ORGANIC COMPOUNDS OF SELENIUM, III

W. E. Bradt, State College of Washington

Introduction. This paper is the third of a series having as its object the furthering of research work in the chemistry of organic selenium compounds. It presents a complete list of the known organic selenides, a resume of the methods of preparation for each compound, and a complete bibliography for each compound.

Discussion. A consideration of the body of this paper will show that it consists of three parts: General methods for the preparation of selenides, a classified list of selenides, and a bibliography. An examination of the methods of preparation will show that each method is assigned a number, and that with each method are listed reference numbers which correspond to the number assigned to the pertinent references in the bibliography. In this way, by a consideration of the table of methods, one can ascertain by the reference numbers something of the extent to which that method has been used. In the same manner, any compound in the lists of selenides will show by number the methods by which that compound has been prepared, and, also by number, the references in which that compound is mentioned.

A more detailed consideration of the general methods for the preparation of selenides will show that in many cases the first equation is not balanced, and is in fact only a listing of reagents and products. When this is the case, the equation is ended by a plus sign to indicate that it is incomplete. Following this, frequently, will be found balanced equations which endeavor to show the probable mechanism of the reaction. Regarding these equations, it must be remembered that they are often based upon properties reported during the early work in this field, and consequently are in no sense authoritative. Additional information will possibly necessitate the revision of several equations. This is well illustrated by Preparation Methods Nos. 24 and 25. In these two cases, the first equation is a list of the reported products, while the explanatory equations are merely an effort to explain the presence of these products. Additional information regarding the properties of the organic selenocyanates would no doubt necessitate some modification in these instances.

A consideration of the chemistry of the preparation of selenides will show that the actual preparation of the selenide is based upon fewer reactions than the forty listed. This can be well illustrated as follows: Any one of several starting materials can be converted to organic selenols, which can in turn be oxidized to organic diselenides, which if heated will decompose to form selenides. From this it can be seen that the methods of preparation listed have been classified from the basis of starting material, rather than from the basis of the reaction immediately concerned in the preparation of the selenide. This is necessary because of the lack of definite information regarding the mechanism of these reactions.

Special notice should be called to Methods Nos. 40, 41, and 42. Method No. 40 includes all methods based on chemistry not affecting the selenium atom in the molecules concerned. Here, then, are listed cases of nitration, reduction,

Proc. Ind. Acad. Sci. 40: 141-163. (1930) 1931.

dehydration, and other reactions of like nature. Methods Nos. 41 and 42 are actually not methods of preparation, but are merely remarks designed to indicate that a compound may have been erroneously classified as a selenide, or that it may have been erroneously reported to have been prepared, respectively.

Nomenclature. In many cases, the nomenclature used by the original authors has been modified in order to obtain a uniform system. In the case of the heterocyclic compounds, the common name "selenopyrine" has been replaced by a systematic name. In the aliphatic compounds, the name "selenoglycollic acid" has been changed to carboxymethylselenide. This change was considered desirable since the term "seleno" indicates a divalent selenium atom attached to another atom by both valences. In the case of the "selenoglycollic acids" the valences of the selenium atom are attached to different carbon atoms, thus demanding a name including the term selenide. Other changes which have been made for similar reasons will be noted in the tables. Abbreviations which have been used in the tables are those recommended by Chemical Abstracts, as follows: Ac = CH_3CO-; Bz = C_6H_5CO-; Et = C_2H_5-; Me = CH_3-; Ph = C_6H_5-; R = a hydrocarbon radical; X = an inorganic acid radical; M = an inorganic metallic radical.

Properties. Selenides are oxidized to selenoxides when treated with acetic acid and either potassium dichromate or potassium permanganate. Treatment with fuming nitric acid forms a hydronitrate of the selenoxide ($R_2SeO \cdot HNO_3$). Hydrogen peroxide is frequently without action, probably due to the insolubility of the selenides used as starting material. Selenides react with solutions of potassium platinochloride, and with the corresponding palladium salt to form compounds of the type $2R_2Se \cdot PtCl_2$ and $2R_2Se \cdot PdCl_2$. Treatment of solutions of selenides with halogens forms dihalides, R_2SeX_2. Moderate heating of selenides with metallic selenium causes the addition of another selenium atom to form diselenides, R_2Se_2. Higher temperatures cause a reversal of this reaction with re-formation of the original selenide.

The only selenide used industrially is diethylselenide, which is part of the "anti-knock" mixture used in "Ethyl gas."

THE PREPARATION OF SELENIDES

GENERAL METHODS

Method No.	*Equations*	*Ref. Nos.*
1.	$Se+RMgX+Et_2O;+H_2O+HCl=R_2Se+R_2Se_2+RSeH+.$ $Se+RMgX=RSeMgBr;+HCl=RSeH+MgBrCl.$ $2Se+2RMgX=RSeR+Se(MgBr)_2.$ $3Se+3RMgX=R_2Se_2+Se(MgBr)_2.$	72, 79, 80
2.	$2Se+R_2Hg+heat=R_2Se+HgSe.$	39, 52, 94.
3.	$Se+R_2SO_2+heat=R_2Se+SO_2.$	28, 37, 38.
4.	$2Se+RH+H_2SO_4=R_2Se+H_2Se+H_2SO_4+.$ (R = Heterocyclic).	19.
5.	$Se+RX_4+heat=$ complex selenides +. (not verified by recent work).	1, 8.
6.	$Se_2X_2+RMgX=R_2Se+R_2Se_2+.$ $SeX_2+2RMgX=R_2Se_2+2MgX_2.$ $R_2Se_2+heat=R_2Se+Se.$	67, 68, 77.
7.	$Se_2X_2+RH+Al_2X_6+CS_2=R_2Se+R_2Se_2+RX+.$ $Se_2X_2+2RH+(Al_2X_6)=R_2Se_2+2HX.$ $R_2Se_2+heat=R_2Se+Se.$ $Se_2X_2+RH+(Al_2X_6)=RX+HX+2Se.$	50.
8.	$Se_2X_2+RH=R_2Se+R_2Se_2+.$ $Se_2X_2+2RH=R_2Se_2+2HX.$ $R_2Se_2+heat=R_2Se+Se.$ (R = Heterocyclic).	36.
9.	$Se_2X_2+R{=}R'(X{=}R'-)_2Se+(XR-R'-)^2SeX_2+.$ $Se_2X_2+2R{=}R'=(XR-R'-)_2Se+Se.$ $(XR-R'-)_2Se+Se_2X_2=(XR-R'-)_2SeX_2+2Se.$ (R=R' = Ethylenic).	7, 32.
10.	$SeX_4+RH+(Al_2X_6)=R_2Se+R_2SeX_2+R_2Se_2+HCl+RX+.$ (R = Aromatic).	10, 11, 12, 40.
11.	$SeX_4+R_2Cu+CHCl_3=R_2Se+R_2Se_2+RX+CuX_2+.$ $2SeX_4+3CuR_2=2R_2Se+2RX+3CuX_2.$ $4SeX_4+5CuR_2=2R_2Se_2+6RX+5CuX_2.$ (R = Diketone univalent radical, e.g., $(Ph-CO-CH=C(Ph)-O-)_2Cu$).	61.
12.	$SeO_2+H_2R+Al_2X_6+heat=(HR)_2Se+(HR)_2Se_2+$ $(HR)_2SeX_2+(XR)_2Se+HCl+.$ $2H_2R+SeO_2+Al_2X_6=(HR)_2SeO+H_2O.$ $2(HR)_2SeO+2HX+Al_2X_6=(HR)_2SeX_2+H_2O.$ $2H_2O+Al_2X_6=2AlOHX_2+2HX.$ $2(HR)_2SeX_2+heat=(HR)_2Se+(XR)_2Se+2HX.$ $(HR)_2Se+Se+warm=(HR)_2Se_2.$ (R = Aromatic).	53.
13.	$SeO_2+HR=R_2Se+H_2O+O.$ (R = Phenolic or Heterocyclic).	19, 20.
14.	$M_2Se+RNNX=R_2Se+R_2Se_2+MX+N_2+.$ $M_2Se+2RNNX=R_2Se+N_2+2MX.$ $M_2Se_2+2RNNX=R_2Se_2+N_2+2MX.$ (M = H, Na, K. M_2Se_2 is a common impurity in M_2Se).	45, 46, 47.

LIST OF AROMATIC SELENIDES

Method No.	*Equations*	*Ref. Nos.*
15.	$M_2Se+RX+M'OH=R_2Se+R_2Se_2+MX+.$ $M_2Se+2RX=R_2Se+2MX.$ $M_2Se_2+2RX=R_2Se_2+2MX.$ (M = Na, K, NH_4, P. X = Cl, KSO_4, C_2O_4. M' = Na, K).	6, 14, 33, 34, 35, 51, 59, 69, 70, 73, 74, 75, 78, 85, 89, 90, 91.
16.	$M_2Se_3+ROH+heat=RSeH+R_2Se+R_2Se_2+.$ $M_2Se_3+3ROH=3RSeH+M_2O_3.$ $6RSeH+M_2O_3=3R_2Se_2+2M(OH)_3.$ $R_2Se_2+heat=R_2Se+Se.$ (R = Aliphatic).	65.
17.	$M_2Se_3+R_2O+heat=R_2Se+R_2Se_2+.$ $M_2Se_3+2R_2O=2R_2Se+Se.$ $R_2Se+Se+warm=R_2Se_2.$ (R = Aliphatic).	65.
18.	$H_2SeO_4+RH+(H_2SO_4)=R_2Se+H_2O+3(O).$ (R = Heterocyclic).	20.
19.	$MSeCN+RNNX+(neutral\ solution)=R_2Se+RSeCN+.$ $MSeCN+RNNX=RSeCN+N_2+MX.$ $2RSeCN=R_2Se+(CN)_2.$ (M = K).	13.
20.	$SeOCl_2+HR=R_2Se+RCl+R_3SeCl+.$ $SeOCl_2+3HR=R_2Se+RCl+H_2O+HCl.$ $R_2Se+RCl=R_3SeCl.$	30, 43, 54, 63.
21.	$K_2SeSO_3+RX=R_2Se+.$ $2K_2SeSO_3=K_2Se+Se+K_2S_2O_6.$ $2RX+K_2Se=R_2Se+2KX.$	88.
22.	$RSeH+R'NNX=RSeR'+N_2+HX.$	3, 48.
23.	$RSeM+R'X+heat=RSeR'+MX.$	3, 15, 16, 26, 27, 28, 41, 46, 47, 48, 59, 62, 71, 72, 80, 87.
24.	$RSeCN+HOH=R_2Se+R_2Se_2+NH_3+CO_2+HCN+H_2C_2O_4+.$ $2RSeCN+heat=R_2Se+Se+(CN)_2.$ $RSeCN+HOH=RSeH+HOCN.$ $2RSeH+O=R_2Se_2+H_2O.$ $(CN)_2+4H_2O=2NH_3+H_2C_2O_4.$ $(CN)_2+H_2O=HOCN+HCN.$	3, 13, 22.
25.	$RSeCN+R'X+NaOAc+heat=R'SeR+R'_2Se+.$ $RSeCN=RSeH+HOCN.$ $RSeH+R'X=RSeR'+HX.$ $RSeCN+R'X=R'SeCN+RX.$ $R'SeCN+HOH=R'SeH+HOCN.$ $R'SeH+R'X=R'_2Se=HX.$	5.
26.	$RSeOOH+HR'NH_2+heat=RSeOR'NH_2+RSeR'NH_2+H_2O+.$ $RSeOOH+HR'NH_2+heat=RSeOR'NH_2+H_2O.$ $RSeOR'NH_2+R'NH_2=RSeR'NH_2+H_2O+.$	29.

27.	$R_2SeO+(M+HX)=R_2Se+H_2O+MX.$	28.
28.	$R_2Se(OH)_2+(M+HX)+heat=R_2Se+2H_2O+MX.$ ($M=Zn$. $X=CH_3COOH$).	2, 17, 29.
29.	$R_2SeO_2+heat=R_2Se+O_2+$detonation.	41.
30.	$(HR)_2SeO_2+PX_5=(XR)_2Se+2HX+.$ ($X=Cl$. R = Aromatic).	76.
31.	$R_2SeO_2+PX_3=R_2Se+.$	76.
32.	$2HRSeX_2+heat=(RX)_2Se+(HR)_2Se+2HX.$ $(HR)_2SeX_2+heat=HRSeRX+HX.$	17, 29, 38, 53, 57, 60, 94.
33.	$R_2SeX_2+M+heat+CS_2=R_2Se+MX_2.$ ($M=Zn$).	44.
34.	$R_2SeX_2+2MOH+heat=R_2Se+2MX+H_2O+.$ $R_2SeX_2+2MOH=R_2Se(OH)_2+2MX.$ $R_2Se(OH)_2=R_2Se+H_2O+O.$ (R = Naphthyl. $M=K$).	38.
35.	$R_2SeX_2+HOH+ether=R_2Se+RX+Se+.$ $2R_2SeX_2+HOH=R_2Se+2RX+X_2+Se.$	44.
36.	$R_2=Se=Se+heat=R_2Se+Se.$	49.
37.	$2(RCOCH_2)_2Se_2+3NaOH+heat=(RCOCH_2)_2Se+$ $RCSeCOR+2HOH+HSeCH_2COONa+Na_2Se+.$	21.
38.	$XR(-R')-Se-R''+heat=R''X+R-Se-R'.$ (R = Heterocyclic. R′ and R″ = Aliphatic).	16.
39.	$R=Se+R'X+heat=XR-Se-R'.$ (R = Heterocyclic. R′ = Aliphatic).	57, 58, 60.
40.	All methods not affecting the selenium atom.	3, 6, 11, 12, 14, 16, 38, 47, 48, 56, 57, 58, 60. 74, 75, 89, 90, 91, 92.
41.	Erroneously classified in references as a selenide.	57, 59.
42.	Reported but now considered not to have been prepared.	1, 8, 11, 35, 93.

LIST OF AROMATIC SELENIDES

Selenides	*Formulas*	*M.P. or B.P.°C.*	*Methods of Prep.*	*Ref. Nos.*
Diphenyl-	$(C_6H_5)_2Se$	B = 301-2 B_{10} = 159 B_{16} = 167 B_{55} = 199 B_{100} = 219 B_{126} = 227	1, 2, 6, 7, 10, 12, 14, 23, 29, 31.	10, 11, 12, 17, 23, 25, 26, 37, 38, 39, 40, 41, 42, 45, 50, 52, 53, 68, 76, 77, 80.
4-Bromdiphenyl-	*4*-Br-$C_6H_4SeC_6H_5$	B_{12} = 196-8 M = 32-3	32.	17.
4-Tolylphenyl-	*4*-CH_3-$C_6H_4SeC_6H_5$	B_{20} = 175-8	3.	28.
4-Carboxydiphenyl-	*4*-HOOC-$C_6H_4SeC_6H_5$	M = 182-4	27.	28.
2-Carboxydiphenyl-	*2*-HOOC-$C_6H_4SeC_6H_5$	M = 189-90	22.	48.
Acid chloride of Carboxydiphenyl-	*2*-ClOC-$C_6H_4SeC_6H_5$	M = 72-3	40.	48.
Amide of Carboxydiphenyl-	*2*-NH_2OC-$C_6H_4SeC_6H_5$	M = 201-2	40.	48.
Anilide of Carboxydiphenyl-	*2*-C_6H_5NHOC-$C_6H_4SeC_6H_5$	M = 145.5-6.5	40.	48.
Methyl ester of Carboxydiphenyl-	*2*-CH_3OOC-$C_6H_4SeC_6H_5$	M = 71-2	40.	48.
4-Aminodiphenyl-	*4*-NH_2-$C_6H_4SeC_6H_5$	M = 93-4	26.	29.
4-Acetaminodiphenyl-	*4*-CH_3CONH-$C_6H_4SeC_6H_5$	M = 169-70	28, 40.	29.
Di-*2*-tolyl-	$(2\text{-}CH_3\text{-}C_6H_4)_2Se$	B_{16} = 186 M = 61-2 M = 62 M = 64	1, 2, 7, 24.	3, 50, 52, 72, 94.
Di-*4*-tolyl-	$(4\text{-}CH_3\text{-}C_6H_4)_2Se$	B_{16} = 196 M = 69 M = 69.5-70.5 M = 286?	2, 19, 23, 24.	3, 13, 52, 94.

Di(*3*-methyl-*4*-hydroxyphenyl)-	(*3*-CH_3-*4*-HO-C_6H_3)$_2$Se	M = 98-9	20.	63.
Di(*3*-methyl-*2*-hydroxyphenyl)-	(*3*-CH_3-*2*-HO-C_6H_3)$_2$Se	M = 111	20.	63.
Di-*2*-carboxyphenyl-	(*2*-HOOC-C_6H_4)$_2$Se	M = 228-9 M = 234-5	14.	46, 47, 48.
Di-acid chloride of carboxyphenyl-	(*2*-COC-C_6H_4)$_2$Se	M = 107-8	40.	47.
Di-amide of carboxyphenyl-	(*2*-H_2NOC-C_6H_4)$_2$Se	M = 212-3	40.	47.
Di-methyl ester of carboxyphenyl-	(*2*-CH_3OOC-C_6H_4)$_2$Se	M = 70-1	40.	47.
Di-ethyl ester of carboxyphenyl-	(*2*-C_2H_5OOC-C_6H_4)$_2$Se	M = 64-5	40.	47.
Di-*4*-carboxyphenyl-	(*4*-HOOC-C_6H_4)$_2$Se	M = 315-6	14.	47.
Di-*3*-carboxyphenyl-	(*3*-HOOC-C_6H_4)$_2$Se	M = 296-7	14.	47.
Di-(*4*-hydroxy-*3*-carboxyphenyl)- (Disalicyl selenide)	(*4*-HO-*3*-HOOC-C_6H_3)$_2$Se	S = 260± D = 272	20.	63.
Di-*4*-chlorophenyl-	(*4*-Cl-C_6H_4)$_2$Se	B_{18} = 212 M = 96.5-97 M = 94 M = 95 M = 96	1, 12, 30, 32.	38, 52, 53, 76, 79, 80.
Di-*4*-bromophenyl-	(*4*-Br-C_6H_4)$_2$Se	M = 114-5 M = 114 M = 115.5 M = 112 M = 116	1, 24, 32, 40.	11, 12, 13, 17, 38, 52, 79, 80.
Di-*x*-hydroxyphenyl-	(*x*-HO-C_6H_4)$_2$Se	—	13, 20.	54, 81.
Di-*x*-methoxyphenyl-	(*x*-CH_3O-C_6H_4)$_2$Se	M = 48	20.	43.
Di-4-methoxyphenyl-	(*4*-CH_3O-C_6H_4)$_2$Se	—	24.	3.
Di-*x*-ethoxyphenyl-	(*x*-C_2H_5O-C_6H_4)$_2$Se	M = 56	20.	35, 43.
Di-*3*-aminophenyl-	(*3*-H_2N-C_6H_4)$_2$Se	B = 130-50	6.	68.

LIST OF AROMATIC SELENIDES—Continued

Selenides	*Formulas*	*M.P. or B.P.°C.*	*Methods of Prep.*	*Ref. Nos.*
Di-*x*-dimethylaminophenyl-	$(x\text{-}(CH_3)_2N\text{-}C_6H_4)_2Se$	M = 124	20.	30.
Picrate of dimethylaminophenyl-	$R_2Se\text{-}2C_6H_3N_3O_7$	M = 135	40.	30.
Di-*x*-diethylaminophenyl-	$(x\text{-}(C_2H_5)_2N\text{-}C_6H_4)_2Se$	M = 83	20.	30.
Picrate of diethylaminophenyl-	$R_2Se\text{-}2C_6H_3N_3O_7$	M = 135	40.	30.
Di-(*2*-methyl-*4*-bromophenyl)-	$(2\text{-}CH_3\text{-}4\text{-}Br\text{-}C_6H_3)_2Se$	—	32.	94.
Di-(*3*-aminohydrobromide-*x*-bromophenyl)-	$(3\text{-}NH_2\text{-}HBr\text{-}x\text{-}Br\text{-}C_6H_4)_2Se$	M = 115-6	6.	68.
x-*y*-dichloro-*4*-acetaminodiphenyl-	$x\text{-}y\text{-}Cl_2\text{-}4\text{-}AcNH\text{-}C_6H_2SePh$	M = 186-7	39.	29.
x-*y*-dibromo-*4*-acetaminodiphenyl-	$x\text{-}y\text{-}Br_2\text{-}4\text{-}AcNH\text{-}C_2H_2SePh$	M = 167	32.	29.
Di-(*2*-*4*-dinitrophenyl)-	$(2\text{-}4\text{-}(NO_2)_2\text{-}C_6H_3)_2Se$	M = 194 M = 195-6 D = 240	21, 25.	5, 88.
Di-(*2*-*4*-*6*-trinitrophenyl)	$(2\text{-}4\text{-}6(NO_2)_3\text{-}C_6H_2)_2Se$	M = 240+ D = 240+	21.	88.
x-hydroxy-*x'*-chlorodiphenyl-	$x\text{-}HO\text{-}C_6H_4SeC_6H_4\text{-}Cl\text{-}x'$	M = 145	39, 42.	11, 12, 38.
Di-*1*-naphthyl-	$(1\text{-}C_{10}H_7)_2Se$	M = 114	2.	52.
Di-*1*-methoxy-*x*-naphthyl-	$(1\text{-}CH_3O\text{-}x\text{-}C_{10}H_6)_2Se$	M = 138	20.	54.
Di-*1*-ethoxy-*x*-naphthyl-	$(1\text{-}C_2H_5O\text{-}x\text{-}C_{10}H_6)_2Se$	M = 149	20.	54.
Di-*2*-naphthyl-	$(2\text{-}C_{10}H_7)_2Se$	B_{12} = 298 M = 138.5	3, 34, 36.	38, 49, 52.
Di-*2*-hydroxy-1-naphthyl-	$(2\text{-}HO\text{-}1\text{-}C_{10}H_6)_2Se$	M = 186	20.	54, 63.
Di-*2*-methoxy-*x*-naphthyl-	$(2\text{-}CH_3O\text{-}x\text{-}C_{10}H_6)_2Se$	M = 162	20.	54.
Di-*2*-ethoxy-*x*-naphthyl-	$(2\text{-}C_2H_5O\text{-}x\text{-}C_{10}H_6)_2Se$	M = 176	20.	54.

Selenides	*Formulas*	*M.P. or B.P.°C.*	*Methods of Prep.*	*Ref. Nos.*
Dimethyl-	$(CH_3)_2Se$	B = 58.2 B_{753} = 54-5	15, 42.	23, 24, 25, 33, 34, 73, 78, 83, 84, 93.
Methylbenzyl-	CH_3SeCH_2-C_6H_5	—	23.	27.
Methyl-*2*-cyanobenzyl	$CH_3SeC_6H_4$-CN-*2*	B = 180-200	23.	15.
Methylethyl-	$CH_3SeC_2H_5$	B = 86	23.	87.
Methyl-*n*-propyl-	$CH_3SeC_3H_7$-*n*	B = 114	23.	87.
Methyl-*n*-butyl-	$CH_3SeC_4H_9$-*n*	B = 141	23.	87.
Di(carboxymethyl)- (Diglycollic Acid-)	$(HOOCCH_2)_2Se$	M = 107	15, 24.	5, 75.
Di-amide of (Diglycollic Acid-)	$(H_2NOCCH_2)_2Se$	—	39.	75.
Di-anilide of (Diglycollic Acid-)	$(C_6H_5HNOCCH_2)_2Se$	M = 198	36.	21.
Di (*2*-toluidide) of (Diglycollic Acid-)	$(2$-CH_3-$C_6H_4NHCOCH_2)_2Se$	—	36.	21.
Di (*3*-toluidide) of (Diglycollic Acid-)	$(3$-CH_3-$C_6H_4NHCOCH_2)_2Se$	M = 170-1	36.	21.
Di (*4*-toluidide) of (Diglycollic Acid-)	$(4$-CH_3-$C_6H_4NHCOCH_2)_2Se$	M = 217-8	36.	21.
Di (*4*-chloranilide) of (Diglycollic Acid-)	$(4$-Cl-$C_6H_4NHCOCH_2)_2Se$	M = 190-1	36.	21.
Di (*4*-ethoxyanilide) of (Diglycollic Acid-)	$(4$-C_2H_5O-$C_6H_4NHCOCH_2)_2Se$	M = 199-200	36.	21.
s-Dibenzoyldimethyl-	$(C_6H_5COCH_2)_2Se$	M = 73	33, 35.	44.
Di (phenylhydrazone) of *s* Dibenzoyldimethyl-	$(C_6H_5NHNC(C_6H_5)CH_2)_2Se$	M = 70-100	40.	44.
s-Tetrabenzoyldimethyl-	$((C_6H_5CO)_2CH)_2Se$	M = 150-2	11.	61.
s-Di (*4*-methylbenzoyl) dimethyl-	$(4$-CH_3-$C_6H_4COCH_2)_2Se$	M = 103	33, 35.	44.
Di (phenylhydrazone) of "dimethyl-"	$(C_6H_5NHNC(C_6H_4$-CH_3-$4)CH_2)_2Se$	M = indef.	40.	44.
Dibenzyl-	$(C_6H_5CH_2)_2Se$	M = 45.5	15, 23.	27, 33, 34, 77.
Benzylethyl-	$C_6H_5CH_2SeC_2H_5$	—	23.	27.
1-2-Di (benzylselenide)-ethane	$(C_6H_5CH_2SeCH_2)_2$	M = 68-9	23.	27.
Carbamyl (N-phenyl-*alpha*-acetamido)-	$NH_2COSeCH_2CONHC_6H_5$	M = 118-9	24.	21, 22.
Carbamyl (N-phenyl-N-methyl-*alpha*-acetamido)-	$NH_2COSeCH_2CON(CH_3)C_6H_5$	M = 123	24.	22.

LIST OF ALIPHATIC SELENIDES—Continued

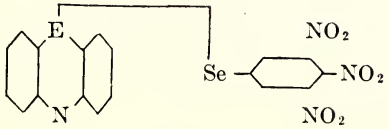
Selenides	*Formulas*	*M.P. or B.P.°C.*	*Methods of Prep.*	*Ref. Nos.*
Carbamyl (N-phenyl-N-benzyl-*alpha*-acetamido)-Diethyl-	$NH_2COSeCH_2CON(C_6H_5)CH_2C_6H_5$ $(C_2H_5)_2Se$	M = 140-1 B = 107-8 B = 108 B = 110 B = 109.6-110.1	24. 15, 16, 17, 42.	22. 9, 18, 23, 24, 25, 35, 51, 63, 64, 65, 66, 69, 70, 73, 82, 85, 86, 95.
1-3-(Diethylselenide)-propane	$(C_2H_5SeCH_2)_2CH_2$	B_{15} = 135	23.	23, 25, 87.
1-1′-Dicarboxyethyl-(cis- and trans-)	$(CH_3CH(COOH))_2Se$	M = 106-7 M = 145	15.	14.
Di-acid chloride of *1-1′*-Dicarboxyethyl-	$(CH_3CH(COCl))_2Se$	—	40.	14.
Di-acid amide of *1-1′*-Dicarboxyethyl-	$(CH_3CH(CONH_2))_2Se$	—	40.	14.
Diethyl ester of *1-1′*-Dicarboxyethyl-	$(CH_3CH(COOC_2H_5))_2Se$	—	40.	14.
2-2′-Dichloroethyl-	$(ClCH_2CH_2)_2Se$	M = 23-5	9, 28.	2, 7, 31.
Trichlorodiethyl-	$C_4H_7Cl_3Se$	—	—	31.
s-Tetrachlorodiethyl-	$(CHCl_2CH_2)_2Se$	M = 118	9.	32.
Dichlorovinyl-	$(ClCH=CH)_2Se$	—	—	31.
"Selenium chloroethylene deriv."		—	—	31.
"Selenium bromoethylene deriv."		—	—	31.
"Selenium acetylene chlorine cmpd."		—	—	31.
"Selenium cmpd. of acetylene."	(HOSeC-C-SeC-)$_2$	—	6.	67.
Di-*n*-propyl-	$(n\text{-}C_3H_7)_2Se$	B_{13} = 99 B = 159	23.	23, 24, 25, 87.
Di-(*1*-diacetyl)-*n*-propyl	$(CH_3CH_2C(COCH_3)_2)_2Se$	M = 81-2	11.	61.
Di-(*2*-chloropropyl)-	$(CH_3CHClCH_2)_2Se$	B_{10} = 134	9.	7.
Di-*iso*propyl-	$((CH_3)_2CH)_2Se$	—	16.	65.
Di-*n*-butyl-	$(n\text{-}C_4H_9)_2Se$	—	—	23, 24.

Di-(*2*-chloro-*n*-butyl)-	$(CH_3CH_2CHClCH_2)_2Se$	$B_8=138$	9.	7.
Di-*iso*butyl-	$((CH_3)_2CHCH_2)_2Se$	—	—	23, 24, 25.
Di-(*2*-chloro-*n*-amyl)-	$(n\text{-}C_3H_7CHClCH_2)_2Se$	$B_{10}=158$	9.	7.
Di-*iso*amyl-	$((CH_3)_2CHCH_2CH_2)_2Se$	—	—	23, 24, 25.
Diglucosyl-*6*-	$(C_6H_{11}O_5)_2Se$	M = 160+ D = 200	40.	91, 92.
Octa-acetyl deriv. of Diglucosyl-*6*-	$(C_6H_7O_5(COCH_3)_4)_2Se$	M = 150-5	40.	91.
Di-*1*-methoxy deriv. of Di-glucosyl-*6*-	$(1\text{-}CH_3O\text{-}C_6H_{10}O_4)_2Se$	M = 138	40.	91.
Hexa-acetyl deriv. of "Di-glucosyl-*6*-"	$(1\text{-}CH_3OC_6H\ O_4(COCH_3)_3)_2Se$	M = 179-80	15.	91, 92.
Galactosylglucosyl-*6*-*6'*-	$(C_6H_{11}O_5)_2Se$	—	40.	90.
Octa-acetyl deriv. of "Di-glucosyl-6-"	$(C_6H_7O_5(COCH_3)_4)_2Se$	M = 161	15.	90.
Digalactosyl-	$(C_6H_{11}O_5)_22Se$	M = 228	40.	6.
Octaacetyl deriv. of Digalactosyl-	$(C_6H_7O_5(COCH_3)_4)_2Se$	M = 202	15.	6.
Di-isotrehalosyl-	$(C_6H_{11}O_5)_2Se$	M = 193	40.	74, 89.
Octa-acetyl deriv. of Di-isotrehalosyl-	$(C_6H_7O_5(COCH_3)_4)_2Se$	M = 186	15.	74, 89.
Cellulosylglucosyl-	$C_{12}H_{21}O_{10}SeC_6H_{11}O_5$	D = 160±	40.	90.
Hendeca-acetyl deriv. of Cellylosylglucosyl-	$C_{12}H_{14}O_{10}(COCH_3)_7SeC_6H_7O_5Ac_4$	M = 141	15.	90.
Dicellulosyl-	$(C_{12}H_{21}O_{10})_2Se$	M = 215 D = 215	40.	90.
Tetradeca-acetyl deriv. of Dicellulosyl-	$(C_{12}H_{14}O_{10}(COCH_3)_7)_2Se$	M = 252	15.	90.
Complex selenide	$C_2Br_2Se_4$	M = 154	5, 42.	1, 8.
Complex selenide	$C_3BrSe_3+3H_2O$	M = 120	5, 42.	1, 8.
Complex selenide	$C_3Br_2Se_2$	M = 210	5, 42.	1, 8.
Complex selenide	C_4Se	—	5, 42.	1, 8.
Complex selenide	C_5Se_2	—	5, 42.	1, 8.
Complex selenide	$C_9Br_2Se_4$	—	5, 42.	1, 8.
Complex selenide	$C_{16}BrSe_5$	—	5, 42.	1, 8.

LIST OF HETEROCYCLIC SELENIDES

Selenides	*Formulas*	*M.P. or B.P.°C.*	*Methods of Prep.*	*Ref. Nos.*
Di (*1*-phenyl-*2-3*-dimethyl-*4*-pyrro(a)monazolonyl-) (Diantipyryl-)	$(OC\text{-}NPh\text{-}NMe\text{-}CMe=C\text{-})_2Se$	M = 238 M = 240 D = 240	4, 8, 13, 18.	19, 20, 36.
Di (*1*-(*p*-nitrophenyl-)*2-2*-di-methyl-*4*-pyrro(a)monazolonyl-)	$(OC\text{-}N(PN(p\text{-}NO_2\text{-}C_6H_4)\text{-}NMe\text{-}CMe=C\text{-})_2Se$	M = 260± D = 260±	13.	20.
Di (*1*-(*p*-toly-)*2-3*-dimethyl-*4*-pyrro(a) monazolonyl-)	$(OC\text{-}N(p\text{-}Me\text{-}C_6H_4)\text{-}NMe\text{-}CMe=C\text{-})_2Se$	D = 255 M = 255	13.	20.

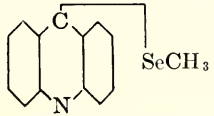
LIST OF AROMATIC HETEROCYCLIC SELENIDES

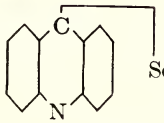
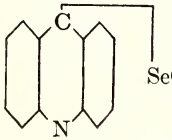
2-4-6-Trinitrophenyl-*5*-acridyl-		D = 198	23.	16.
Picrate of "acridyl-"	$R_2Se\text{-}C_6H_2(NO_2)_3OH$	M = 166	40.	16.

LIST OF HETEROCYCLIC ALIPHATIC SELENIDES

Selenides	*Formulas*	*M.P. or B.P.°C.*	*Methods of Prep.*	*Ref. Nos.*
Methyl-(*1*-phenyl-*3*-methyl-*4*-nitroso-*5*-pyrro(a)monazolyl)-	NPh-N=CMe-C(NO)=CSeCH$_3$	M=117.5	40.	60.
Methyl-(*1*-phenyl-*3*-methyl-*4*-bromo-*5*-pyrro(a)monazolyl)-	NPh-N=CMe-CBr=CSeCH$_3$	M=147	32.	60.
Methyl-(*1*-phenyl-*2*-methiodo-*3*-methyl-*5*-pyrro(a)-monazolyl)-	NPh-N(IMe)=CMe-CH=CSeCH$_3$	M=197	39.	55, 60.
Methyl-(*1*-phenyl-*3*-methyl-*5*-pyrro(a)monazolyl)-	NPh-N=CMe-CH=CSeMe	B_{11}=181	40.	60.
Di *4*-*4'*-(methyl-(*1*-phenyl-*3*-methyl-*5*-pyrro(a)monazolyl)-)	(NPh-N=CMe-C'=CSeMe)$_2$	M=115	40.	60.
Methyl-(*1*-phenyl-*2*-methiodo-*3*-methyl-*4*-dimethylamino-*5*-pyrro-(a)monazolyl)-	(NPh-N(IMe)=CMe-C(NMe$_2$)=CSeMe	M=208	39.	59.
Methyl-(*1*-methyl-*3*-phenyl-*4*-nitroso-*5*-pyrro(a)monazolyl)-	NMe-N=CPh-C(NO)=CSeMe	M=136	40.	58.
Methyl-(*1*-methyl-*3*-phenyl-*4*-bromo-*5*-pyrro(a)monazolyl)-	NMe-N=CPh-CBr=CSeMe	M=129	40.	58.
Methyl-(*1*-methyl-*3*-phenyl-*5*-pyrro-(a)monazolyl)-	NMe-N=CPh-CH=CSeMe-8H$_2$O	M=152	39.	58.
Methyl(*1*-phenyl-*3*-methyl-*4*-benzoyl-*5*-pyrro(a)monazolyl)-	NPh-N=CMe-CBz-CSeMe	M=70	23.	59.
Methyl(*1*-methyl-*3*-phenyl-*5*-pyrro (a) monazolyl)-	NMe-N=CPh-CH=CSeMe	B_{15}=196-7	40.	58.
Di-*4*-*4'*-(Methyl(*1*-phenyl-*3*-methiodo-*3*-methyl-*5*-pyrro(a)monazolyl)-)-	(NPh-N(IMe)=CMe-C'=CSeMe)$_2$	M=249	39.	60.

LIST OF HETEROCYCLIC ALIPHATIC SELENIDES—Continued

Selenides	*Formulas*	*M.P. or B.P.₀C.*	*Methods of Prep.*	*Ref. Nos.*
Methyl-(*1*-phenyl-*4*-bromo-*5*-methyl-*3*-pyrro(a)monazolyl)-	$CBr=CMe\text{-}NPh\text{-}N=C\text{-}SeMe$	M = 178-81	32.	57.
Methyl-(-*1*-phenyl-*2*-methiodo-*5*-methyl-*3*-pyrro(a)monazolyl)-	$CH=CMe\text{-}NPh\text{-}N(IMe)=CSeMe$	M = 180	39.	57.
Methyl(*1*-phenyl-*5*-methyl-*3*-pyrro(a)-monazolyl)-	$CH=CMe\text{-}NPh\text{-}N=CSeMe$	B_{13} = 195	40.	57.
Methyl(*1*-phenyl-*2*-*3*-*4*-*5*-tetrabromo-*5*-methyl-*3*-pyrro(a)monazolyl)-	$CHBr\text{-}CMeBr\text{-}NPh\text{-}NBr\text{-}CBr\text{-}SeMe$	M = 191	40, 41.	57.
Methyl-*2*-pyridyl-	$2\text{-}C_5H_4N\text{-}SeCH_3$	B = 212	40.	56.
Methyl(*1*-methiodo-*2*-pyridyl)-	$1\text{-}(ICH_3)\text{-}C_5H_4N\text{-}2\text{-}SeCH_3$	M = 186	40.	56.
Methyl(1-methchloro-*2*-pyridyl)-	$1\text{-}(ClCH_3)\text{-}C_5H_4N\text{-}2\text{-}SeCH_3$	M = 86	40.	56.
Methyl(*1*-methiodo-*2*-*5*-dimethyl-*4*-pyridyl)-	$1\text{-}(ICH_3)\text{-}2\text{-}5(CH_3)_2\text{-}C_5H_2N\text{-}4\text{-}SeCH_3$	M = 219	40.	56.
Methyl(*1*-methchloro-*2*-*5*-dimethyl-*4*-pyridyl)-	$1\text{-}(ClCH_3)\text{-}2\text{-}5(CH_3)_2\text{-}C_5H_2N\text{-}4\text{-}SeCH_3$	M = 210	40.	56.
Methyl(*2*-*5*-dimethyl-*4*-pyridyl)-	$2\text{-}5\text{-}(CH_3)_2\text{-}C_5H_2N\text{-}4\text{-}SeCH_3$	M = 70	40.	56.
Methyl-*5*-acridyl-		M = 108	23.	16.
Picrate of "acridyl-"	$R_2Se\text{-}C_6H_2(NO_2)_3OH$	M = 176	40.	16.
Methylene di(*1*-phenyl-*2*-methiodo-*3*-methyl-*5*-pyrro(a)monazolyl)-	$(NPh\text{-}N(MeI)=CMe\text{-}CH=CSe\text{-})_2CH_2$	M = 205	39.	60.
Carboxymethyl-(*1*-phenyl-*3*-methyl-*4*-benzoyl-*5*-pyrro(a)monazolyl)-	$NPh\text{-}N=CMe\text{-}CBz=CSe\text{-}CH_2COOH$	M = 157	23.	59.

Benzyl-(*1*-phenyl-*3*-methyl-*4*-benzoyl-*5*-pyrro(a)monazolyl)-	NPh-N=CMe-CBz-CSeCH$_2$Ph	M=146	23.	59.
s-Ethane di(*1*-phenyl-*2*-methiodo-*3*-methyl-*5*-pyrro(a)monazolyl)-	(NPh-N(MeI)=CMe-CH=CSeCH$_2$)$_2$	M=181-8	39.	60.
Benzyl-*5*-acridyl-		M=110	23.	16.
Picrate of Benzyl-*5*-acridyl-	R_2Se-$C_6H_2(NO_2)_3OH$	M=179	40.	16.
2-4-Dinitrobenzyl-*5*-acridyl-		M=273	23.	16.
Picrate of "acridyl-"	R_2Se-$C_6H_2(NO_2)_3OH$	M=218	40.	16.
Ethyl-(*1*-phenyl-*2*-methiodo-*3*-methyl-*4*-dimethylamino-*5*-pyrro(a)monazolyl)-	NPh-N(IMe)=CMe-C(NMe$_2$)=CSeEt	M=170	39.	59.
Ethyl-(*1*-phenyl-*2*-methiodo-*3*-methyl-*5*-pyrro(a)monazolyl)-	NPh-N(IMe)=CMe-CH=CSeEt	M=185	39.	60.
Ethyl (1-methyl-*2*-methiodo-*3*-phenyl-*5*-pyrro(a)monazolyl)-	NMe-N(IMe)=CPhCH=CSeEt	M=118	39.	58.
Ethyl(*1*-phenyl-*3*-methyl-*4*-benzoyl-*5*-pyrro(a)monazolyl)-	NPh-N=CMe-CBz=CSeEt	M=84.	23.	59.
Ethyl(*1*-phenyl-*3*-methyl-*5*-pyrro(a) monazolyl)-	NPh-N=CMe-CH=CSeEt	B_{15}=182	38, 40.	60.

LIST OF ALIPHATIC AROMATIC SELENIDES—Continued

Selenides	*Formulas*	*M.P. or B.P.°C.*	*Methods of Prep.*	*Ref. Nos.*
Ethyl(*1*-phenyl-*2*-methiodo-*3*-methyl-*5*-pyrro(a)monazolyl)-	NPh-N(IMe)=CMe-CH=CSeEt	M=152	39.	55.
Ethyl(*1*-phenyl-*2*-methiodo-*5*-methyl-*3*-pyrro(a)monazolyl)-	CH-CMe-NPh-N(IMe)=CSeEt	M=132	39.	57.
Ethyl(*1*-phenyl-*2*-methiodo-*5*-methyl-*3*-pyrro(a)monazolyl)-	CH=CMe-NPh-N(IMe)=CSeEt	M=110	39.	57.
Ethyl(*1*-methiodo-*2*-*5*-dimethyl-*4*-pyridyl)-	*1*-(ICH_3)-*2*-*5*-(CH_3)$_2$-C_5H_2N-*4*-SeEt	M=155	40.	56.
Ethyl(*1*-methchloro-*2*-*5*-dimethyl-*4*-pyridyl)-	*1*-($ClCH_3$)-*2*-*5*-(CH_2-C_5H_2N-*4*-SeEt	M=126	40.	56.

LIST OF ALIPHATIC AROMATIC SELENIDES

Methyl-phenyl-	CH_3-Se-C_6H_5	B=200-1 B=202-3	23, 32.	17, 26, 71.
Methyl-*2*-carboxyphenyl-	$CH_3SeC_6H_4$-COOH-*2*	M=181 M=180-1	23.	47.
Methyl ester of "carboxyphenyl-"	$CH_3SeC_6H_4$-$COOCH_3$-*2*	M=64-6	40.	47.
Methyl-*4*-carboxyphenyl-	$CH_3SeC_6H_4$-COOH-*4*	M=174	23.	28.
Methyl-*1*-naphthyl-	$CH_3SeC_{10}H_9$-*1*	B_{16}=173	23.	49.
Methyl-*2*-naphthyl-	$CH_3SeC_{10}H_9$-*2*	M=54	23.	49.
Carboxymethylphenyl-	$HOOCCH_2SeC_6H_5$	B_{750}=160 M=36-7 M=40	23.	17, 62.
Carboxymethyl-*4*-bromophenyl-	$HOOCCH_2SeC_6H_4$-Br-*4*	M=127	23.	62.

Carboxymethyl-*2*-chlorophenyl-	$HOOCCH_2SeC_6H_4$-Cl-*2*	M = 98-9	23.	3, 4.
Carboxymethyl-4-chlorophenyl-	$HOOCCH_2SeC_6H_4$-Cl-*4*	M = 113-4	23.	3, 4.
Carboxymethyl-*2*-methoxyphenyl-	$HOOCCH_2SeC_6H_4$-OCH_3-*2*	M = 86-7	23.	3, 4.
Carboxymethyl-*4*-methoxyphenyl-	$HOOCCH_2SeC_6H_4$-OCH_3-*4*	M = 69-70	23.	3, 4.
Carboxymethyl-*4*-methyl mercaptophenyl-	$HOOCCH_2SeC_6H_4$-SCH_3-*4*	M = 75-6	40.	3, 4.
Carboxymethyl-*4*-(carboxymethyl thio) phenyl-	$HOOCCH_2Se$-C_6H_4-SCH_2COOH-*4*	M = 204-5	40.	3.
4-carboxymethyl-selenide of the ethyl ester of phenyl dithiocarbonic acid	$HOOCCH_2SeC_6H_4$-$SCSOC_2H_5$-*4*	—	40.	3.
Carboxymethyl-*2*-tolyl-	$HOOCCH_2SeC_6H_4$-CH_3-*2*	M = 70-1	23.	3, 4, 72.
Carboxymethyl-*2*-carboxyphenyl-	$HOOCCH_2SeC_6H_4$-COOH-*2*	M = 233-4	23.	46, 47.
Dimethyl ester of Carboxymethyl-*2*-carboxyphenyl-	$CH_3OOCCH_6SeC_6H_4$-$COOCH_3$-*2*	M = 62-3	40.	47.
Diethyl ester of Carboxymethyl-*2*-carboxyphenyl-	$C_2H_5OOCCH_2SeC_6H_4$-$COOC_2H_5$-*2*	B = —	40.	47.
Carboxymethyl-*4*-tolyl-	$HOOCCH_2SeC_6H_4$-CH_3-*4*	M = 97-8	23.	3, 4, 17, 62.
Carboxymethyl-*3*-*4*-dimethylphenyl-	$HOOCCH_2SeC_6H_3$-$(CH_3)_2$-*3*-*4*	M = 88	23.	72.
Carboxymethyl-*2*-*4*-dimethylphenyl-	$HOOCCH_2SeC_6H_3$-$(CH_3)_2$-*2*-*4*	M = 90.5	23.	72.
Carboxymethyl-*2*-nitrophenyl-	$HOOCCH_2SeC_6H_4$-NO_2-*2*	M = 165	23.	3, 4.
Acid anhydride of carboxymethyl-*2*-aminophenyl-	$O(COCH_2SeC_6H_4$-NH_2-*2*$)_2$	M = 182	40.	3.
Carboxymethyl-*3*-nitrophenyl-	$HOOCCH_2SeC_6H_4$-NO_2-*3*	M = 90-1	22.	3.
Carboxymethyl-*4*-nitrophenyl-	$HOOCCH_2SeC_6H_4$-NO_2-*4*	M = 119-20	23.	3, 4.
Carboxymethyl-*4*-aminophenyl-	$HOOCCH_2SeC_6H_4$-NH_2-*4*	M = 156	40.	3.
Carboxymethyl-*2*-*4*-dinitrophenyl-	$HOOCCH_2SeC_6H_4$-$(NO_2)_2$-*2*-*4*	M = 168	23, 25.	5.
Carboxymethyl-*1*-naphthyl-	$HOOCCH_2SeC_{10}H_7$-*1*	M = 54	23.	62.
Benzyl-*4*-tolyl-	$C_6H_5CH_2Se$-C_6H_4-CH_3-*4*	M = 32-3	23.	79, 80.
Benzyl-*1*-naphthyl-	$C_6H_5CH_2Se$-$C_{10}H_7$-*1*	M = 68-9	23.	79, 80.
Picrate of "naphthyl-"	R_2Se-$C_6H_2(NO_2)_3OH$	M = 118	40.	79, 80.

LIST OF HETEROCYCLIC ALIPHATIC SELENIDES—Continued

Selenides	*Formulas*	*M.P. or B.P.°C.*	*Methods of Prep.*	*Ref. Nos.*
Ethylphenyl-	$C_2H_5SeC_6H_5$	B = 214-6	23.	17, 26
Ethyl-*4*-tolyl-	$C_2H_5Se\text{-}C_6H_4\text{-}CH_3\text{-}4$	—	—	17.
Ethyl-*1*-naphthyl-	$C_2H_5SeC_{10}H_7\text{-}1$	B_{13} = 167-8	23.	49.
Isopropyl-*1*-naphthyl-	$(CH_3)_2CHSeC_{10}H_7\text{-}1$	B_{14} = 165-7	23.	49.
n-Butyl-*1*-naphthyl-	$n\text{-}C_4H_9SeC_{10}H_7\text{-}1$	B_{13} = 180	23.	49.
n-Butyl-*2*-naphthyl-	$n\text{-}C_4H_9SeC_{10}H_7\text{-}2$	M = 137	23.	49.
Iso-Amylphenyl-	$(CH_3)_2CHCH_2CH_2SeC_6H_5$	B_3 = 105	23.	26.

BIBLIOGRAPHY

1. Bartal, A. von. Action of selenium on carbontetra bromide. J. Chem. Soc. **1906**, A II. 746. Same as Chem. Ztg. **30**, 810-2 (1906).

2. Bauser, H. W., Gibson, C. S. and Pope, W. J. Interaction of ethylene and selenium monochloride. J. Chem. Soc. **1920**, T. I. 1453-6.

3. Behaghel, O. and Rollmann, M. Zur Kenntnis einiger Aryl-selenglykolsauren. J. prakt. Chem. **123**, 336-45 (1929).

4. Behaghel, O. and Rollman, M. Ueber die Veranderung der Aceditat von Glykolsaure—und Thio-glykolsäure-Abkommlingen beim Ersatz des Sauerstoffs und Schwefels durch Selen. Ber. **62B**, 2693-6 (1929).

5. Behaghel, O. and Rollmann, M. Ueber die Spaltung der Selen-cyanessigsaure. Ber. **62B**, 2696-9 (1929).

6. Beuther, A. and Schneider, W. Schwefelhaltige Dissaccharide aus Galaktose. Ber. **52B**, 2131-5 (1919).

7. Boord, C. E. and Cope, F. F. The action of selenium monochloride on propylene, butylene, and amylene. J. Am. Chem. Soc. **44**, 395-401 (1922).

8. Briscoe, H. V. A., Peel, J. B. and Rowlands, J. R. Interaction of carbontetrabromide with sulphur and selenium. J. Chem. Soc. **1929**, 1766-8.

9. Carrara, G. Sulle selenitine. Nuova serie di composti del selenio. Gazz. chim. ital. **24**, II, 173-9 (1894).

10. Chabrie, M. C. Premiers essais de synthese de compose organiques selenies dans la serie aromatique. Bull. soc. chim. **50**, 133-7 (1888).

11. Chabrie, M. C. Synthese de quelques composes selenies dans la serie aromatique. Compt. rend. **109**, 182-5 (1889).

12. Chabrie, M. C. Sur la Synthese de quelques composes selenies dans la serie aromatique. Ann. chim. phys. (6), **20**, 202-86 (1890).

13. Challenger, F., Peters, A. T. and Halévy, J. The introduction of the selenocyano-group into aromatic compounds. J. Chem. Soc. **1926**, 1648-55.

14. Coos, N. Ueber Selendilactylsauren. Ber. **35**, 4109-12 (1902).

15. Drory, A. Zur Kenntnis des *o*-Cyanbenzylchlorids und des *o*-Cyanbenzalchlorides. Ber. **24**, 2563-74 (1891).

16. Edinger, A. and Ritsema, J. C. Zur Kenntnis des Thioakridons und des Selenakridons. J. prakt. chem. (2) **68**, 72-99 (1903).

17. Edwards, O. K., Gaythwaite, W. R., Kenyon, J. and Phillips, H. The quadrivalency of selenium. Part III. The instability of the compounds of quadrivalent selenium derived from phenylmethyl and phenylethyl selenides and phenyl and *p*-tolylselenoglycollic acids. J. Chem. Soc. **1928**, 2293-2303.

18. Ethyl Gasoline Advertisement. Ind. Eng. Chem. **21**, 112 (Adv. sect.) (1929).

19. Farbwerke vorm. Meister, Lucius and Bruning. Production of aromatic selenium compounds. J. Chem. Soc. 1918, A. I. 218. Same as Chem. Zentr. **1917**, II. 509-10 and as D. R. P. 299510 (1917).

20. Farbwerke vorm. Meister, Lucius and Bruning. Preparation of aromatic selenium compounds. J. Chem. Soc. **1922**, A. I. 1066. Same as Chem. Zentr. **1922**, IV, 46 and as D. R. P. No. 348906 and No. 350376.

21. Frerichs, H. and Wildt, E. Ueber die Einwirkung von Natriumhydroxid auf Verbindungen der Dithiodiglycolsaure und der Diselenodiglykolsaure. Ann. **360**, 105-27 (1908).

22. Frerichs, H. Action of potassium selenocyanate on compounds of chloracetic acid. J. Chem. Soc. **1903,** A. I. 609. Same as Arch. Pharm. **241,** 177-222 (1903).

23. Fritzmann, E. Ueber Komplexverbindungen des Platins mit organischen Seleniden. I. Zeit. anorg. chem. **73,** 239-55 (1911).

24. Fritzmann, E. Ueber elektrische Leitfahigkeit komplexer Verbindungen des Platins und Palladiums mit organischen Monoseleniden. III. Zeit. anorg. chem. **133,** 133-52 (1924).

25. Fritzmann, E. Ueber Komplexverbindungen des Palladiums mit organischen Seleniden. II. Zeit. anorg. chem. **133,** 119-32 (1924).

26. Foster, D. G. and Brown, S. F. Organic selenium compounds. Some derivatives of aromatic seleno-ethers. J. Am. Chem. Soc. **50,** 1182-8 (1928).

27. Fromm, E. and Martin, K. Versuche zur Einführung von Selen in organische Verbindungen. Ann. **401,** 177-88 (1913).

28. Gaythwaite, W. R., Kenyon, J. and Phillips, H. The quadrivalency of selenium. Part I. 4-carboxydiphenyl and *p*-carboxyphenylmethyl selenoxides. J. Chem. Soc. **1928,** 2280-7.

29. Gaythwaite, W. R., Kenyon, J. and Phillips, H. The quadrivalency of selenium. Part II. The simple halogen derivatives and the dihydroxide of 4-acetamidodiphenyl selenide. J. Chem. Soc. **1928,** 2287-93.

30. Godchaux, E. Ueber die Einwirkung von Selenylchlorid auf tertiäre aromatische amine. Ber. **24,** 765-7 (1891).

31. Hanzlik, P. J. and Tarr, J. The comparative skin irritant properties of dichloroethyl sulfide ("Mustard gas") and other agents. J. Pharmacol. **14,** 221-8 (1919).

32. Heath, F. H. and Semen, W. L. The reaction between selenium monochloride and ethlene. J. Ind. Eng. Chem. **12,** 1101-1 (1920).

33. Jackson, C. L. Ueber einige Methyl und Benzyl-selenverbindungen. Ann. **179,** 1-21 (1875).

34. Jackson, C. L. Ueber Methyl und Benzylmonoselenid. Ber. **8,** 109-12 (1875).

35. Joy, C. A. Ueber das Selenäthyl. Ann. **86,** 35-9 (1853).

36. Konek, F. von and Schleifer, O. Ueber neue selenhaltige Derivate des Antipyrins. Ber. **51,** 842-55 (1918).

37. Krafft, F. and Vorster, W. Ueber Unwandlung des Diphenylsulfons in Diphenylsulfid und Diphenylselenid, Ber. **26,** 2813-22 (1893).

38. Krafft, F. and Lyons, R. E. Ueber Diphenylselenid und einige Derivate desselben. Ber. **27,** 1761-8 (1894).

39. Krafft, F. and Lyons, R. E. Ueber Diphenyltellurid und ein Verfahren zur Darstellung von Sulfiden, Seleniden, und Telluriden. Ber. **27,** 1768-73 (1894).

40. Krafft, F. and Kaschau, A. Ueber die Synthese der aromatischen Selvenverbindungen vermittelst chloraluminium. Ber. **29,** 429-35 (1896).

41. Krafft, F. and Lyons, R. E. Ueber Diphenylselenon. Ber. **29.** 424-8 (1896).

42. Krafft, F. and Steiner, O. Ueber Verdrangungen in der Schwefel-Selen-Tellur-Gruppe. Ber. **34,** 560-5 (1901).

43. Kunckell, F. Ueber einige Selenderivate des Anisols und Phenetols. Ber. **28,** 609-12 (1895).

44. Kunckell, F. and Zimmermann, R. Ueber selenderivate aromatischen Ketone. Ann. **314,** 281-95 (1901).

45. Leicester, H. M. and Bergstrom, F. W. Salts of triphenylselenonium Hydroxide. J. Am. Chem. Soc. **51,** 3587-91 (1929).

46. Lesser, R. and Weiss, R. Ueber den "Selenindigo" (Bis-selenonaphthenindigo) und selenhaltige aromatische Verbindungen I. Ber. **45,** 1835-41 (1912).

47. Lesser, R. and Weiss, R. Ueber selenhaltige aromatische Verbindungen. II. Ber. **46,** 2640-58 (1913).

48. Lesser, R. and Weiss, R. Ueber Selenoxanthon und Selenoxanthoncarbonsaure. Ueber selenhaltige aromatische Verbindungen. V. Ber. **47,** 2510-26 (1914).

49. Loevenich, J. Fremdling, H. and Fohr, M. Ueber *alpha*-und *beta*-Selen-Abkömmlinge des Naphthalins. Ber. **62B,** 2856-65 (1929).

50. Loevenich, J. and Sipmann, K. Ueber die Einwirkung von Selenbromur auf aromatische Kohlenwasserstoff. J. prakt. Chem. **124,** 127-32 (1930).

51. Lowig, C. Pogg. Ann. **37,** 552 (1836).

52. Lyons, R. E. and Bush, G. C. Concerning *alpha*-dinaphthyl selenide and telluride. J. Am. Chem. Soc. **30,** 831-6 (1908).

53. Lyons, R. E. and Bradt, W. E. Ueber die Darstellung von Organoselenverbindungen mittels der Friedel-Craftsschen Reaktionen. Ber. **60B,** 60-3 (1927).

54. Michaelis, A. and Kunckell, F. Ueber organische Selenverbindungen. Ber. **30,** 2823-8 (1897).

55. Michaelis, A. and Stein, M. Ueber das Selenopyrin und dessen Homologe. Ann. **320,** 32-44 (1902).

56. Michaelis, A. and Holken, A. Ueber Thio- und Selenoderivate von N-Alkyl-pyridonen und -lutidonen. Ann. **331,** 245-64 (1904).

57. Michaelis, A. and Hahn, W. Untersuchungen ueber 3-Pyrazolone. 2. Ueber das 3-Thiopyrin und das 3-Selenopyrin. Ann. **338,** 292-310 (1905).

58. Michaelis, A. and Hagen, T. von. Untersuchungen ueber das 1-methyl-3-phenyl-5-pryazolon. 3. Das Isoselenopyrin. Ann. **352,** 193-8 (1907).

59. Michaelis, A. and Langenkamp, P. Ueber ein Selenopyrazolon und ueber das Selenopyramidon. Ann. **404,** 21-36 (1914).

60. Michaelis, A. and Duntze, E. Ueber das Pseudo- und Bis-selenopyrin. Ann. **404,** 36-45 (1914).

61. Morgan, G. T., Drew, H. D. K., and Barker, T. V. Researches on residual affinity and coordination. Part IX. Interaction of selenium tetrachloride with *beta*-diketones. J. Chem. Soc. **1922,** T. II. 2432-73.

62. Morgan, G. T. and Porritt, W. H. Arylselenoglycollic Acids. J. Chem. Soc. **1925,** T. II. 1755-9.

63. Morgan, G. T. and Burstall, F. H. Interactions of selenium oxychloride and phenols. J. Chem. Soc. **1928,** 3260-70.

64. Nagai, Y. Effect of antiknock materials on the condenser-discharge-spark energy required to ignite the mixture of air with the vapor of ethyl ether. Chem. Absts. **22,** 1231 (1928). Same as Proc. Imp. Acad. (Japan), **3,** 664-9 (1927).

65. Natta, G. Einwirkung von Aluminiumselenid, tellurid und arsenid und von Magnesiumarsenid auf Alkohole und Äther. Chem. Zentr. **98,** I, 415-6 (1927). Same as Giorn. di Chim. ind. ed appl. **8,** 367-70 (1926).

66. Petren, J. Ueber Platinathylselenverbindungen. Zeitsch. anorg. Chem. **20,** 62-6 (1899).

67. Pieroni, A. and Coli, C. Azione del bromuro di selenio sui magnesioalchili. Gazz. chim. ital. **44,** II, 349-53 (1914).

68. Pieroni, A. and Balduzzi, G. The action of selenium bromide on the magnesium bromide derivatives. II. Chem. Abst. **10,** 1514 (1916). Same as Gazz. chim. ital. **45,** II, 106-111 (1915).

69. Pieverling, L. von. Beitrag zur Kenntnis der Selenverbindungen. Ann. **185,** 331-9 (1877).

70. Pieverling, L. von. Ein Beitrag zur Kenntnis der Selenverbindungen. Ber. **9,** 1469-71 (1877).

71. Pope, W. J. and Neville, A. Assymetric optically active selenium compounds and the sexavalency of selenium and sulphur. d- and l-Phenylmethylselenetine salts. J. Chem. Soc. **1902,** T. II. 1552-63.

72. Porritt, W. H. Arylseleninic acids. J. Chem. Soc. **1927,** 27-9.

73. Rathke, B. Beitrage zur Kenntnis des Selens. Ann. **152,** 181-220 (1869).

74. Schneider, W. and Wrede, F. Synthese eines schwelfelhaltingen und eines selenhaltingen Dissaccharides. Ber. **50,** 793-804 (1917).

75. Schulze, E. and Ulrich, A. Correspondenzen. Ber. **8,** 773, (1875).

76. Stoecker, M. and Krafft, F. Ueber Oxydation von Diphenyldiselenid. Ber. **39,** 2197-2201 (1906).

77. Strecker, W. and Willing, A. Einwirkung von Organomagnesiumverbindungen auf die Halogenide des Selens. Ber. **48,** 196-206 (1915).

78. Strecker, W. and Daniel, W. Spektrochemische Untersuchungen an den Estern der selenigen Saure und der Selensaure. Ann **462,** 186-94 (1928).

79. Taboury, M. F. Sur quelques composes selenies. Bull. soc. chim. (3), **35,** 668-74 (1906).

80. Taboury, M. F. Contribution a l'etude des composes sulfures et selenies dans la serie aromatique. Ann. chim. phys. (8) **15,** 5-66 (1908).

81. Takamatsu, M. Organoselenic Compound. Chem. Abst. **22,** 3400 (1928). Same as J. Pharm. Soc. Japan **48,** 450-3 (1928).

82. Tanaka, Y. and Nagai, Y. III. Influence of diethylselenide and of hydrogen selenide on the limits of inflammability of hydrogen—air mixtures. Chem. Absts. **21,** 1186 (1927). Same as Proc. Imp. Acad. (Japan) **2,** 494-7 (1926).

83. Tanaka, Y. and Nagai, Y. IV. Influence of dimethyl selenide and dimethyl telluride on the limits of inflammability of hydrogen—air mixtures. Chem. Absts. **21,** 4071 (1927). Same as Proc. Imp. Acad. (Japan) **3,** 348-51 (1927).

84. Tanaka, Y. and Nagai, Y. V. Influence of dimethyl selenide and dimethyl telluride on the limits of inflammability of hydrogen—air mixtures. Chem. Absts. **22,** 1854 (1928). Same as J. Soc. Chem. Ind. Japan, **30,** 653-7 (1927).

85. Tanaka, Y. and Nagai, Y. Spontaneous ignition temperatures of various inflammable liquids and the effects of anti-knock materials. Chem. Absts. **21,** 323 (1927). Same as J. Soc. Chem. Japan. **29,** 266-72 (1926).

86. Tanaka, Y. and Nagai, Y. Vapor pressures of diethyl-selenide, tetramethyl tin and tetramethyl lead. Chem. Absts. **23,** 2622 (1929). Same as Proc. Imp. Acad. (Japan) **5,** 78-9 (1929).

87. Tschugaeff, L. Ueber Selenomercaptane und einige Derivate derselben. Ber. **42,** 49-54 (1909).

88. Twiss, D. F. Action of nitrosubstituted aryl haloids on alkali thiosulfates and selenosulfates. Proc. Chem. Soc. **30,** 185 (1914).

89. Wrede, F. Synthese von zwei neuen Dissachariden und ihr biologisches Verhalten. Biochem. Zeitsch. **83,** 96-102 (1917).

90. Wrede, F. Synthese von schwefel- und selenhaltigen Zuckern. Zeitsch. Physiol. Chem. **112,** 1-12 (1920).

91. Wrede, F. Synthese von schwefel- und selenhaltigen Dissacchariden durch Verkettung von zwei Glucoseresten in der C_6-Stellung -Ueber einige neue Derivate der 6-Bromglucose. Zeitsch. Physiol. Chem. **115,** 284-304 (1921).

92. Wrede, F. and Zimmermann, W. Ueber Versuche zur kunstlichen Darstellung von Dissacchariden aus schwefel- und selenhaltigen zucherderivaten und ueber deren Oxydationsprodukte. Zeitsch. Physiol. Chem. **148,** 65-82 (1925).

93. Wöhler, F. and Dean, J. Versuche über Tellyramyl und Selenmethyl. Ann. **97,** 1-9 (1856).

94. Zeiser, F. Ueber einige schwefel- selen- und tellurhaltige Ditolylverbindungen. Ber. **28,** 1670-5 (1895).

95. Zoppellari, Gazz. chim. ital. **24,** II, 398 (1894).