

Index

a

- (+)-absinthin 124–126
- (+)-ABT-341 69
- acetic acid, Kolbe's synthesis of 2
- 11-acetoxy-4-deoxyasbestinin D, Crimmins' total synthesis 164, 165
- acid hydrolysis 375
- (+)-acutiphyacin synthesis 277–278
- aeruginosin 384
- ainsliatrimmer A 400
- alcohol esterification 414
- aldehydes, *in situ* protection 39
- alkaloids, synthesis of
 - amino acids 347–361
 - carbohydrates 361–369
 - terpene and α -hydroxyl acid 370–371
- alkaloids total synthesis
 - (–)-flustramine B 298–299
 - (–)-galanthamine 304–305
 - galbulimima alkaloid (–)-GB17 304–305
 - (+)-lunarine 304–305
 - (–)-lycoramine 303–304
 - (+)-minfiensine 299–300
 - (–)-nakadomarin A 300–301
 - spiroindolines 303
 - tetracyclic intermediate 301–302
- alkenes, Sharpless enantioselective dihydroxylation of 31
- (+)-aloperine, Overman's total synthesis of 161, 162
- (+)-ambruticin S 385, 387, 388
- amides 34
- α -amino acids 346, 347
- amino acids, chiron approach
 - aeruginosin 384
 - (+)-ambruticin S 385, 387, 388
 - benzotrifluoride 385
 - 2-carboxy-5-hydroxyoctahydroindole core 383
 - cyclopropane 387
 - D-arabinose 385
 - enantiopure aeruginosin 383
 - "epoxide-inversion" reaction 382
 - hemiaminal acetate 384
 - L-theronine 382, 383
 - Marshall's protocol 387
 - pactamycin and pactamycate 383
 - polygalolides 384, 385
 - (R)-Roche ester 387
 - stereoselective Mukaiyama-type intramolecular aldol condensation 382
 - trans*-chloroallyl phosphonamide 386
- amorpha-4,11-diene 468, 469

(-)-angiopterlactone A 77–79
aniline purple (mauveine) 8
antibiotic tetracycline analogs 54
arabinogalactan 10–11
Armstrong, R. 322–324
aromadendrane sesquiterpenes
93–94
artemisinic acid 468
artemisinin 16–18, 469–471, 473
aspergillide A synthesis 288, 289
asymmetric multicomponent
reactions (AMCRs) 38
asymmetric organocatalysis
alkaloids total synthesis
(-)-flustramine B 298–299
(-)-galanthamine 304–305
galbulimima alkaloid (-)-GB17
304–305
(+)-lunarine 304–305
(-)-lycoramine 303–304
(+)-minfiensine 299–300
(-)-nakadomarin A 300–301
spiroindolines 303
tetracyclic intermediate
301–302
macrolides synthesis
callipeltoside C 310–311
(+)-cytotrienin A 311–312
diazonamide A 312–313
peptide natural products
313–314
terpenoids and multicyclic natural
products
(+)-brasoside 306–307
(+)-hirsutene 306
(+)-littoralisone 306–307
ricciocarpin A 307–308
seragakinone A 308–309
azonalenin 71, 72
atom economy 32
auristatins 408
avermectin 16–18
azadirachtin 14

b
Baeyer–Villiger oxidation 375
Baran, P. S. 34, 456–457
basiliolide B, Stoltz's total synthesis
of 173
Batey, R. A. 320–321
Bauer, S. M. 322–324
BE-43472B, Nicolaou's total synthesis
of 183–185
benzotrifluoride 385
betulin 416
betulinic acid 416
Biginelli reaction (B-3CR) 38
bioactive natural products
chemical biology
ainsliatrimmer A 400
cell-based phenotypic
screenings 401
colchicinevinblastine 397
diazonamide A 397
diterpenoids 399
genetic manipulation 397
ornithine δ -amino transferase
(OAT) 398
signaling pathways 397
chemical genomics 396
macromolecular targets 396
promiscuous enzymes and
mutations 396
random mutations 396
secondary metabolites 395
therapeutic intervention 396
biology-oriented synthesis (BIOS)
52, 420–422
Diels–Alder reaction of diene 420
dysidiolide-inspired compounds 422
nakijiquinone C 420, 421
natural phosphatase inhibitor
dysidiolide 420
phosphatases and cytotoxic
activity 422
protein structure similarity
clustering 420

- ring-closing metathesis (RCM)
 reaction 422
 structural classification of
 natural products
 (SCONP) 420
 VEGFR-2 inhibitor 420
- biomimetic synthesis 41
 biosynthesis 42
 building-block strategy 47, 49
 cascade polycyclizations 45
 C–H bond functionalization
 strategy 46–48
 collective synthesis strategy
 49, 50
 (\pm)-dihydroprotodaphniphylline 44
 oligomerization 50
 one-pot cascade reactions/
 sequences 42–43
 organocatalytic asymmetric cascade
 reactions 45
 (\pm)-progesterone 44
 site and stereoselective
 reactions 46
 unique complexity index 46
- Boger, D. L. 55–56
- bolivianine, Liu's total synthesis
 of 180–181
- bovine insulin 2
- (+)-brasoside 306–307
 (–)-brasoside 376
- brevetoxin B synthesis 278–281
- bryostatins 419–420
- Burns, N. Z. 34
- c**
- Cadiot–Chodkiewicz
 heterocoupling 327
- callipeltoside C 310–311
- calystegine B-4 synthesis
 333–334
- Campbell, W.C. 16
- camphorsulfonic acid 321
- (*S*)-camptothecin 86–87
- carbohydrates 346, 361–369
- carbonyl/alkene reductive reactions,
 SmI₂-mediated 275–276
- 2-carboxy-5-hydroxyoctahydroindole
 core 383
- (+)-cardamom peroxide 78–79
- (+)-3-carene 373
- carpanone 415
- (+)-carvone 121, 375, 376
- (*s*)-carooneoxide 89, 91
- cascade reactions 42–45, 159–160
- celogentin 262
- C3 ester pyrrole, iridium-catalyzed
 C–HG borylation of 267–268
- C–H activation-based strategy
 celogentin 262
 complanadine 267
 coralydine 263, 264
 dragmacidin D 265, 266
 eudesmane diterpenoids 270
 (+)-linoxepin 266
 (+)-lithospermic acid 263, 265
 oxychelerythrine 268, 269
 piperaborenine B 262–263
 (–)-rhazinilam 261–262
 (–)-chaetominine 80–81
 (+)-chatancin
 Deslongchamps' total synthesis
 of 166–167
 Maimone's eight-step total synthesis
 of 103–105
- Chauvin, Y. 245
- C–H bond functionalization strategy
 46–48
- chelidonine, Hsung's total synthesis
 of 172–173
- chemical biology 51
- chemical genetics 51
- chemoselectivity 29, 30
- Chida's chemoselective transformations
 29, 30
- (–)-chimonanthine 79–80
- chiral building block 47, 345

- chiron approach 47, 345
 - alkaloids, synthesis of
 - amino acids 347–361
 - carbohydrates 361–369
 - terpene and α -hydroxyl acid 370–371
 - amino acids
 - aeruginosin 384
 - (+)-ambruticin S 385, 387, 388
 - benzotrifluoride 385
 - 2-carboxy-5-hydroxyoctahydroindole core 383
 - cyclopropane 387
 - D-arabinose 385
 - enantiopure aeruginosin 383
 - “epoxide-inversion” reaction 382
 - hemiaminal acetate 384
 - L-theronine 382, 383
 - Marshall’s protocol 387
 - pactamycin and
 - pactamycate 383
 - polygalolides 384, 385
 - (*R*)-Roche ester 387
 - stereoselective Mukaiyama-type intramolecular aldol condensation 382
 - trans*-chloroallyl phosphonamide 386
 - α -amino acids 346, 347
 - carbohydrates 346
 - cyclitols 346, 347
 - α -hydroxy acids 346
 - terpenes 346
 - terpenoids, synthesis of
 - acid hydrolysis 375
 - Baeyer–Villiger oxidation 375
 - (–)-brasoside 376
 - (+)-3-carene 373
 - (+)-carvone 375, 376
 - chelation-controlled hydride reduction 373
 - chemoselective NaBH_4 reduction 382
 - C-12 hydroxyl group 373
 - Dess–Martin oxidation 376
 - (+)-fomannosin 382
 - Horner–Emmons olefination 375
 - ingenol 371
 - (+)-ingenol 373
 - intramolecular Diels–Alder reaction 375
 - (–)-littoralisone 376, 377
 - Mn-catalyzed allylic oxidation 375
 - N*-chlorosuccinimide (NCS) 373
 - non-strategic redox transformations 382
 - nucleophilic addition 379
 - oxidase phase 373
 - Pauson–Khand cyclization 373
 - (–)-platensimycin 375
 - regioselective allylic oxidation 373
 - (–)-samaderine Y 373
 - sesquiterpenoid peribysin E 379, 380
 - Shibuya allylic oxidation 373
 - SmI_2 -mediated dehydroxylation 382
 - zirconocene-promoted ring contraction reaction 379, 381
- chloptosin 313–314
- C–H oxidative macrolactonization reaction 270
- (–)-citronellol 376
- complanadine 267
- construction reactions 28
- convergent synthesis 41
- coralydine 263, 264

- Corey, E. J. 8
- (-)-cyanolide A 87–89
- (-)-cyanthiwigin F 110–111
- cyclitols 346, 347
- cyclization-initiated Diels–Alder
cascades 175–179
- (-)-cycloclavine 105–108
- cyclopropane 387
- (+)-cytotrienin A 311–312
- cytovaricin 6
- d**
- D-arabinose 385
- Dess–Martin oxidation 376
- diazonamide A 282–284,
312–313, 397
- Diels–Alder initiated cascades
180–185
- Diels–Alder reaction 159
of diene 420
Povarov hetero reaction 320
- (+)-dihydrocompactin, Trauner’s total
synthesis of 175, 176
- dimerization strategy 416
- direct C–H oxidation 268
- diterpenoids 399
- (-)-ditryptophenaline 71–73
- diversity-oriented synthesis
(DOS) 51, 411–418
alcohol esterification 414
aminolysis of lactone moiety
414
benzyl iodide substituents 413
betulin and betulinic acid 416
carpanone 415
cross-coupling reactions 414
dimerization strategy 416
electrophilic lactone and epoxide
moieties 413
epoxide ring opening 414
functional group pairing patterns
(FGPPs) 416
glycopeptide antibiotics 414
intramolecular Diels–Alder 415
library design strategies 415
lycopodium alkaloids 417
paclitaxel (Taxol) and
vincristine 415
protein–protein interactions
412, 415
ring-opening-closing olefin
metathesis 415
skeletal diversification 416
solid-phase split-and-pool
technique 413
structure-activity relationships
(SAR) 416
tandem acylation/1,3-dipolar
cycloaddition 413
Ugi four-component coupling 415
- D-myoinositol-1-phosphate
(D-I-1P) 46, 47
- dragmacidin D 265, 266
- du Vigneaud, V. 3
- e**
- echinopines A and B, Chen’s total
synthesis of 167–168
- (±)-echitamidine 163, 164
- E factors 32
- eight-step enantioselective total
synthesis
(+)-chatancin 103–105
(-)-cycloclavine 105–108
(-)-englerin A 100–101
(-)-jiadifenolide 102–103
(-)-neothiobinupharidine
108–109
(+)-*trans*-clerodane
iterpenoid 99–100
- electrochemical synthesis
Baran’s total synthesis of dixiamucin
B 456–457
(-)-guanacastepene E
synthesis 454
(-)-heptemerone B synthesis 454

- electrochemical synthesis (*cont'd*)
- Little's total synthesis of
 - daucene 455
 - Moeller's total synthesis of
 - alliacol 453
 - principle 453
 - radical ions 452
 - renewable energy 452
 - stoichiometric oxidants and
 - reductants 452
 - Umpolung process 454
 - Yao's synthesis of azonazine
 - 455–456
- eleven-step enantioselective total synthesis, of (–)-maoecrystal V 125–128
- Eli Lilly's Open Innovation Drug Discovery Program 473
- elisabethin A, Mulzer's total synthesis of 168–169
- enantiopure aeruginosin 383
- enantioselective synthesis 67, 138–149, 467
- (–)-englerin A 100–101
- α - β -enone, *in situ* protection 39
- (–)-6-*epi*-ophiobolin N 112–114
- epothilone A synthesis
 - 284, 285
- "epoxide-inversion" reaction 382
- erythromycin 6
- erythronolide B 6
- erythropoietin (EPO) 10
- eudesmane diterpenoids 270
- Euphorbia* diterpenes, biosynthetic pathway for 129
- eurystatin, synthesis of 321–322
- f**
- (+)-fastigiatine 96–98
- fifteen-step enantioselective total synthesis
 - (+)-pactamycin 134–137
 - (+)-ryanodol 132–134
- five-step/five-pot enantioselective total synthesis
 - aflatoxin B₂ 85, 86
 - (+)-artemisinin 84–85
 - (+)-machaeriols B and D 83–84
 - Δ^9 -tetrahydrocannabinols
 - 81–83
- flow chemistry
 - 2,3-butane diacetal synthesis 458
 - flow reactor configurations and
 - components 457
 - homoallylic alcohol synthesis 459
 - Oishi's reductive etherification 458
 - spirodial synthesis 458, 459
- flow electrochemistry 462
- flow photochemistry 460–461
- (–)-flustramine B 298–299
- (+)-fomannosin 382
- four-step enantioselective total synthesis
 - (–)-angiopterlactone A 77–79
 - (+)-cardamom peroxide 78–79
 - (–)-chaetominine 80–81
 - (–)-chimonanthine 79–80
- fourteen-step enantioselective total synthesis 129–132
- fragmentation reactions,
 - SmI₂-mediated 277
- FR901483, Huang's enantioselective synthesis 30
- (–)-FR182877, Nakada's total synthesis of 182, 183
- (+)-FR182877, Sorensen's total synthesis of 182
- Fukui, K. 4
- functional group pairing patterns (FGPPs) 416
- function-oriented synthesis
 - (FOS) 51–52, 418–420
 - activity-determining structural features 418–419
 - bryostatins 419–420
 - (+)-fusarisetin A 118–121

g

- (-)-galanthamine 304–305
- (±)-galanthamine, Cho's total synthesis of 161
- galbulimima alkaloid (-)-GB17 304–305
- α -Gal pentasaccharide 40
- Ganem's chemoselective transformations 29, 30
- Gao, X. 324–326
- George, M. W. 469
- ginkgolide 6
- glycopeptide antibiotics 414
- gold-catalyzed reactions
 - aldehydes/ketones and enynes 194
 - azadirachtin 193, 194
 - azaspiracids 192
 - benzannulation reactions 194
 - bryostatin 192, 193
 - dihydropyran derivatives 192
 - englerin A 194–195
 - fawcettimine 194
 - intramolecular hydrogen-bonding 193
 - intramolecular O-H addition 192
 - o-alkynylbenzaldehydes 194
 - oxonium 194
 - phosphines and *N*-heterocyclic carbenes 191
 - reaction conditions 191
 - silylenol ether 193
- green synthesis 32
- Grubbs, R. H. 245
- Gung, B. W. 326–328

h

- Halaven 15
- halichondrin B 15
- Hall, D. G. 324–326
- hamigerans, Nicolaou's total synthesis of 171–172
- hapalindole-type natural products 89–91

- Hayashi, Y. 34
- hemiaminal acetate 384
- Hendrickson, J. B. 28
- hirsutellone B, Nicolaou's total synthesis of 177
- (+)-hirsutene 306
- Hoffmann, R. W. 4, 34
- Horner–Emmons olefination 375
- Huang's redox-economical and chemoselective amine *N*-methylation 36
- (-)-huperzine A 121–122
- α -hydroxy acids 346
- α -hydroxyl acids 370–371

i

- ideal synthesis 28
- indanomycin, Burke's total synthesis of 170
- ingenol 371
- (+)-ingenol 373
- (-)-ingenol 129–132
- in situ* generated silyl-tethered intramolecular Diels–Alder cycloaddition cascade strategy 161
- intramolecular Michael additions 304
- ircinal A, Martin's total synthesis 164, 165
- (-)-ircinianin synthesis 162, 163
- iridium-catalyzed borylation of arenes 267
- (+)-isoschizandrin synthesis 290
- ivermectin 16, 18

j

- jerangolid D synthesis 334–335
- (-)-jiadifenin 202
- (-)-jiadifenolide 102–103
- Julia–Kocienski olefination 326

k

- Kagan's reagent, *see* samarium (II) iodide (SmI₂)
 (–)- α -kainic acid 14
 Kerr, M. A. 335–337
 Kolbe, H. 2
 Krische reactions 35

l

- lead-oriented synthesis (LOS) 52
 (+)-linoxepin 266
 (+)-lithospermic acid 263, 265
 Little, R. D. 455
 (+)-littoralisone 306–307
 (–)-littoralisone 376, 377
 (+)-loline 122–124
 (–)-longithorone A, Shair's total synthesis of 169–170
 lovastatin 403
 L-theronine 382, 383
 (+)-lunarine 304–305
 (+)-lycoflexine 116–118
 lycopodium alkaloids 96–98, 417
 (–)-lycoramine 303–304

m

- macrolide antibiotics 54, 55
 macrolides synthesis
 callipeltoside C 310–311
 (+)-cytotrienin A 311–312
 diazonamide A 312–313
 maitotoxin 465, 466
 Mannich reaction (M-3CR) 38
 (–)-maoecrystal V 125–128
 marine natural products 465
 Marko, I. E. 334–335
 Marshall's protocol 387
 maytasines 409
 (\pm)-merrilactone A 204
 mevastatin 403
 (+)-minfiensine 181, 299–300
 minquartynoic acid synthesis
 326–328

- Mn-catalyzed allylic oxidation 375
 Moeller, K. D. 453
 (\pm)-momilactone A, Deslongchamps' total synthesis of 177, 178
 monensin 6
 motuporin, synthesis of 322–324
 multicomponent reactions
 (MCRs) 38–40, 319
 calystegine B-4 synthesis
 333–334
 eurystatin synthesis 321–322
 jerangolid D synthesis 334–335
 martinelline synthesis
 camphorsulfonic acid 321
 Povarov hetero Diels–Alder reaction 320
 three-component reaction
 (3-MCR) 321
 minquartynoic acid synthesis
 326–328
 motuporin synthesis 322–324
 (–)-nakadomarin A synthesis
 335–337
 prebiotic synthesis of
 adenine 319–320
 spongistatin 2 synthesis 328–330
 thiomarinol H synthesis 324–326
 vannusal A and B synthesis
 331–332
 Myers, A. G. 53–55
- n**
- (–)-nakadomarin A 300–301,
 335–337
 nakijiquinone C 420, 421
 N-arylimine 320
 (+)-naseezazine B 71–73
 natural products
 aniline purple (mauveine) 8
 arabinogalactan 10–11
 azadirachtin 14
 bovine insulin 2
 cytovaricin, total synthesis of 6

- 1991–2000 decade 9–10
 definition 1
 discoveries and impact on science
 and society 5, 8, 16–18
 as drug candidates 14–15
 efficiency challenges in total
 synthesis of 12–14
 erythromycin synthesis 6
 erythronolide B synthesis 6
 erythropoietin synthesis 10
 ginkgolide synthesis 6
 golden age of total synthesis 2–9
 Halaven 15
 halichondrin B 15
 (–)- α -Kainic acid 14
 Kolbe's synthesis of acetic acid 2
 monensin, total synthesis of 6
 palytoxin (PTX) 6–8
 palytoxin carboxylic acid (PTC),
 total synthesis of 6
 Penicillin 12–13
 prostaglandins, total synthesis
 of 3, 4
 steroids, total synthesis of 3
 Taxol 13–14
 total synthesis in 21st
 century 10–12
 vitamin B₁₂, total synthesis of 4
 Wöhler's synthesis of urea 2
- natural products, in drug discovery
 antibiotics 402
 antibody-drug conjugate (ADC)
 payloads
 clinical development 408
 cytotoxic agents 408
 cytotoxic drug
 development 409
 DNA-damaging agents 409
 monoclonal antibodies
 407, 408
 stoichiometry and
 homogeneity 408
 tubulin inhibitors 409
- Baran's synthesis of ingenol 435
 bioassay-guided fractionation 403
 biology-oriented synthesis
 (BIOS) 420–422
 Danishefsky's synthesis of
 epothilone A 429
 diversity-oriented synthesis
 (DOS) 411–418
 function-oriented synthesis
 (FOS) 418–420
 genome encodes 404
 HMG-CoA reductase 404
 lovastatin 403
 mevastatin 403
 microbial genomics 407
N-acetylneuraminic acid
 (NeuAc) 404
 Neu5Ac 405
 neuraminidase (NA) 404
 Nicolaou and Li's synthesis of
 platensimycin 432–434
 Nicolaou and Yang's synthesis of
 taxol 427–429
 Relenza 405
 salicylic acid 402
 semisynthesis 401, 423–427
 Shasun Pharma Solutions Ltd's
 synthesis of (–)-huperzine
 A 434–435
 sialic acids 404
 Smith's synthesis of kendomycin
 429–430
 statins 404
 Tamiflu (oseltamivir) 405
 target-oriented synthesis (TOS)
 410–411
 Yao's synthesis of
 camptothecin 430–432
N-chlorosuccinimide (NCS) 373
 (–)-neothiobinupharidine
 108–109
 neuraminidase (NA) 404
 Nicolaou, K. C. 9, 331–332

- nine-step enantioselective total synthesis
 - (-)-cyanthiwigin F 110–111
 - (-)-6-*epi*-ophiobolin N 112–114
 - (+)-fusarisetin A 118–121
 - (+)-lycoflexine 116–118
 - (-)-vincorine 114–116
- non-strategic redox transformations 382
- norchelidonine, Hsung's total synthesis of 172–173
- Nozaki–Hiyama–Kishi (NHK) reaction 162, 163
- nucleophilic addition 379
- o**
- Oishi, T. 457–458
- 1-*O*-methylforbesione, Nicolaou's total synthesis of 173–174
- Ōmura, S. 16
- one-step/one-pot enantioselective total synthesis
 - (+)-ABT-341 69
 - tropinone 68
- organic chemistry 2
- organometallics-based syntheses
 - Ag-catalyzed reactions
 - acetylenic acid 196
 - alkylidenebromolactone 197
 - α -allenones 196
 - antibiotic analog 196
 - (-)-ascofuranone 198
 - C–N bond formation 197
 - C–O bond formation 196
 - heterocyclization reaction 197
 - homogenous silver-mediated reactions 195
 - Linstrumelle's coupling 197
 - triphenylphosphine 196
 - Au-catalyzed reactions
 - aldehydes/ketones and enynes 194
 - azadirachtin 193, 194
 - azaspiracids 192
 - benzannulation reactions 194
 - bryostatin 192, 193
 - dihydropyran derivatives 192
 - englerin A 194–195
 - fawcettimine 194
 - intramolecular hydrogen-bonding 193
 - intramolecular O–H addition 192
 - o*-alkynylbenzaldehydes 194
 - oxonium 194
 - phosphines and *N*-heterocyclic carbenes 191
 - reaction conditions 191
 - silylenol ether 193
 - chromium-catalyzed reactions
 - carbonyl cross coupling protocol 214
 - (-)-dacetylolide 216
 - dactylolide 215
 - Danishefsky's diene 215
 - Diels–Alder reaction 214
 - eribulin 210–211
 - halichondrin B 210–211
 - hetero-Diels–Alder (HDA) reaction 214
 - Jacobsen HDA method 215
 - low-valent chromium 213
 - Nozaki–Kishi–Hiyama reactions 210
 - organic halides and aldehydes 210
 - oxidation reactions 209
 - Pinacol coupling reaction 213
 - Reformatsky reaction 211–213
 - sodium iodide 214
 - tonantzitlolone 212
 - vinyl ketones and acroleins 214
 - Cu-catalyzed reactions
 - arene cyclopropanation 208–209
 - asymmetric conjugate addition 205–207

- Fe-mediated coupling reactions
 - acid chlorides reaction 217
 - alkenyl electrophiles reaction 217–218
 - alkyl electrophiles and 216
 - alkyl halides reaction 220
 - aryl halides reaction 218–220
 - iron-catalyzed C–C bond formations 220–221
- manganese-mediated coupling reactions
 - allyl α -methyl- β -ketoesters 223
 - carbon-carbon bond-forming reactions 222
 - cycloperoxidation reactions 222
 - enol acetates and alkynes 224
 - exo*-methylene derivative 224
 - γ -keto acrylates 224
 - lactone 223
 - lactonization reactions 222
 - metal oxidants 221
 - olefinic β -diketoester 222
 - paeoniflorigenin 223
 - podolactons 224
 - pyrenophorin 224
- nickel-catalyzed reactions
 - amphidinolide T1 and amphidinolides T4 226
 - coupling reactions 225, 226
 - cycloaddition reactions 225
 - epoxide moiety 227
 - (–)-gloeosporone 227
 - internal and terminal alkynes 227
 - organozincs 226
 - unsaturated compounds 227
- palladium-catalyzed cross-coupling reactions
 - 2-bromoaniline
 - intermediate 230
 - domino (cascade) reactions 238–240
 - β -hydride elimination 229
 - enantioselective C–C bond formation 229
 - Negishi reactions 237–238
 - Stille reactions 233–235
 - (–)-strychnine 230
 - Suzuki reactions 231–233
 - Tsuji–Trost reactions 235–237
- Pauson–Khand reaction and hetero-Pauson–Khand reactions 202–204
- Pt-catalyzed reactions
 - cascade reactions 201
 - cycloisomerization 199
 - cyclopropyl carbonyl derivative 199
 - propargyl acetates 200
 - propargylic esters 199
 - quaternary chiral centers 201
 - unconventional nucleophiles 200–201
- Rh-catalyzed reactions
 - C–H functionalization 241
 - Du Bois method 242
 - (+)-gonyautoxin 3, 242
 - lithospermic acid 240
 - tetrodotoxin (TTX) 243–244
- Ru-catalyzed RCM and RCAM
 - alkyne metathesis 244
 - amphidinolide V 246
 - catalyst optimization 250
 - flueggine A and virosaine B 248
 - lactimidomycin 249
 - macrocyclization 245
 - (–)-nakadomarin A 245–246
 - ring-closing alkyne metathesis (RCAM) 245
 - ring-opening metathesis 251
 - spirofungins A and B 251
 - Z/E* selectivity and separability 247
- ornithine δ -amino transferase (OAT) 398

(-)-oseltamivir 69–71
oxychelerythrine 268, 269

p

paclitaxel synthesis 287–288
pactamycate 383
pactamycin 383
(+)-pactamycin 134–137
palladium-catalyzed Catellani reaction
265, 266

Palythoa 7

palytoxin (PTX) 6–8
palytoxin carboxylic acid (PTC), total
synthesis of 6
panepophenanthrin, Porco's total
synthesis of 183, 184

PASE (Pot, Atom, and Step
Economy) 34

Pauson–Khand cyclization 102, 130,
132–134, 146, 148, 149, 373

peganumine A 94–96

Penicillin 12–13

peptide natural products 313–314

Perkin, W. H. 8

pestalotiopsin A synthesis 288, 289

Petasis–Borono–Mannich reaction 333

(+)-PGF₂α 90–93

pharmaceutical industry 471–472

(±)-physostigmine 204

pinacol-type couplings,
SmI₂-mediated 276–277

pinnatal, Trauner's total synthesis
of 175

piperaborenine B 262–263

(-)-platensimycin 375

polygalolides 384

Pospisil, J. 334–335

pot economy 34

Povarov hetero Diels–Alder
reaction 320

Powell, D.A. 320–321

procedure economy 67

prostaglandins 3, 4

protecting group-free syntheses
36–38

protein structure similarity clustering
(PSSC) 420

Pyne, S.G. 333–334

q

qinghaosu *see* artemisinin

quorum sensing 395

r

racemic cantharidin, step-economical
synthesis of 33, 34

rearrangement-initiated Diels–Alder
cascades 170–174

redox economy 34–36

Reformatsky reaction,
SmI₂-mediated 274–275

regioselectivity 30

(-)-rhazinilam 261–262

ricciocarpin A 307–308

ring-closing metathesis (RCM)
reaction 422

(*R*)-Roche ester 387

(+)-ryanodol 132–134

s

salicylic acid 402

(-)-samaderine Y 373

samarium (II) iodide (SmI₂)-mediated
reactions 273

(+)-acutiphyacin synthesis 277–278

aspergillide A synthesis 288, 289

brevetoxin B synthesis 278–281

carbonyl/alkene reductive
reactions 275–276

diazonamide A synthesis 282–284

epothilone A synthesis 284, 285

fragmentation reactions 277

(+)-isoschizandrin synthesis 290

paclitaxel synthesis 287–288

pestalotiopsin A synthesis 288, 289

pinacol-type couplings 276–277

- reduction of alkyl halides and carbonyl compounds 273, 274
- Reformatsky reaction 274–275
- (–)-stemoamide synthesis 289
- strychnine synthesis 284–287
- tricyclo[4,3,1,0^{1,5}]decane core of plumisclerin A synthesis 289–290
- (±)-vigulariol synthesis 280–282
- scalability 40–41
- Schmidt, U. 321–322
- Schwartz's reagent 29, 30
- secondary metabolites *see* natural products
- Seebach, D. 8
- Seeberger, P. H. 468
- selectivity 29–31
- semisynthetic approaches
 - artemisinin 426
 - cortistatinone 425
 - cortistatins 424
 - cyanosafraicin B 423
 - dihydroartemisinic acid 426
 - ecteinascidin 743, 423
 - fermentation process 423
 - human umbilical vein endothelial cells (HUVECs) 424
 - methoxy-*p*-quinone, hydroxylation of 423
 - oxygenation/acid-mediated ring closure sequence 427
 - prednisone 425
 - safracin B 423
- seragakinone A 308–309
- sesquiterpenoid peribysin E 379, 380
- seven-step enantioselective total synthesis
 - aromadendrane sesquiterpenes 93–94
 - hapalindole-type natural products 89–91
 - Lycopodium* alkaloid
 - (+)-fastigiatine 96–98
 - peganumine A 94–96
 - (+)-PGF₂α 90–93
- Sharpless enantioselective (asymmetric) dihydroxylation, of alkenes 31
- Shibuya allylic oxidation 373
- sialic acids 404
- six-step enantioselective total synthesis
 - (*S*)-camptothecin 86–87
 - (–)-cyanolide A 87–89
- small-molecule synthesis 471
- Smith, III, A. B. 328–330
- Smith–Tietze coupling 328
- (–)-spinosyn A, Roush's total synthesis of 177, 178
- spiroindolines 303
- spongistatin 2 synthesis 328–330
- (–)-stemoamide synthesis 289
- stenine, Aubé's total synthesis of 180
- (±)-stenine, Padwa's total synthesis of 176
- step economy 33–34, 67
- Stephenson, C. R. J. 448
- stereoselectivity 31
- steroid chemistry 3
- steroids 3
- sterol biosynthesis 43
- strategic redox reactions 28
- structural classification of natural products (SCONP) 420
- structure–activity relationships (SAR) 416
- strychnine synthesis 284–287, 467
- synthetic biology and chemical synthesis
 - amorpha-4,11-diene 468, 469
 - artemisinic acid 468
 - artemisinin synthesis 469–471
 - dihydroartemisinic acid (DHAA) 468

- synthetic biology and chemical synthesis (*cont'd*)
- George's "green" photochemical strategies 469
 - Seeberger's one-pot photochemical continuous-flow strategy 468
 - semi-synthetic Artemisinin Project 467
 - toxic dimethyl sulfate 470
 - Wu's "dark singlet oxygen" strategy 468
- synthetic efficiency 27
- t**
- Taxol 13–14
- Taxol[®] 473
- ten-step enantioselective total synthesis
- (+)-absinthin 124–126
 - (-)-huperzine A 121–122
 - (+)-loline 122–124
- terpene biosynthesis 43
- terpenes 346, 370–371
- terpenoids and multicyclic natural products
- (+)-brasoside 306–307
 - (+)-hirsutene 306
 - (+)-littoralisone 306–307
 - ricciocarpin A 307–308
 - seragakinone A 308–309
- terpenoids synthesis
- acid hydrolysis 375
 - Baeyer–Villiger oxidation 375
 - (-)-brasoside 376
 - (+)-3-carene 373
 - (+)-carvone 375, 376
 - chelation-controlled hydride reduction 373
 - chemoselective NaBH₄ reduction 382
 - (-)-citronellol 376
 - Dess–Martin oxidation 376
 - (+)-fomannosin 382
 - Horner–Emmons olefination 375
 - ingenol 371
 - (+)-ingenol 373
 - intramolecular Diels–Alder reaction 375
 - (-)-littoralisone 376, 377
 - Mn-catalyzed allylic oxidation 375
 - N*-chlorosuccinimide (NCS) 373
 - non-strategic redox transformations 382
 - nucleophilic addition 379
 - oxidase phase 373
 - Pauson–Khand cyclization 373
 - (-)-platensimycin 375
 - reagents and conditions 372, 374
 - regioselective allylic oxidation 373
 - (-)-samaderine Y 373
 - sesquiterpenoid peribysin E 379, 380
 - Shibuya allylic oxidation 373
 - SmI₂-mediated dehydroxylation 382
 - zirconocene-promoted ring contraction reaction 379, 381
- thiomarinol H, synthesis of 324–326
- Thorpe–Ingold effect 305
- three-step/three-pot enantioselective total synthesis
- (+)-aszonalenin 73
 - (-)-brevicompanine B 73, 74
 - (+)-frondosin B 75
 - (+)-hyperibone K 76–77
 - (-)-PGE₁ methyl ester 75–76
 - (-)-sibirine 73–75
 - (+)-torreyanic acid, Porco's total synthesis of 179
- traditional Chinese medicine (TCM) 17–18
- (+)-*trans*-clerodane iterpenoid 99–100

- Trauner, D. 27
 tricyclo[4,3,1,0^{1,5}]decane core of
 plumisclerin A
 synthesis 289–290
 tropinone 68
 Trost, B. M. 29, 32
 Tu, Y. 16
 two-step/two-pot enantioselective
 total synthesis
 aszonalenin 71, 72
 (–)-ditryptophenaline 71–73
 (+)-naseaezine B 71–73
 (–)-oseltamivir 69–71
 (+)-WIN 64821 71–73
- u**
 Ugi four-component coupling 415
 Ugi reaction (U-4CR) 38, 323
 undirected catalytic sp³ C–H
 activation 263
 α,β-unsaturated lactams 204
 urea, Wöhler's synthesis of 2
- v**
 vancomycin-related glycopeptide
 antibiotics 56
 vannusal A and B synthesis 331–332
 VEGFR-2 inhibitor 420
 (±)-vigulariol synthesis 280–282
 (–)-vincorine 114–116
 visible-light photochemistry
 (–)-aplyviolene synthesis 449
 bromopyrroloindoline coupling
 reaction 448
 (±)-cannablorcyclolic acid, Yoon's
 total synthesis of 451
 drimentine F and indotetine A
 synthesis 448–449
 electron-transfer process 448
 energy-transfer process 448
 fusarisetin A synthesis 452
 iminium-olefin cyclization 449
 kuwanons I and J synthesis 451
 photoredox reductive
 dehalogenation 448
 photosensitizers and
 photocatalysts 447
 (*N*-acyloxy)phthalimide
 reaction 449
 prenylflavonoid natural products
 synthesis 451
 principle of 448
 ruthenium complex/methylene
 blue 452
 Stephenson's synthesis of gliocladin
 C 448
 α,β-unsaturated carbonyl
 compounds 448
 vitamin B₁₂, total synthesis of 4
- w**
 Weinbrenner, S. 321–322
 Wender, P. A. 28, 33
 (+)-WIN 64821 71–73
 (–)-wistarin synthesis 162, 163
 Wittig/IMDA cascade strategy
 165, 166
 Wöhler, F.
 Woodward–Hoffmann rules 4
 Wu, Y. 468
- y**
 Yao, Z.-J. 455–456
 Young, I. S. 335–337
- z**
 Zhang's two-step catalytic
 transformation 470–471

