)

(1J) Truce, W. E., Toren, G. A., *J. Am. Chem. Soc.* **76**, 695–8 (1954).

Ring-Closure Acylation (Complex)

(1K) Buu-Hoï, N. P., Jacquignon, P., *J. Chem. Soc.* **1954**, 513–15.
(2K) Dokunikhin, N. S., Gaeva, L. A., *Zhur. Obshcheĭ Khim.* **24**, 1871–3 (1954).
(3K) Huls, R., *Bull. soc. roy. sci. Liege* **23**, 31–40 (1954).
(4K) Kuroda, C., *Proc. Imp. Acad. (Tokyo)* **20**, 20–2 (1944).
(5K) Mosby, W. L., *J. Org. Chem.* **19**, 294–304 (1954).
(6K) Pankajamani, K. S., Seshadri, T. R., *J. Sci. Ind. Research* **13B**, 396–400 (1954).
(7K) Schubert, W. M., Sweeney, W. A., Latourette, H. K., *J. Am. Chem. Soc.* **76**, 5462–6 (1954).
(8K) Winternitz, F., Mousseron, M., Rouzier, G., *Bull. soc. chim. France* **1954**, 316–20.

Fries Rearrangement

(1L) Aleykutty, A. A., Baliah, V., *Current Sci. (India)* **22**, 307–8 (1953).
(2L) Amin, J. H., Desai, R. D., *J. Sci. Ind. Research (India)* **13B**, 178–80 (1954).
(3L) Amin, J. H., Desai, R. D., Parekh, K., *Ibid.*, **13B**, 181–3 (1954).
(4L) Arakawa, K., *Pharm. Bull. (Japan)* **1**, 331–4 (1953).
(5L) Bhavsar, M. D., Desai, R. D., *J. Indian Chem. Soc.* **31**, 167–9 (1954).
(6L) Bradsher, C. K., Brown, F. C., Porter, H. K., *J. Am. Chem. Soc.* **76**, 2357–62 (1954).
(7L) Buu-Hoï, N. P., Xuong, N. D., Thang, K. v., *Rec. trav. chim.* **72**, 774–80 (1953).
(8L) Chaughuley, A. S. U., Amin, G. C., *Science and Culture (India)* **19**, 614 (1954).
(9L) Chen, F.-C., Chang, C. T., *J. Chinese Chem. Soc.* **1**, 156–8 (1954).
(10L) Chen, F.-C., Chang, K. T., *J. Taiwan Pharm. Assoc.* **4**, 38–41 (1952).
(11L) Chen, F.-C., Tsai, T. H., *Ibid.*, **4**, 42–4 (1952).
(12L) Cullinane, N. M., Lloyd, E. T., Tudball, J. K., *J. Chem. Soc.* **1954**, 3894–5.
(13L) Dean, F. M., Evans, E., Robertson, A., *J. Chem. Soc.* **1954**, 4565–72.
(14L) Franklin, C. S., Morris, D. S., Smith, S. D., *J. Chem. Soc.* **1954**, 1683–6.
(15L) Futaki, K., *J. Pharm. Soc. Japan* **74**, 154–6 (1954).
(16L) Gardner, D., Grove, J. F., Ismay, D., *J. Chem. Soc.* **1954**, 1817–19.
(17L) Gerecs, Á., *Magyar Tudomânyos Akad. Kem Tudomânyok Osztályánoh Közlemenyei* **3**, 77–82 (1953).
(18L) Gerecs, Á., Széll, T. Windholz, M., *Acta Chim. Acad., Sci. Hung.* **3**, 459–67 (1953).
(19L) Gerecs, Á., Windholz, M., Sipos, G., *Ibid.*, **4**, 123–7 (1954).
(20L) Gilman, H., Cook, T. H., others, *J. Am. Chem. Soc.* **76**, 5783–6 (1954).
(21L) Gupta, A. R., Saharia, G. S., *J. Sci. Ind. Research (India)* **13B**, 763–4 (1954).
(22L) Hauptmann, H., Rothschild, H., *Anais assoc. quim. Brasil.* **10**, 254–70 (1951).
(23L) Huls, R., *Bull. classe sci. Acad. roy. Belg.* **39**, 1064–77 (1953).
(24L) Joshi, G. G., Shah, N. M., *J. Indian Chem. Soc.* **31**, 220–2 (1954).
(25L) *Ibid.*, **31**, 223–30 (1954).
(26L) *Ibid.*, **31**, 325–6 (1954).
(27L) Joshi, S. S., Singh, H., *J. Am. Chem. Soc.* **76**, 4993–4 (1954).
(28L) Kindler, K., Oelschläger, H., *Chem. Ber.* **87**, 194–202 (1954).
(29L) Kinsley, D. A., Plant, S. G. P., *J. Chem. Soc.* **1954**, 1341–3.
(30L) Klamann, D., *Ann.* **583**, 63–80 (1953).
(31L) Loudon, J. D., Razdan, R. K., *J. Chem. Soc.* **1954**, 4299–4303.
(32L) MacGregor, I. R., Neblett, R. F., Cook, C. H., *J. Org. Chem.* **19**, 626–30 (1954).
(33L) Marathey, M. G., Athavale, J. M., *J. Univ. Poona, Science and Technol.* **1953**, pp. 90–3.
(34L) Marvell, E. N., Logan, A. V., others, *J. Am. Chem. Soc.* **76**, 1922–6 (1954).
(35L) Nagano, T., Matsumura, K., *J. Am. Chem. Soc.* **75**, 6237–8 (1953).
(36L) Nakazawa, K., Matsuura, S., Baba, S., *J. Pharm. Soc. Japan* **74**, 498–501 (1954).
(37L) Nakazawa, K., Tsubouchi, S., *Ibid.*, **74**, 1254–5 (1954).
(38L) Parikh, R. J., Thakor, V. M., *J. Indian Chem. Soc.* **31**, 137–40 (1954).
(39L) Ramage, G. R., Stead, C. V., *J. Chem. Soc.* **1953**, 3602–6.
(40L) Reynolds, D. D., Cathcart, J. A., Williams, J. L. R., *J. Org. Chem.* **18**, 1709–15 (1953).
(41L) Rosenblatt, D. H., Epstein, J., Levitch, M., *J. Am. Chem. Soc.* **75**, 3277–8 (1953).

(42L) Saharia, G. S., *J. Sci. Ind. Research (India)* **13B**, 544–6 (1954).
(43L) Sen, A. B., Bhattacharji, S., *J. Indian Chem. Soc.* **31**, 581–2 (1954).
(44L) Sen, A. B., Parmar, S. S., *Ibid.*, **30**, 720–2 (1953).
(45L) Setalvad, J. I., Shah N. M., *Ibid.*, **30**, 373–8 (1953).
(46L) Shah, D. N., Shah, N. M., *J. Org. Chem.* **19**, 1681–5 (1954).
(47L) Thakor, V. M., Shah, R. C., *J. Indian Chem. Soc.* **31**, 597–9 (1954).
(48L) Tiwari, S. S., Tewar, B. N., *Ibid.*, **31**, 79–82 (1954).
(49L) Treibs, W., Falk, F., *Chem. Ber.* **87**, 345–9 (1954).
(50L) Vereš, K., Horák, V., *Chem. Listy* **48**, 1644–7 (1954).
(51L) Williams, J. L. R., *J. Am. Chem. Soc.* **74**, 6132–3 (1952).

Olefin Acylation

(1M) Belov, V. N., Rudol'fi, T. A., *Sbornik Stateĭ Obshcheĭ Khim., Akad. Nauk S.S.S.R.* **1**, 266–74 (1953).
(2M) Bergmann, F., Klein, J., *J. Am. Chem. Soc.* **75**, 4078 (1953).
(3M) Bullock, M. W., Brockman, J. A., Jr., others, *Ibid.*, **76**, 1828–32 (1954).
(4M) Burton, H., Praill, P. F. G., *Chemistry & Industry* **1954**, p. 75.
(5M) Cauquil, G., Barrera, H., Barrera, R., *Bull. soc. chim. France* **1953**, 1111–16.
(6M) Chipman, H. R., U. S. Patent **2,690,439** (Sept. 28, 1954).
(7M) Dermer, O. C., Simpson, D., *Proc. Oklahoma Acad. Sci.* **34**, 160–2 (1953).
(8M) Ginsburg, D., *J. Chem. Soc.* **1954**, 2361–4.
(9M) Gunstone, F. D., Tulloch, A. P., *J. Appl. Chem.* **4**, 291–6 (1954).
(10M) Henecka, H., *Ann.*, **583**, 110–28 (1953).
(11M) Henne, A. L., Tedder, J. M., *J. Chem. Soc.* **1953**, 3628–30.
(12M) Hills, P. R., McQuillin, F. J., *Ibid.*, **1953**, 406–5.
(13M) Kosuge, T., Okeda, H., others, *J. Pharm. Soc. Japan* **74**, 819–20 (1954).
(14M) Mathieson, D. W., *J. Chem. Soc.* **1953**, 3248–51.
(15M) *Ibid.*, pp. 3251–7.
(16M) Reed, L. J., Niu, C.-I., *J. Am. Chem. Soc.* **77**, 416–19 (1955).
(17M) Rosenmund, K. W., Herzberg, H., *Chem. Ber.* **87**, 1575–81 (1954).
(18M) Sondheimer, F., Woodward, R. B., *J. Am. Chem. Soc.* **75**, 5438–9 (1953).
(19M) Soper, Q. F., Buting, W. E., others, *Ibid.*, **76**, 4109–12 (1954).
(20M) Wichterle, O., Vogel, J., *Chem. Listy* **48**, 1225–31.

Open-Chain Alkylation (Aromatics)

(1N) Abdurasuleva, A. R., *Doklady Akad. Nauk Uzbek. S.S.R.* **11**, 26–8 (1953).
(2N) Albert, H. E., *J. Am. Chem. Soc.* **76**, 4983–5 (1954).
(3N) Bader, A. R., *Ibid.*, **75**, 5967–9 (1953).
(4N) Bartlett, P. D., Roha, M., Stiles, R. M., *Ibid.*, **76**, 2349–53 (1954).
(5N) Brintzinger, H., Ellwanger, H., *Chem. Ber.* **87**, 300–14 (1954).
(6N) Brown, H. C., Grayson, M., *Ibid.*, **75**, 6285–92 (1953).
(7N) Bryner, F., U. S. Patent **2,655,547** (Oct. 13, 1953).
(8N) Buhler, D. R., Wang, C. H., Christensen, B. E., *J. Am. Chem. Soc.* **75**, 4336 (1953).
(9N) Burtner, R. R., *Ibid.*, **75**, 2334–40 (1953).
(10N) Buu-Hoï, N. P., Eckert, B., Demerseman, P., *J. Org. Chem.* **19**, 726–32 (1954).
(11N) Carpenter, A. T., Hunter, R. F., *J. Chem. Soc.* **1954**, 2731–5.
(12N) Carpenter, M. S., Easter, W. M., *J. Org. Chem.* **19**, 87–102 (1954).
(13N) Cauquil, G., Barrera, H., Barrera, R., *Bull. soc. chim. France* **1953**, 1111–16.
(14N) Clar, E., Stewart, D. G., Brit. Patent **718,711** (Nov. 17, 1954).
(15N) Clar, E., Stewart, D. G., *J. Am. Chem. Soc.* **76**, 3504–7 (1955).
(16N) Cook, C. D., Woodworth, R. C., *J. Am. Chem. Soc.* **75**, 6242–4 (1953.)
(17N) Corson B. B., Dorsky, J., others, *J. Org. Chem.* **19**, 17–26 (1954).
(18N) Crawford, H. M., Glesmann, M. C., *J. Am. Chem. Soc.* **76**, 1108–9 (1954).
(19N) Cross, J. M., Chiddix, M. E., U. S. Patent **2,694,727** (Nov. 16, 1954).
(20N) Dixon, J. K., Saunders, K. W., IND. ENG. CHEM. **46**, 652–60 (1954).
(21N) Dobryanskiĭ, A. F., Kornilova, Y. I., *Sbornik Stateĭ Obshcheĭ Khim., Akad. Nauk S.S.S.R.* **1**, 315–19 (1953).
(22N) Emr, A., *Chem. Listy* **48**, 279–80 (1954).
(23N) Finn, S. R., James, J. W., Standen, C. J. S., *J. Appl. Chem.* **4**, 296–300 (1954).
(24N) Fuson, R. C., Mange, F. E., *J. Org. Chem.* **19**, 806–9 (1954).
(25N) Gardner, P. D., *J. Am. Chem. Soc.* **76**, 4550–2 (1954).
(26N) Gray, G. W., Jones, B., *J. Chem. Soc.* **1954**, 678–83.
(27N) Gupta, P. S., Bhattacharyya, B. K., *J. Indian Chem. Soc.* **31**, 337–45 (1954).
(28N) Hart, H., Cassis, F. A., *J. Am. Chem. Soc.* **76**, 1634–9 (1954).
(29N) Hart, H., Spliethoff, W. L., Eleuterio, H. S., *Ibid.*, **76**, 4547–50 (1954).
(30N) Henkel and Cie. G. m. b. H., Ger. Patent, **816,855** (Oct. 15, 1951).
(31N) Hirschmann, R. F., Miller, R., Wendler, N. L., *J. Am. Chem. Soc.* **76**, 4592–4 (1954).
(32N) Ipatieff, V. N., Germain, J. E., Pines, H., *Ibid.*, **75**, 6056–7 (1953).
(33N) Isler, O., Doebel, K., *Helv. Chim. Acta* **37**, 225–33 (1954).
(34N) Jílek, J. O., Šimák, V., Protiva, M., *Chem. Listy* **47**, 874–80 (1953).
(35N) Jönsson, Å., *Acta Chem. Scand.* **8**, 1203–10 (1954).
(36N) Kaye, I. A., Klein, H. C., Burlant, W. J., *J. Am. Chem. Soc.* **75**, 745–6 (1953).
(37N) King, J., Ramage, G. R., *J. Chem. Soc.* **1954**, 936–8.
(38N) Koike, E., Okawa, M., *J. Chem. Soc. Japan* **74**, 971–4 (1953).
(39N) *Ibid.*, **75**, 83–6 (1954).
(40N) Komatsu, S., Japan. Patent **1282** (March 11, 1954).
(41N) Kosolapoff, G. M., *J. Am. Chem. Soc.* **76**, 3222 (1954).
(42N) Krimmel, C. P., Thielen, L. E., others, *Org. Syntheses* **33**, 98–100 (1953).
(43N) Kubba, V. P., Vig, O. P., Mukherji, S. M., *Current Sci. (India)* **23**, 158–9 (1954).
(44N) Kundiger, D. G., Ovist, E. B. W., *J. Am. Chem. Soc.* **76**, 2501–2 (1954).
(45N) Lagidze, R. M., Potskhverashvili, B. S., *Soobshcheniya Akad. Nauk Gruzinskoĭ S.S.R.* **14**, 473–80 (1953).
(46N) Lakhumna, I. C., Gaind, V. S., Mukherji, S. M., *Current Sci. (India)* **23**, 159–60 (1954).
(47N) Lenneman, W. L., Hites, R. D., Komarewsky, V. I., *J. Org. Chem.* **19**, 463–8 (1954).
(48N) Losev, I. P., Smirnova, O. V., Ryadneva, L. P., *Sbornik Stateĭ Obshcheĭ Khim. Akad. Nauk S.S.S.R.* **1**, 548–51 (1953).
(49N) Maki, R., Ishida, Y., others, *J. Chem. Soc. Japan* **57**, 42–4 (1954).
(50N) Mamedaliev, Y. G., Veliev, S. V., *Doklady Akad. Nauk S.S.S.R.* **92**, 325–8 (1953).
(51N) *Ibid.*, **96**, 531–3 (1954).
(52N) Matti, J., Perrier, M., *Bull. soc. chim. France* **1955**, 525–30.
(53N) Moore, R. F., Waters, W. A., *J. Chem. Soc.* **1954**, 243–6.
(54N) Mosby, W. L., *J. Org. Chem.* **19**, 294–304 (1954).
(55N) Mukherji, S. M., Gaind, V. S., Rao, P. N., *J. Org. Chem.* **19**, 328–32 (1954).
(56N) Mukherji, S. M., Vig, O. P., others, *Ibid.*, **18**, 1499–1505 (1953).
(57N) Nightingale, D. V., Shackelford, J. M., *J. Am. Chem. Soc.* **76**, 5767–70 (1954).
(58N) Oláh, G., Pavláth, A., *Acta Chim. Acad. Sci. Hung.* **3**, 425–9 (1953).
(59N) Petrova, A. M., *Zhur. Obshcheĭ Khim.* **24**, 491–3 (1954).
(60N) Petrov, A. D., Mironov, V. F., others, *Doklady Akad. Nauk S.S.S.R.* **97**, 687–90 (1954).
(61N) Phillips, D. D., McWhorter, E. J., *J. Am. Chem. Soc.* **76**, 4948–50 (1954).
(62N) Pochwalski, J., Zowall, H., *Roczniki Chem.* **28**, 29–37 (1954).
(63N) Pokrovskaya, E. S., Stepantseva, T. G., *Trudy Inst. Nefti, Akad. Nauk S.S.S.R.* **1**, 300–5 (1950).
(64N) Rabjohn, N., Fronabarger, J. W., Linstromberg, W. W., *J. Org. Chem.* **20**, 271–3 (1955).
(65N) Rodionov, V. M., Belov, V. N., Kore, S. A., *Zhur. Obshcheĭ Khim.* **23**, 1802–8 (1953).
(66N) Romadane, I., Rodiņš, E., *Latvijas PSR Zinātnu Akad. Vēstis*, **1954**, 115–18.
(67N) Sanford, R. A., Kovach, S. M., Friedman, B. S., *J. Am. Chem. Soc.* **75**, 6326–7 (1953).
(68N) Schlatter, M. J., *Ibid.*, **76**, 4952–7 (1954).
(69N) Schmerling, L., West, J. P., *Ibid.*, **75**, 6216–17 (1953).
(70N) Searles, S., *Ibid.*, **76**, 2313–14 (1954).
(71N) Shirley, D. A., Zietz, J. R., Jr., *Ibid.*, **75**, 6333–4 (1953).
(72N) Shishido, K., Nozaki, H., others, *J. Org. Chem.* **19**, 1699–1703 (1954).
(73N) Sidorova, N. G., *Zhur. Obshcheĭ Khim.* **24**, 255–9 (1954).
(74N) Somers, B. G., Cook, C. D., *J. Chem. Educ.* **32**, 312–13 (1955).
(75N) Sprengling, G. R., *J. Am. Chem. Soc.* **76**, 1190–3 (1954).
(76N) Torf, S. F., Khromov-Borisov, N. V., *Zhur. Obshcheĭ Khim.* **24**, 1674–84 (1954).

(77N) Truce, W. E., Hoerger, F. D., *J. Am. Chem. Soc.* **76**, 5357–60 (1954).
(78N) Truce, W. E., Simms, J. A., Hill, H. E., *Ibid.,* **75**, 5411–13 (1953).
(79N) Vaĭser, V. L., Polikarpova, A. M., *Doklady Akad. Nauk S.S.S.R.* **97**, 671–3 (1954).
(80N) Vig, O. P., Maheshwary, N. K., Mukherji, S. M., *Research Bull. East Punjab Univ.* **34**, 107–15 (1953).
(81N) Vig, O. P., Sandhu, S. S., *Science and Culture (India)* **19**, 311–12 (1953).
(82N) Weiler, J. F., U. S. Patent **2,697,123** (Dec. 14, 1954).
(83N) Westfahl, J. C., Gresham, T. L., *J. Am. Chem. Soc.* **76**, 1074–6 (1954).
(84N) Winternitz, F., Mousseron, M., Rouzier, G., *Bull. soc. chim. France* **1954**, 316–20.
(85N) Zagorodniĭ, S. V., *Doklady, Akad. Nauk S.S.S.R.* **97**, 257–9 (1954).
(86N) Zagorodniĭ, S. V., Faustova E. M., *Zhur. Obshcheĭ Khim.* **23**, 1651–4 (1953).
(87N) Zagorodniĭ, S. V., Gostev, M. M., *Ibid.*, **24**, 2002–6 (1954).
(88N) Zaheer, S. H., Singh, B., others, *J. Chem. Soc.* **1954**, 3360–2.

Dealkylation, Disproportionation, and Isomerization

(1P) Carpenter, A. T., Hunter, R. F., *J. Chem. Soc.* **1954**, pp. 2731–5.
(2P) Bartlett, P. D., Roha, M., Stiles, R. M., *J. Am. Chem. Soc.* **76**, 2349–53(1954).
(3P) Burtner, R. R., *Ibid.*, **75**, 2334–40 (1953).
(4P) Dobryanskiĭ, A. F., Gavrilov, B. G., *Uchenye Zapiski Leningrad. Gasudarst. Univ. A. A. Zhdanova, Ser. Khim. Nauk* **11**, 261–9 (1952).
(5P) Gavrilov, B. G., Mal'tseva, N. A., *Ibid.*, **13**, 203–9 (1953).
(6P) Gavrilov, B. G., Pushnoĭ, S. K., *Ibid.*, **13**, 210–19 (1953).
(7P) Gavrilov, B. G., Zhgun, O. I., *Ibid.*, **12**, 177–85 (1952).
(8P) Hanai, S., Morikawa, N., Kogo, H., *J. Coll. Arts Sci. Chiba Univ.* **1**, 156–9 (1954).
(9P) Hoatson, J. R., Rosenwald, R. H., U. S. Patent **2,676, 191** (April 20, 1954).
(10P) Kinney, R. E., Hamilton, L. A., *J. Am. Chem. Soc.* **76**, 786–7 (1954).
(11P) Kulka, M., *Ibid.*, **76**, 5469–71 (1954).
(12P) Lien, A. P., McCaulay, D. A., Brit. Patent *713,247* (Aug. 11, 1954).
(13P) Lien, A. P., McCaulay, D. A., U. S. Patent **2,662,926** (Dec. 15, 1953).
(14P) McCaulay, D. A., Lien, A. P., *Ibid.*, **2,683,758** (July 13, 1954).
(15P) *Ibid.*, **2,683,759.**
(16P) *Ibid.*, **2,683,760.**
(17P) *Ibid.*, **2,683,761.**
(18P) *Ibid.*, **2,683,762.**
(19P) *Ibid.*, **2,700,689** (Jan. 25, 1955).
(20P) McCaulay, D. A., Lien, A. P., Launer, P. J., *J. Am. Chem. Soc.* **76**, 2354–7 (1954).
(21P) Nightingale, D. V., Hucker, H. B., *J. Org. Chem.* **18**, 1529–37 (1953).
(22P) Nightingale, D. V., Shackelford, J. M., *J. Am. Chem. Soc.* **76**, 5767–70 (1954).
(23P) Pearson, D. E., Bruton, J. D., *J. Org. Chem.* **19**, 957–63 (1954).
(24P) Pigman, I., Del Bel, E., Nevworth, M. B., *J. Am. Chem. Soc.* **76**, 6169–71 (1954).
(25P) Schlatter, M. J., *Ibid.*, **76**, 4952–7 (1954).

Open-Chain Alkylation (Pseudoaromatic)

(1Q) Gol'dfarb, Y. L., Korsakova, I. S., *Doklady Akad. Nauk S.S.S.R.* **96**, 283–6 (1954).
(2Q) Gol'dfarb Y. L., Korsakova, I. S., *Izvest. Akad. Nauk S.S.S.R., Otdel. Khim. Nauk* **1954**, 564–9.
(3Q) Hurd, C. D., Oliver, G. L., *J. Am. Chem. Soc.* **76**, 50–1 (1954).
(4Q) Kaye, I. A., Klein, H. C., Burlant, W. J., *Ibid.*, **75**, 745–6 (1953).
(5Q) Sy, M., Buu-Hoï, N. P., Xuong, N. D., *J. Chem. Soc.* **1954**, 1975–8.
(6Q) Treibs, A., Michl, K. H., *Ann.* **589**, 163–73 (1954).
(7Q) Wagner, C. R., U. S. Patent **2,689,-855** (Sept. 21, 1954).
(8Q) Westfahl, J. C., Gresham, T. L., *J. Am. Chem. Soc.* **76**, 1074–6 (1954).

Open-Chain Pseudoalkylation (Aromatics)

(1R) Akashi, H., Hanabusa, S., Oda, R., *J. Chem. Soc. Japan* **56**, 970–1 (1953).
(2R) Brintzinger, H., Ellwanger, H., *Chem. Ber.* **87**, 300–14 (1954).
(3R) Brintzinger, H., Langheck, M., *Ibid.*, **86**, 557–63 (1953).
(4R) Brintzinger, H., Langheck, M., Ellwanger, H., *Ibid.*, **87**, 320–4 (1954).
(5R) Leandri, G., Maioli, L., *Ann. chim.* **45**, 3–13 (1955).
(6R) Kharasch, N., Swidler, R., *J. Org. Chem.* **19**, 1704–7 (1954).
(7R) Kosolapoff, G. M., *J. Am. Chem. Soc.* **76**, 3222 (1954).

Ring-Closure Alkylation (Aromatics)

(1S) Abramovitch, R. A., Hey, D. H., *J. Chem. Soc.* **1954**, 1697–1703.
(2S) Baddeley, G., Makar, S. M., Ivinson, M. G., *Ibid.*, **1953**, 3969–71.
(3S) Bradsher, C. K., Jackson, W. J., Jr., *J. Am. Chem. Soc.* **76**, 4140–3 (1954).
(4S) Campbell, A. D., *Ibid.*, **1954**, 3659–69.
(5S) Cavill, G. W. K., Dean, F. M., others, *J. Chem. Soc.* **1954**, 4573–81.
(6S) Clar, E., Kelly, W., Wright, J. W., *Ibid.*, **1954**, 1108–11.
(7S) Cologne, J., Arsac, A., *Bull. soc. chim. France* **1954**, 445–8.
(8S) Cook, J. W., Gailey, R. M., Loudon, J. D., *J. Chem. Soc.* **1954** 568–9.
(9S) Dufraisse, C., Etiénne, A., Goffinet, B., *Compt. rend.* **235**, 1349–52 (1952).
(10S) Faseeh, S. A., *J. Chem. Soc.* **1953**, p. 3708.
(11S) Hart, E. P., *Ibid.*, **1954**, 4030–1.
(12S) Koike, E., Okawa, M., Kaneko, T., *J. Chem. Soc. Japan* **55**, 535–8 (1952).
(13S) Kubba, V. P., Vig, O. P., Mukherji, S. M., *Current Sci. (India)* **23**, 158–9 (1954).
(14S) Lakhumna, I. C., Gaind, V. S., Mukherji, S. M., *Ibid.*, **23**, 159–60 (1954).
(15S) Maitte, P., *Ann. chim.* **9**, 431–75 (1954).
(16S) Mukherji, S. M., Gaind, V. S., Rao, P. N., *J. Org. Chem.* **19**, 328–32 (1954).
(17S) Scheuer, P. J., Kimoto, W. I., Ohinata, K., *J. Am. Chem. Soc.* **75**, 3029–30 (1953).
(18S) Vig, O. P., Maheshwary, N. K., Mukherji, S. M., *Research Bull. East Punjab Univ.* **34**, 107–15 (1953).
(19S) Vig, O. P., Sandhu, S. S., *Science and Culture (India)* **19**, 311–12 (1953).

Ring-Closure Alkylation (Pseudoaromatics)

(1T) Hart, E. P., *J. Chem. Soc.* **1954**, 4030–1.

Ring-Closure Alkylation (Complex)

(1U) Archer, S., Jackman, M., *Chemistry & Industry* **1954**, 784–5.
(2U) Assony, S. J., Kharasch, N., *Ibid.*, **1954**, 1388.
(3U) Bader, A. R., *J. Am. Chem. Soc.* **75**, 5967–9 (1953).
(4U) Bergstrom, F. W., Furst, A., *Ibid.*, **75**, 5415–16 (1953).
(5U) Berner, E., Gramstad, T., Vister, T., *Acta Chem. Scand.* **7**, 1255–60 (1953).
(6U) Bradsher, C. K., Beavers, D. J., Little, E. D., *J. Am. Chem. Soc.* **76**, 948 (1954).
(7U) Byatnal, V. N., Desai, R. D., Maraballi, M. S., *J. Indian Chem. Soc.* **29**, 443–6 (1952).
(8U) Campbell, A. D., *J. Chem. Soc.* **1954**, pp. 3659–69.
(9U) Clar, E., Kelly, W., *J. Am. Chem. Soc.* **76**, 3502–4 (1954).
(10U) Corson, B. B., Dorsky, J., others, *J. Org. Chem.* **19**, 17–26 (1954).
(11U) Dean, F. M., Evans, E., Robertson, A., *J. Chem. Soc.* **1954**, pp. 4565–72.
(12U) Demerseman, P., Buu-Hoï, N. P., Royer, R., *Ibid.*, **1954**, pp. 4193–7.
(13U) Evans, R. F., Smith, J. C., *Ibid.*, **1954**, pp. 798–800.
(14U) Iguchi, S., Utsugi, N., *J. Pharm. Soc. Japan* **73**, 1290–4 (1953).
(15U) Koelsch, C. F., Masley, P. T., *J. Am. Chem. Soc.* **75**, 3596 (1953).
(16U) Lagidze, R. M. Potskhverashvili, B. S., *Soobshcheniya Akad. Nauk Gruzinskoĭ S.S.R.* **14**, 473–80 (1953).
(17U) Losev, I. P., Smirnova, O. V., Ryadneva, L. P., *Sbornik Stateĭ Obshcheĭ Khim., Akad. Nauk S.S.S.R.* **1**, 548–51 (1953).
(18U) Loudon, J. D., Razdan, R. K., *J. Chem. Soc.* **1954**, pp. 4299–4303.
(19U) Pandit, P. N., Tilak, B. D., Venkataraman, K., *Proc. Indian Acad. Sci.* **38A**, 355–60 (1953).
(20U) Quelet, R., *Bull. soc. chim. France* **1953**, pp. C46-8.
(21U) Richter, H. J., *Org. Syntheses* **33**, 37–9 (1953).
(22U) Shah, D. N., Shah, N. M., *J. Org. Chem.* **19**, 1681–5 (1954).
(23U) Tatsuta, H., Ochii, Y., *J. Chem. Soc. Japan* **75**, 719 (1954).

(24U) Usgaonkar, R. N., Thakor, V. M., and Jadhav, G. V., *J. Indian Chem. Soc.* **30**, 535–8 (1953).
(25U) Vig, O. P., Maheshwary, N. K., Mukherji, S. M., *Research Bull. East Punjab Univ.* **34**, 107–15 (1953).

Baeyer-Type Condensations

(1V) Bradsher, C. K., Jackson, W. J., Jr., *J. Am. Chem. Soc.* **76**, 734–8 (1954).
(2V) *Ibid.*, pp. 4140–3.
(3V) Buu-Hoï, N. P., Xuong, N. D., Lavit, D., *J. Org. Chem.* **19**, 1562–6 (1954).
(4V) Cologne, J., Arsac, A., *Bull. soc. chim. France* **1954**, 445–8.
(5V) Dannenberg, H., Dannenberg v. Dresler, D., *Ann.* **585**, 1–15 (1954).
(6V) Dhingra, D. R., Kapoor, S. N., Kacker, P. N., *J. Proc. Inst. Chemists (India)* **25**, 171–3 (1953).
(7V) Dixon, J. K., Saunders, K. W., IND. ENG. CHEM. **46**, 652–60 (1954).
(8V) Driver, J. E., Sousa, J. B., *J. Chem. Soc.* **1954**, pp. 985–9.
(9V) Dunbar, R. E., Gieszler, A. O., *Science* **122**, 241–2 (1955).
(10V) Haarmann and Reimer, Chemische Fabrik zu Holzminden G. m. b. H., Ger. Patent **824,939** (Dec. 13, 1951).
(11V) Ito, Y., Ohdera, I., Japan Patent **6179** (Nov. 30, 1953).
(12V) King, J., Ramage, G. R., *J. Chem. Soc.* **1954**, pp. 936–8.
(13V) Lacey, R. N., *Ibid.*, **1954**, pp. 854–60.
(14V) Müller, A., Lempert-Sréter, M., Karczag-Wilhelms, A., *J. Org. Chem.* **19**, 1533–47 (1954).
(15V) Orlando, A. M., *Rev. fac. cienc. quim. (Univ. nacl. La Plata)* **25**, 97–102 (1950).
(16V) Quelet, R., Gavarret, J., Pineau, R., *Compt. rend.* **238**, 1427–9 (1954).
(17V) Rabindran, K., Tilak, B. D., *Proc. Indian Acad. Sci.* **38A**, 271–6 (1953).
(18V) Riemschneider, R., *Monatsh.* **84**, 1228–33 (1953).
(19V) Riemschneider, R., *J. Am. Chem. Soc.* **75**, 4853–5 (1953).
(20V) Teramura, K., Itagaki, H., Oda, R., *J. Chem. Soc. Japan* **57**, 126–7 (1954).
(21V) Usgaonkar, R. N., Thakor, V. M., others, *J. Indian Chem. Soc.* **30**, 743–6 (1953).
(22V) *Ibid.*, pp. 765–71.
(23V) Yasue, M., Kato, Y., *J. Pharm. Soc. Japan* **74**, 116–19 (1954).
(24V) Zaheer, S. H., Singh, B., others, *J. Chem. Soc.* **1954**, 3360–2.
(25V) Zaugg, H. E., Horrom, B. W., *J. Am. Chem. Soc.* **76**, 5817–18 (1954).

Claisen Rearrangement

(1W) Belov, V. N., Volkova, E. D., *Doklady Akad. Nauk S.S.S.R.* **93**, 1037–40 (1953).
(2W) Buděšínský, Z., Ročková, E., *Chem. Listy* **48**, 427–34 (1954).
(3W) Burton, H., Munday, D. A., *J. Chem. Soc.* **1954**, pp. 1456–60.
(4W) Conroy, H., Firestone, R. A., *J. Am. Chem. Soc.* **75**, 2530–1 (1953).
(5W) Crabbé, P., *Ing. chim.* **36**, 75–83 (1954).
(6W) Curtin, D. Y., Johnson, H. W., Jr., *J. Am. Chem. Soc.* **76**, 2276–7 (1954).
(7W) Hart, H., *Ibid.*, **76**, 4033–4 (1954).
(8W) Hart, H., Eleuterio, H. S., *Ibid.*, **76**, 516–19 (1954).
(9W) *Ibid.*, pp. 519–22.
(10W) Hart, H., Elia, R. J., *Ibid.*, **76**, 3031–2 (1954).
(11W) Hart, H., Spliethoff, W. L., Eleuterio, H. S., *Ibid.*, **76**, 4547–50 (1954).
(12W) Lauer, W. M., Lockwood, R. G., *Ibid.*, **76**, 3974–6 (1954).
(13W) Marvell, E. N., Logan, A. V., others, *Ibid.*, **76**, 1922–6 (1954).
(14W) Marvell, E. N., Teranishi, R., *Ibid.*, **76**, 6165–8 (1954).
(15W) Rhoads, S. J., Raulins, R., Reynolds, R. D., *Ibid.*, **75**, 2531–2 (1953).
(16W) *Ibid.*, **76**, 3456–63 (1954).
(17W) Schmid, K., Haegele, W., Schmid, H., *Experientia* **9**, 414–15 (1953).
(18W) Schmid, K., Haegele, W., Schmid, H., *Helv. Chim. Acta* **37**, 1080–93 (1954).
(19W) Sebe, E., Matsumoto, S., *Proc. Japan Acad.* **29**, 207–9 (1953).
(20W) Sen, A. B., Rastogi, R. P., *J. Indian Chem. Soc.* **30**, 556–8 (1953).
(21W) Sen, A. B., Gupta, A. K., *Ibid.*, **30**, 433–4 (1953).
(22W) Takahashi, T., Oshika, T., *J. Pharm. Soc. Japan* **74**, 48–51 (1954).

Haloalkylation

(1X) Arcoleo, A., La Marca, G., *Ricerca sci.* **24**, 835–6 (1954).
(2X) Arcoleo, A., Oliverio, A., *Ann. chim.* **44**, 183–9 (1954).
(3X) Bailey, P. S., Pomerantz, S. H., *J. Am. Chem. Soc.* **75**, 281–4 (1953).
(4X) Baltazzi, E., *Bull. soc. chim. France* **1953**, pp. 167–8.
(5X) Bapsères, P., Quelet, R., *Ibid.*, **1953**, pp. C50–1.
(6X) Baskakov, Y. A., Mel'nikov, N. N., *Doklady Akad. Nauk S.S.S.R.* **97**, 453–4 (1954).
(7X) Bergstrom, F. W., Furst, A., *J. Am. Chem. Soc.* **75**, 5415–16 (1953).
(8X) Blair, J., Newbold, G. T., *J. Chem. Soc.* **1954**, 3935–40.
(9X) Bogdanov, K. A., *Masloboino-Zhirovaya Prom.* **18**, 20 (1953).
(10X) Bright, W. M., Cammarata, P., *J. Am. Chem. Soc.* **74**, 3690 (1952).
(11X) Brown, H. C., Nelson, K. L., *Ibid.*, **75**, 6292–9 (1953).
(12X) Cagniant, P., Cagniant, P., *Bull. soc. chim. France* **1953**, pp. 713–25.
(13X) Carpenter, A. T., Hunter, R. F., *J. Chem. Soc.* **1954**, pp. 2731–5.
(14X) Carpenter, M. S., Easter, W. M., *J. Org. Chem.* **19**, 87–102 (1954).
(15X) Clemo, G. R., Temple, R. W., *J. Chem. Soc.* **1953**, pp. 678–83.
(16X) Čtvrtník, J., Czeck. Patent **84,221** (May 1, 1955).
(17X) Cymerman-craig, J., Loder, J. W., *J. Chem. Soc.* **1954**, pp. 237–42.
(18X) Dengel, F., U. S. Patent **2,695,319** (Nov. 23, 1954).
(19X) Fuson, R. C., House, H. O., Melby, L. R., *J. Am. Chem. Soc.* **75**, 5952–5 (1953).
(20X) Gaertner, R., *Ibid.*, **74**, 2991–4 (1952).
(21X) Griehl, W., *Faserforsch. u. Textiltech.* **4**, 464–9 (1953).
(22X) Gudriniece, E., Rozīte, L., Lepika, E., *Latvijas PSR Zinātnu Akad. Vēstis* **1954**, pp. 111–14.
(23X) Harley-Mason, J., Jackson, A. H., *J. Chem. Soc.* **1954**, pp. 1158–9.
(24X) Howard, E. G., Jr., U. S. Patent **2,662,098** (Dec. 8, 1954).
(25X) Krausz, F., *Bull. soc. chim. France* **1953**, pp. C51–2.
(26X) Ikuma, S., Takemura, M., others, *Ann. Rept. Takamine Lab.* **3**, 6–10 (1951).
(27X) Koishi, F., Nakazawa, J., *Ibid.*, **5**, 18–20 (1953).
(28X) Levshina, K. V., Sergievskaya, S. I., *Zhur. Obshcheĭ Khim.* **24**, 905–9 (1954).
(29X) L. Givaudan and Cie., S. A., Brit. Patent. **718,335** (Nov. 10, 1954).
(30X) Lichtenberger, J., Muller, P., Huguet, M., *Bull. soc. chim. France* **1953**, pp. C45–6.
(31X) Maquin, C., Gault, H., *Ind. parfum.* **9**, 438 (1954).
(32X) Miles Laboratories, Inc., Brit. Patent, **703,309** (Feb. 3, 1954).
(33X) Oláh, G., Pavláth, A., *Acta Chim. Acad. Sci. Hung.* **3**, 425–9 (1953).
(34X) Petrov, K. D., Lagucheva, E. S., Pukhova, V. I., *Zhur. Obshcheĭ Khim.* **24**, 1248–50 (1954).
(35X) Profft, E., *Chem. Tech.* **5**, 503–7 (1953).
(36X) Quelet, R., *Bull. soc. chim. France* **1953**, pp. C46–8.
(37X) Rabjohn, N., *J. Am. Chem. Soc.* **76**, 5479–81 (1954).
(38X) Randall, D. I., Renfrew, E. E., U. S. Patent **2,642,444** (June 16, 1953).
(39X) *Ibid.*, **2,662,902** (Dec. 15, 1953).
(40X) Rodionov, V. M., Belov, V. N., Kore, S. A., *Zhur. Obshcheĭ Khim.*, **23**, 1802–8 (1953).
(41X) Sahashi, Y., Akamatsu, H., Genda, H., *Proc. Imp. Acad. Japan* **21**, 44–52 (1945).
(42X) Schlatter, M. J., *J. Am. Chem. Soc.* **76**, 4952–7 (1954).
(43X) Schlögl, K., Fabitschowitz, H., *Monatsh.* **85**, 1223–33 (1954).
(44X) Seto, S., Horiuchi, H., *J. Chem. Soc. Japan* **57**, 235–6 (1954).
(45X) Southwich, P. L., Foltz, G. E., McIntyre, W. E., Jr., *J. Am. Chem. Soc.* **75**, 5877–80 (1953).
(46X) Sugihara, M., *Sci. Ind. (Japan)* **27**, 89–93 (1953).
(47X) Summers, L., *J. Am. Chem. Soc.* **76**, 3481–4 (1954).
(48X) Teramura, K., Itagaki, H., Oda, R., *J. Chem. Soc. Japan* **57**, 407–8 (1954).
(49X) Thomson, R. H., *J. Chem. Soc.* **1953**, pp. 1196–9.
(50X) Union Carbide and Carbon Corp., Brit. Patent **707,598** (April 21, 1954).
(51X) Vereinigte Glanzstoff-fabriken, A.-G., *Ibid.*, **719,184** (Nov. 24, 1954).
(52X) Weinmayr, V., U. S., Patent **2,694,721** (Nov. 16, 1954).
(53X) Wichterle, O., Černý, J., *Chem. Listy* **49**, 1038–40 (1955).

Miscellaneous

(1Y) Lesbre, M., Roques, G., *Compt. rend.* **1953**, pp. 423–8.
(2Y) Newman, M. S., Pinkus, A. G., *J. Org. Chem.* **19**, 978–84 (1954).
(3Y) *Ibid.*, pp. 985–91.
(4Y) *Ibid.*, pp. 992–5.
(5Y) *Ibid.*, pp. 996–1002.