Index

abomasum of ruminants, 227
abrasion, 55
N-acetylmuramic acid, bacteria–metal interactions and, 154
acid mine drainage, 148–70
bioremediation, 161–3
development and release of, 153–4
indigenous bacteria, responses, 159–61
mineralized biofilms with, 148–70
acidity, see pH
Aeromonas spp. in dental plaque, 286, 288–9, 291
adenylate distribution, determination, 110–12
adhesins of dental plaque-forming bacteria, 288–9
adhesion/adherence, 2–3, 49, 50, 126
antimicrobial susceptibility relating to, 126
bacterial surface affecting, 50
to catheter, 267
to crystalline asphaltes, 184–7
by dental plaque-forming bacteria, 267, 288–9
to eukaryotic cell surface, 86
growth cycle and, 50–1
to inert surfaces (in general), 8, 137–8
to living surfaces (in general), 8–9
to lung by P. aeruginosa in cystic fibrosis, 240
in mixed cell suspensions to solid surfaces, 52
passive vs active, 49
phenotypic responses to, 2–3
to plastic medical devices, 257
positioning behaviour and, 31
in purified water systems, prevention, 137–8
see also attachment
aerobes and anaerobes, oxygen and substrate penetration in mixed cultures, 106–7
aerobic conditions
anaerobic and, corrosion and interface between, 177–80
biofilm physiology in, 106
corrosion, 177
surface water, acid mine drainage and its effects on, 159–61
Aeromonas hydrophila growth in drinking water system model, 200
agar, growth on, 84–5
antimicrobial susceptibility studies observing, 119–21
liquid media growth compared with, 82
agar bead model of P. aeruginosa lung infection, 235–6
aggregates, cell, channels and, 27–8
aggregation, 27–8, 67
see also coaggregation
Agrobacterium tumefaciens, attachment of plant cell surface, 86
Alcaligenes faecalis Type 2, 189, 191
Alcaligenes spp. (in wastewater treatment), 189
alfalfa, low-lignin, 230
alginate, P. aeruginosa production of cystic fibrosis and, 87, 240–1
on solid surface, 87
alginate bead model of P. aeruginosa lung infection, 236–7
alimentary tract of ruminants, see ruminant
alpha-1-antitrypsin therapy in cystic fibrosis, 243
Alvisella spp. on ruminant tongue, 222–3
anaerobes
oxygen and substrate penetration in mixed cultures of aerobes and, 106–7
in wastewater treatment, 191–2
anaerobic conditions (anoxic conditions)
aerobic and, corrosion and interface between, 177–80
aquatic systems, acid mine drainage affecting, 161
biofilm physiology in, 106
corrosion, 173, 177, 178
anaerobic wastewater treatment systems, 192–4
start-up phase, 192
anionic cell surface, bacteria–metal interactions and, 155
anoxic conditions, see anaerobic conditions
antagonism
in dental plaque, 292
in rhizosphere, 214
antibody responses to P. aeruginosa
in cystic fibrosis, 240, 241, 242
immunization-related, 237, 238
antigens, P. aeruginosa, cystic fibrosis patient antibody responses to, 242
anti-inflammatory drug therapy in cystic fibrosis, 243
antimicrobial agents (including antibiotics), 118–30
effects on biofilms, 34
prostatitis and, 265
protection from/ resistance to, 83, 118–30
in biliary tract, 254–5
mechanisms, 118–30, 254–5
antimicrobial agents (cont.)
in rhizosphere, production/utilization, 214
in toothpastes/ mouthwashes, 296
urogenital infection, 265, 277
recovery of flora after, 277
α-1-antitrypsin therapy in cystic fibrosis, 243
aquatic systems, acid mine drainage affecting, 159–61, 161
archaeobacterial thermophilic bacteria, economic impact, 176
aromatic hydrocarbons, poly cyclic (PAH), degradation/removal, 184–7
asphaltine surfaces, adherence to, 184–7
attachment (to surfaces), 22–3, 48–9, 49–51, 52–3, 60–1
biological processes in, 49–51
chemical processes in, 52–3
to eukaryotic host cell, 85–6
motile, 22–3, 24, 59
in P. aeruginosa chronic lung infection in cystic fibrosis, 239
physical processes in, 54–5, 58–9
to plant cell surface, 86
reversible/ irreversible, 23
wastewater treatment and, 192
see also adhesion
auxanography, community level, 75–7
‘baby factory’, 102
Bacillus subtilis, metal binding, 156, 158
bacteriocins, 292
Bac teroides saccharogenes in reticulo- rumen, 224
BALT, P. aeruginosa infection and, 236
batch enrichment cultures vs steady-state community cultures, 71–3
batch reactors, sequence, wastewater treatment with, 188–90
behaviour of bacteria at surfaces, 21–9
quantifying, 21–2
β-lactam antibiotic susceptibility, factors affecting, 123
bile salt effects on biofilms, 257–8
biliary system, 251–60
biofilms in, 251–60
microbial ecology, 251–2
stents, blockage, 255–6, 257–8
biochemical reactions, 99–107
biocides in purified water systems, 141–2
see also specific (types of) biocides
biological processes
in attachment, 49–51
in detachment, 51–2
biomineralization, see mineralization
bioremediation
acid mine drainage, 161–3
wastewater, 187–91
biosensors in purified water systems, 139
biotic interactions in rhizosphere, 213–16
bimetal-painted mild steel, growth in water systems on, 199–200, 201
bladder infection, 9, 261, 262–5, 266–9, 276–7
catheter-related, 266–9
Bode saltate, predation resistance, 31
bonding, surface, 52–3
‘bottle’ effect, 121, 126
boundary layers, 58, 105
diffusive, 105
flow and, 58
laminar, 58

turbulent, 59–60
bovine digestive tract, 221–32
passive bridge structures across channels, 54
bronchus-associated lymphoid tissue, P. aeruginosa infection and, 236
brown pigment stones in biliary tract, 252–5, 257–8
budding bacteria, surface colonization strategies, 24
calcium ions
biliary, 252, 254–5
gene expression influenced by, 90
calcium salts, biliary sludge and, 252–3
calculi, see stones
Campylobacter fetus, nutritional interactions with other bacteria, 292
capsule, bacterial, bacteria-metal interactions and, 155
carbohydrate sink, rhizosphere biofilms as, 209
carbon granular activated, sterilization of columns of, 143
limitations, detachment and, 54
carbon dioxide concentrations
gene expression and, 88
in rhizosphere, 213–14
caries, dental, 293
prevention, 295–6
cast iron, corrosion, 176–7
cat model of P. aeruginosa lung infection, 236–7
catheter-related urinary tract infection, 266–9
cations, bacteria-metal interactions and, 155–8
chaABC, 189
CDC group IVC–2, 189, 191
cell (bacterial/microbial)
density, gene expression and, 88–9
morphology, attachment and, 50
structure, attachment and, 50
wall, attachment and, 49–50

cell (eukaryotic), microbial growth on surface of, 85–6

cell (plant), bacteria in rhizome associated with wall of, 223

cellular immune response to P. aeruginosa, 233–5

cellulose membrane as in vivo infection model, 124

cetrime susceptibility of E. coli, 123

cells

cell aggregates interspersed by, 27–8
solute transfer by flow through, 106
changes in rhizosphere, 211, 212
chemical characteristics of sulphide tailings, 149–50
chemical heterogeneity of biofilms, 4–7
chemical landfill site, wastewater treatment, 188–90
chemical processes/conditions in attachment, 52–3
in detachment, 54
in gene expression, 87–92
in rhizosphere, 208–10
chemical treatment of purified water systems, 141–2
chemostat, 67
antimicrobial susceptibility studies, 124
multistage, 101–2
solid state (chemostat), 68–70
children, periodontitis, 295
chlorinated drinking water, coliforms in, 197
chlorobenzoate degradation, 187–8, 191
cholangitis, 251
bacteriology, 252
INDEX 303

cultures (cultivation)
antimicrobial susceptibility studies in different conditions
of, 119–20, 124–6
biofilm communities, 2, 64–79, 101–4
steady-state, 71–3, 101–4
systems, 67–73
contaminants in purified water systems, 138
single species/pure, 64–5
end of era, 64–5
planctonic mode of growth, see planktonic mode of growth
surface colonization behaviour/kinetic studies, 21
see also fermentors
cystic fibrosis, 233, 239–44
alginate production and mucoid material in, 87, 240–1
prophylaxis, 243–4
therapy, 243, 244
transmembrane conductance regulator, 239
cystitis, 262–4
acute, 261, 262–4
chronic, 262–4
cytokines in cystic fibrosis, 242–3
_Cystophaga_ spp. on agar surfaces, 85
defence systems (in humans)
immune, _see immune system_ mechanical, lower urinary tract, 261–2
denitrification
rate, determination, 108
rhizosphere and, 212, 213
density, cell, gene expression and, 88–9
dentition, _see caries, plaque_
_Delavallia desulfiticans_, corrosion and, 179
detachment (from biofilms), 48–9, 51–2, 54, 60–1
biological processes in, 51–2
chemical processes in, 54
physical processes, 55–6, 58–9
detergent in bile, 257
detoxification in rhizosphere, 211
dextran in cryosolutions, 110
diet, plaque bacterial growth and, 283–4
diffusion, 19–21
diffusion coefficient, determination, 105
gas, 87–8
solute/substrate, 104, 105, 105–6
diffusion gradients, chemical, in rhizosphere, 209
diffusive boundary layers/diffusive sublayer, 105
digestive tract, rhizobacteria, _see rhizobacteria_
direct count techniques of contaminants in purified water systems, 139
disinfection, _see sterilization and disinfection_ dispersal, 28–7
DNA
conformation, gene regulation and, 90
sequence changes, gene regulation and, 90
DNA gyrase, 90
double-layer theory, 17–18
drinking (potable) water systems, 197–8, 198–200
models, 196–9
pathogens in, 196, 197, 198–200
potential, 197–8

DNA, _see also Food and Drug Administration_
INDEX

DVLO theory, 17–18
dynamics of biofilm formation, 46–63
ecology
microbial, 13–117
biliary tract, 251–2
digestive tract of ruminants, 221–32
fluid dynamics and, 60
living surfaces (in general), 9
urogenital tract, 274–6
soil, rhizosphere biofilms affecting, 215
ecosystems, micro-, 66
E, electrode, 109
elastase, cystic fibrosis and, 243
electrical double-layer theory, 17–18
electrical fields in rhizosphere, 212
electrochemistry in purified water systems monitoring via, 140
sterilization technique employing, 143
electrodes in purified water systems, 140
see also microelectrodes
electron microscopy studies, 113–14
biliary brown pigment stones, 253, 254
dental plaque, 113–14, 284–7
growth on semi-solid media, 85
compared with liquid media, 82
electronic devices, contaminated, 135–6
electrostatic forces, dental plaque formation and, 289
endoprostheses (stents), biliary, blockage, 255–6, 257–8
endotoxin, detection, 140–1
see also lipopolysaccharide
energy, 110–12
ruminant digestive tract biofilms and intake of, 226
sources for sulphate-reducing bacteria, 175
status in biofilms, 110–12
surface free, 18
enrichment cultures, batch, steady-state community cultures
vs, 71–3
Enterobacter cloacae exopolysaccharides, rhizosphere and, 209
environment(s)
climax communities in well-defined, 66–7
genetically manipulated microbes released into, 215
see also microenvironment
environmental factors/conditions, 81
attachment, 55
dental plaque bacterial growth and, 284
attachment, 55–6
growth of community cultures in gradients of various, 75–7
EnvZ, 90
epithelial tissue
biofilms on
formation of, 8–9
of ruminant digestive tract, 223–9 passim
Salmonella adhesion to invasion of, 86
eps gene regulation, 92
erosion (shear forces), 55, 137
Escherichia coli
growth on agar, 85
antimicrobial susceptibility relating to rate of, 123
in drinking water system model, 200
TCA cycle in, oxygen gradients and, 100
uropathogenic, 263, 277
esterase activity, fluorogenic substrates in studies of, 74
eubacterial thermophilic bacteria, economic impact, 176
eukaryotic cell surface, microbial growth on, 85–6
exopolysaccharides (EPS; extracellular polysaccharides),
microbially produced, 32
dental plaque and, 291
gene, regulation, 92
nutrient scavenging and, 30
rhizosphere and, 209
exudates (plant)
infestation requiring prior stimulation by, 214
rhizodeposition, 208
eye, biofilm formation, 9
face, bacterial, attachment and the, 50
FDA recalls related to water, 143–4
feed for ruminants, processing, 229–30
female urogenital tract, 9, 274–81
probiotics and, 274–81
fermentors, 101, 102
antimicrobial susceptibility studies, 124
see also culture
ferric iron, T. ferrooxidans growth with, 152, 153
ferrous iron, T. ferrooxidans growth with, 152
Fibrobacter succinogenes in reticulo-rumen, 224
filters, microporous membrane, 136–7
fissure
plaque, 287
sealants, 296
fixed-film growth systems in wastewater treatment, 193–4
flagellated bacteria, flow and, 58
floxacin effects, 34
Flexibacter spp. on agar surfaces, 85
flora, urogenital, see genital tract; urinary tract
flow (fluid), 56–61, 70
absence of
hydrodynamics with, 19
spoilage biofilms with, 70–1
in channels, solute transfer by, 106
diffusion and, 21, 22
laminar, see laminar flow
turbulent, see turbulent flow
flow cells, culture in, 67–8
fluid, dynamics/flow, see flow
fluorescein-labelled probes, 74
fluoridation, water, 296
fluorometry, 140
food, see diet; feed; nutrients
Food and Drug Administration recalls related to water, 143–4
foreign object implants in bladder infection model, 263, 265
formation (of biofilms), 46–63
dynamics, 46–63
inert surfaces (in general), 7–8, 134–5
initial development, 47
living surfaces (in general), 8–9
P. aeruginosa, 234
Fourier transforming infrared spectroscopy, 139
free energy, surface, 18
frozen sections, 110, 115
fungi in rhizosphere
as plant pathogens, 212
symbiotic, 213
INDEX 305

- β-galactosidase activity, fluorogenic substrates in studies of, 74–5
  - Gardnerella vaginal infections, 277
  - gas(es)
    - diffusion, 87–8
    - rhizodeposition, 209
  - gastrointestinal tract, ruminant, see ruminant
  - gegen-ions, 80–1
  - gel-free microstat, 69–70
  - gene expression/regulation, 80–98
  - lacZ fusion in studies of, 74, 86–7
  - physicochemical conditions affecting, 87–92
  - surface-induced, 29, 80–98
  - genetically manipulated microbes, environmental release of, 215
  - genital tract, 274–81
    - flora, 274–81
      - in disease prevention, 277–9
      - disruption, 276
      - probiotics and, 274–81
      - recovery (post-antimicrobial therapy), 277
      - infection, 276–9
      - management, 277–9
  - gingival crevice
    - plaque growth influenced by fluid bathing, 283, 284
    - plaque in, 288
  - gingivitis, 294, 295
  - acute necrotizing ulcerative, 295
  - glass surfaces, growth in drinking water system model on, 199–200
  - gliding bacteria, 22, 24, 50
  - non-gliding vs, 50
  - on semi-solid media, 85
  - compared with liquid media, 82
  - glucose microelectrode, 109
  - glucosyltransferase gene expression on solid surfaces, S. mutans, 87
  - glycolysis, 47–8, 119–21
    - in antimicrobial resistance, 118, 119–21
      - direct role, 119–21
      - indirect role, 121
    - biliary brown pigment stone formation and, 253–4
    - production, 47–8
  - glycosaminoglycan layer in lower urinary tract, 262
    - gradients, 99–117
    - in biofilms, establishment, 99–117
    - environmental, biofilm development on, 75–7
  - grandost, 101–2
  - Gram-negative bacteria
    - complement system and, 235
    - metals and, 154–5
  - Gram-positive bacteria
    - complement system and, 234–5
    - metals and, 154
  - granular activated carbon columns, sterilization, 143
  - growth (microbial), 15–45
  - antimicrobial susceptibility relating to rate of, 122–3
    - of community cultures in environmental gradients, 75–7
    - of dental plaque, factors affecting, 283–4
    - in drinking water system model, 199–200
    - in planktonic mode, see planktonic mode
  - in sessile/biofilm mode, 2
    - advantages, 29–32
    - laminar flow and, 59
    - wastewater treatment and, 192, 193–4
    - on solid vs liquid media, 82–4
  - growth (plant), rhizobacteria enhancing, 213, 215–16
  - growth cycle
    - attachment/adhesion and, 50–1
    - detachment and, 51
    - growth promoting factors in purified water systems, 134
  - gfp expression on solid surfaces, S. mutans, 87
  - Gunflint Chert formation, microbes involved, 163, 164
  - gut, ruminant, see ruminant
  - habitat range, extension through communal associations, 65
  - hardpan formation, 153
  - heterogeneity, 33–4, 109–12, 173
  - chemical, 4–7
    - physical/structural/spatial, 4–7, 33–4, 109–12, 173
  - corrosion and, 173
  - determination, 109–12
    - in water supplies/systems, 200–2
  - heterotrophic bacteria in drinking water, 197
  - HIV-related periodontal disease, 295
  - hormone (plant) production rhizosphere, 213
  - hospital infections
    - L. pneumophila, 198
    - urinary catheter-related, 266–9
  - hot water
    - sterilization with very, 142–3
    - systems, pathogens in, 198
  - humus degradation, 212
  - Hyde Park chemical landfill site, wastewater treatment, 188–90
  - hydraulic effects in purified water systems, 137–8
  - hydrodynamics, 58
  - hydrogen, oxidation by sulphate-reducing bacteria, 175, 177
  - hydrogen peroxide as biocide, 141
  - Hydrogenase Test, 175
  - hydrophobic bile salt effects on biofilms, 257
  - hydrophobic bile salt effects on biofilms, 257
  - hydrophobicity, surface, 18, 50
  - Hyphomicrobium spp., competitive behaviour, 37
  - ileum of ruminants, 228
  - immune complexes in cystic fibrosis, 242
  - immune system
    - lower urinary tract, 262–3
    - response to biofilms, 233–50
    - immunization against P. aeruginosa
      - animal studies, 237–9
      - in cystic fibrosis, 243–4
      - immunoglobulin production in P. aeruginosa lung infection
      - in cystic fibrosis, 242, 243
      - immunization-related, 237, 238
      - immunophagocytosis, cystic fibrosis, 243–4
      - implants (stents), biliary, blockage, 255–6, 257–8
      - inert surfaces (biofilms on), 131–204
      - formation, 7–8, 134–5
  - see also specific surfaces
infection
human, 118–19, 196–204, 235–44, 261–73, 276–9
biliary tract, 231, 252
lung, see lung
models of, 124, 235–6, 236–7, 262–9
urinary tract, see urinary tract
water-borne, 196–204
plant root, 214
inflammation in cystic fibrosis, chronic pulmonary, 242–3
infrared spectroscopy, Fourier transforming, 139
interactive behaviour, 37–8
intestine of ruminants, 227–9
ion(s)
bacteria–metal interactions and, 155–8
distribution at surfaces, 80–1
gene expression influenced by, 90
in rhizosphere, currents, 212
see also specific ions
ion exchange systems, sterilization, 142
iron (ferrous and ferric)
bacterial–metal interactions in presence of, 158
cast, corrosion, 176–7
T. ferrooxidans growth, 152
iron sulphide corrosion products, formation, 178–9
irrigated discs, 102
IVC-2, CDC group, 189, 191
juvenile periodontitis, 295
N’-(β-ketocaproyl) homoserine lactone, V. fischer, 89
kinetics of surface colonization, quantifying, 21–2
Klebsiella pneumoniae, corrosion and, 179
Koch’s postulates, bacterial communities and, 65–6
Krebs (TCA) cycle, oxygen gradients and, 100
β-lactam antibiotic susceptibility, factors affecting, 123
Lactobacillus casei GR-1, 279
cocaggregation involving, 274–6
in disease prevention
artificial implantation, 279
indigenous, 277–9
Lactobacillus spp. in urogenital tract, 274–81
lacZ fusion in gene expression/regulation studies, 74, 86–7
laf, 84, 126
laminar flow, 56–7, 57, 58–9
biofilm dynamics in, 58–9
landfill site, chemical, wastewater treatment, 188–90
laser microscopy, scanning confocal, see confocal scanning laser microscopy
Legionella pneumophila in water systems, 198, 201–2
leucocytes, polymorphonuclear, see polymorphonuclear neutrophils
life cycles at surfaces, 22
lignin synthesis in alfalfa, manipulation, 230
Lindus amoebocyte lysate test, 140–1
lipopolysaccharide (LPS) detection, 140–1
P. aeruginosa, 234
cystic fibrosis and, 241–2, 244–5
immunization employing, 237, 244–5
T. ferrooxidans in sulphide tailings and, 151–2, 155
colonization of, 151–2
liquid, flow, see flow
liquid ion exchange microelectrodes, 109
liquid media
cells at surfaces vs those in, physiological differences, 81–4
surrounding
attachment and, 53
detachment and, 54
living surfaces (biofilms on), 205–300
formation, 8–9
see also specific surfaces
lung infection by P. aeruginosa, 235–44
in cystic fibrosis, chronic, 239–44
laboratory animals, 235–9
lysates, rhizodeposition, 209
magnesium ions, gene expression influenced by, 90
mains water model, growth in, 199–200
manganese oxidation, bacterial, surface enhancement, 84
marine conditions, corrosion, 178
maturation, biofilm, 48–9
mechanical stress in plant root, 210
media, liquid, see liquid media; semi-solid media
medical devices (growth on), 119, 255–6, 257, 266–9
contaminated, 135
membranes
cellulose, as in vivo infection model, 124
as microporous filters, 136–7
reverse osmosis, fouling problems with, 142
metabolite accumulation, gene expression and, 88–9
metals
corrosion, see corrosion
soluble, bacterial interactions with, 154–63
microcolonies, formation: development, 3–4, 22–3, 25, 28–9
on biliary stents, 255
bladder, 263
control, 28–9
in P. aeruginosa chronic lung infection, 240–1
strategies, 22–3
microecosystems, 66
microelectrodes, 107–9, 115
microelectronic devices, contaminated, 135–6
microenvironment, surface, 16–21, 32–8
nature, 16–21, 32–8
pH of, 81
microflora, urogenital, see genital tract; urinary tract
microporous membrane filters, 156–7
microscopy, 112–14, 115
contaminants in purified water systems, 138–9
see also specific types of microscopy
micromasts, 68–70
mine wastes, sulphide-bearing, see acid mine drainage
mineral(s)
in rhizosphere, release and activation, 211–13
sedimentary deposits, microbes involved in formation of, 163–4
see also ions and specific minerals
mineralization by thiobacilli, 158–9
in urinary catheter-related infections, 267
mineralized bacterial biofilms, 148–70
mixed species biofilms
of aerobes/anaerobes, oxygen and substrate penetration in, 106–7
colonization, 37
INDEX 307

spatial heterogeneity, 33
mixed species inocula/suspensions
adhesion to solid surfaces in, 52
corrosion experiments, 179
*Morganella morgani* infection, 263
morphology (cell), attachment and, 50
most probable number analysis, *T. ferrooxidans* subspecies
identification via, 154
mot/mot’, *P. fluorescens*, 33
motile bacteria
attachment and, 22–3, 24, 59
flow and, 58
on semi-solid vs liquid media, 82
mouth, see oral cavity
mouthwashes, 296
mucoid bacteria, adherence, 50
mucoid material in cystic fibrosis, 87, 240–1
mucous layer/lamina
lower digestive tract of ruminants, 227–9
lower urinary tract of humans, 262
mycorrhizal fungi in rhizosphere, symbiotic, 213
*Mycobacterium avium* growth on agar surfaces, 85

naphthalene degradation, 187
denaturing ultracentrifugation, acute, 295
neonatal ruminant digestive tract biofilms, manipulation, 229
neutrophils, polymorphonuclear, see polymorphonuclear
neutrophils
newborn ruminant digestive tract, manipulation of biofilms, 229
nitrite-oxidizing bacteria, physiological differences in surface-
vs liquid-grown, 84
nitrogen fixation, rhizosphere and, 212–13
nitrotoxin degrading enzymes in ruminants, 229
nitrous oxide profile, determination, 108
nosocomial infection, see hospital infections
nozzle orifice of purified water systems, 138
nucleic acid probes, 175–6
nutrients
antimicrobial susceptibility resistance relating to levels of,
118, 121–2
attachment related to levels of, 51
dental plaque bacterial interactions involving, 291–2
detachment and availability of, 54
gene expression affected by, 89
growth response to
dental plaque-forming bacteria, 283–4
with gradients of nutrients, 75–7
at solid surfaces vs liquid media, 82–3
in rhizosphere, 211–13
recycling, 211–12
screwing, 29–31
see also feed

ocular tissue, biofilm formation, 9
Odd’s sphincter, biliary microbial ecology and, 252
oil production platforms, steel coupon corrosion, 178
omnibus of ruminants, 226–7
OmpC, 90
OmpF, 90
*ompR*, 90
oral cavity, 282–300
bacteria, 282–300
EM studies, 113–14, 284–8

hygiene, 295
ore, cells grown on, 152
osmolarity, gene expression and, 89
osmotic, reverse, fouling problems with, 142
osmZ, 92
oxidant and reductant, balance of, 106–7
oxidation by sulphate-reducing bacteria, 174–5
complete, 174
incomplete, 174
oxygen, 107–8
competition in rhizosphere for, 213
consumption rates, determination, 107
gene expression in response to, 87–8
generation, photosynthetic, determination, 107–8
gradients, 100
limitations, detachment and, 54
profiles, determination, 107–8
ozone as biocide, 141

‘packing’ colony formation behaviour, 25
paranasal sinus infection by *P. aeruginosa*, 240
pathogens, see infection
*Pedomicrobium spp.*, surface colonization strategies, 24
pellicle of salivary proteins, adhesion to, 267, 289
penicillin-binding proteins, 123
peptidoglycans, bacteria-metal interactions and, 154, 155
periodontal disease, 293–4
periodontitis, 294
chronic, 294, 295
juvenile, 295
pH, 109
attachment and, 55
biliary tract, 252–3
dental plaque/caries and, 284, 293
detachment and, 56
determination, 109
gene expression and, 81, 88
rhizosphere biofilm-related modifications, 209
solute transport and, 104
pharmaceutical industry, contamination, 135
phenotypic responses to adhesion, 2–3
photosynthetic oxygen generation, determination, 107–8
physical characteristics of sulphide tailings, 149–50
physical heterogeneity, see heterogeneity
physical processes/conditions
in attachment, 54–5, 58–9
in detachment, 55–6, 58–9
in gene expression, 87–92
in rhizosphere, 210–11
physical treatment of purified water systems, 142–3
physiology
biofilm, 13–17
ruminant, 226
pigment stones in biliary tract, 252–5, 257, 257–8
pipe(s) (man-made and biological)
corrosion, 176–7
flow in, 56–61
pipelines
purified water, contamination, 136
turbulent flow in, 59
planktonic mode of growth, 2, 4
acid mine drainage and its effects on, 159
antimicrobial susceptibility in, 119, 121
308 INDEX

plant cell surface, attachment of bacteria to, 86
cell wall, bacteria in rumen associated with, 223
growth, rhizobacteria enhancing, 213, 215–16
root, zone of soil surrounding, see rhizosphere
plaque, dental, 267, 282–300
approximal surface, 287–8
bacteria/microbes in genera, 283
interactions, 291–3
definition, 282–3
development/formation, 284–7, 288–9
mechanism, 287–9
prevention/control, 295–6
disease and, 293–6
EM studies, 113–14, 284–7
fissure, 288
gingival crevice, 288
structure, 284–7
plasmin, polycyclic aromatic hydrocarbon-degrading genes, 187
plastic (in medical devices), biofilm formation, 295–6, 257
polycyclic aromatic hydrocarbons (PAH), degradation/removal, 184–7
poly-β-hydroxyalkanoate, 139
polymorphonuclear neutrophils (leucocytes), P. aeruginosa and, 234
in cystic fibrosis, 242–3
polynylde fluoride pipelines, contamination, 136
population architecture/structure, 34–7, 66
porin, 90
porosity, determination, 105
positioning manoeuvres/mechanisms, 31, 66
potable water, see drinking water
precipitation, metal, 155, 158
predation, resistance to, 31–2
probiotics, urogenital flora and, 274–81
processing of rumen feed, 229–30
prostatin, chronic, 265–6
prosthecate bacteria, surface colonization strategies, 24
prostheses (implants), biliary, blockage, 255–6, 257–8
protease inhibitors in cystic fibrosis, 243
Proteobacteria, wastewater treatment and, 190, 191
Proteus mirabilis PRM2007 mutants, growth on agar, 85
struvite urolithiasis and, 264
Pseudomonas aeruginosa, 233–50
alginate production, see alginate
chloramphenicol susceptibility, 120, 126
orrhoea and, 179
EM studies, 113
exopolysaccharides, rhizosphere and, 209
immune responses to biofilms of, 233–4
lung infection, see lung
oxygen consumption rates, determination, 107
spatial heterogeneity, 33
Pseudomonas fluorescens
 sessile, nutrient scavenging, 30
spatial heterogeneity, 33, 34
surface colonization strategies, 25, 26, 28
Pseudomonas fragi, surface colonization strategies, 25, 28
Pseudomonas J96, surface colonization strategies, 24
Pseudomonas putida, competitive behaviour, 37
Pseudomonas spp., 233–50
Pseudomonas syringae, surface colonization strategies, 28
pulmonary infection, see lung
pulp wastewater treatment, 193
pure culture, see cultures
purified/contaminant-free water (biofilms in), 133–47
contamination of, 135, 135–6
case histories, 135–6, 143–4
detection, 135, 138–40
prevention, 136–8
treatment, 135, 138, 141–3
design consideration, 136–8
FDA recalls, 143–4
growth in, 134
pyrite, 158, 159
corrosion, 178–9, 179
T. ferrooxidans colonization with, 150, 152
pyrogens, bacterial, 140–1
pyrrolate, 150
quaternary compounds, resistance to, 123
rabbit model of urinary catheter-related infection, 268–9
Raman spectroscopy, 139
RapidChek B, 175
rat model of infection
lower urinary tract, 263, 265
P. aeruginosa in lung, 235–6, 236
reaction and diffusion, relationship between, 105–6
dredox potential electrode, 109
reducing and oxidant, balance of, 106–7
reporter gene technology, solid surface gene expression and, 86–7
resonance Raman spectroscopy, 139–40
resorufin-labelled probes, 74
respiratory tract infection by P. aeruginosa, 235–44
lower, 235–44
in cystic fibrosis, chronic, 239–44
laboratory and, 235–9
upper, 240
reitculo-rumen, 223–6
reverse osmosis membranes, fouling problems with, 142
Reynolds number, 57–8
Rhizobium spp., plant cell attachment, 86
rhizodeposition, 208–9, 215
rhizosphere, 207–20
chemical interactions, 208–10
physical interactions, 210–11
ribosomal RNA probes
Proteobacteria and activated sludge studies, 191
sulphate-reducing bacteria and, 175–6
RNA, ribosomal, see ribosomal RNA
Robbins device, 102, 124
modified, antimicrobial susceptibility studies, 124
P. aeruginosa biofilms in, 234
rolling behaviour, 24
Rototorque, 102
ruminant, 221–32
digestion, 226
digestive tract, biofilms in, 221–32
manipulation, 229–30
S fimbral adhesions, 84–5
INDEX 309

steady-state culture, 67–71, 101–4
batch enrichment culture vs, 71–3
steam sterilization, 142–3
steel, mild
bitumen-painted, growth in water systems on, 199–200, 201
corrosion, 176–7, 178–9
stents, biliary, blockage, 255–6, 257–8
sterilization and disinfection, purified water systems, 138
stones/calculi, biliary, 252–5, 257–8
urinary infection-related, 264–5
Streptococcus spp. in dental plaque, 286, 288–9, 293
Streptococcus mutans, 289, 292
glucoamylase expression on solid surfaces, 87
nutritional interactions with other bacteria, 292, 293
stress in plant root, mechanical, 210
structure (bacterial), attachment and, 50
structure (biofilm), 3–7, 13–17, 81, see also architecture
dental plaque, 284–7
heterogeneity, see heterogeneity
turbulence effects on, 60
struvite urothiuria, 264–5
substratum and bacteria, bonding between, 52–3
succession, 37–8
sugar substrates, 296
sulphate-reducing bacteria, see sulphur-reducing bacteria
sulphide (ion), gradients, determination, 108–9
sulphide tailings, 148–70
metal-microbe interactions, 158–9
mineralized biofilms in, 148–70
physical and chemical characterization, 149–50
physical zones, 150
sulphide type, relevance to colonization, 150
sulphidogens, see sulphur-reducing bacteria
sulphur-oxidizing bacteria, positioning mechanisms, 31
sulphur-reducing bacteria (sulphur-reducing bacteria; SRB; sulphidogens), 161–3, 171–82
acid mine drainage bioremediation and, 161–3
corrosion and, 171–82
population architecture, 144–6
sedimentary mineral deposit formation and, 164
surface(s) (bacterial) adhesion and, 50
to-volume ratio, bacteria–metal interactions and, 155
surface(s) (biofilms on), 16–22, 23–9
attachment to/detachment from, see adhesion; attachment; detachment
bonding to, 52–3
colonization, see colonization
generic responses at, see gene expression
growth on, see growth
inert, see inert surfaces
living, see living surfaces
microenvironment, see microenvironment
properties of, 80–1
texture, 54–5
surface-enhanced Raman spectroscopy, 139–40

surfactants
adhesion to plastics prevented by, 257
biocidal, 142
gene expression and, 89

S layers, bacteria–metal interactions and, 155
salivary components, dental plaque growth influenced by, 267, 283, 284, 288–9
Salmonella spp. adhesion to epithelial cell, 86
sawdust-based ecosystem, acid mine drainage bioremediation, 161
scanning confocal laser microscopy, see confocal scanning laser microscopy
scanning electron microscopy, 113
dental plaque, 286
sea environments, corrosion, 178
sealants, fissure, 296
secrections, rhizodeposition, 208–9
sectioning studies, 109–12
sediment(s), acid mine drainage-receiving, sulphate-reducing bacteria activity, 161–2
sedimentary mineral deposits, microbes involved in formation of, 163–4
semiconductors, contamination, 133, 136
semi-solid media (bacterial responses to), 82, 84–5
liquid media compared with, 82
sequence batch reactors in wastewater treatment, 188–90
sessile bacteria, 29–32
acid mine drainage and its effects on, 159
growth, see growth
surface colonization traits, 16
slime, 84–5
shear forces, 55, 137
sheaths (surrounding chains of cells), bacteria–metal interactions and, 135
shedding behaviour, 23
signal transduction, gene regulation and, 90
Simonsiella spp. on rumenant tongue, 222–3
sinus infection by P. aeruginosa, 240
slide cultures, continuous-flow, 67–8
sloughing, 55
sludge
activated, phylogenetic studies in samples of, 191
bacterial, 252–5
sludge blanket reactors, 193
soil
ecology, rhizosphere biofilms affecting, 215
structuring, 211
zone around plant root, see rhizosphere
solid state chemostat (microbial), 68–70
solid surfaces, growth on, 82–4, 86–7
compared with liquid media, 82–4
solitary cells, surface colonization strategies, 23–4
soluble metals and bacteria, interactions, 154–63
solute transport, 104–7
spatial heterogeneity, see heterogeneity
species (bacterial)
composition, in communities, 66
attachment and, 51–2
spectroscopic detection in purified water systems, 139–40
sphincter of Oddi, biliary microbial ecology and, 252
spinning behaviour, 23
spoilage biofilms, 70–1
Staphylococcus epidermidis, tobramycin susceptibility, 124, 125
starvation conditions
attachment in, 51
in purified water systems, survival, 134
static systems, 19
INDEX

surrounding medium, see medium
suspended growth systems in wastewater treatment, 193–4
swarmer cells, 82, 84
swarming agents, artificial, 296
swimmer cells, 82, 84
symbiosis in rhizosphere, 213
synergism, plant-plant bacteria, 213
systems
hydrodynamics, 19
static, 19
taps of purified water systems, 138
teeth, see caries; plaque
tehicoic acids, bacteria-metal interactions and, 154, 155
teluric arsenic, bacteria-metal interactions and, 154, 155
temperature
attachment and, 55
dental plaque and, 284
detachment and, 56
texture, surface, 54–5
thermophlic bacteria, archaebacterial and eubacterial, economic impact, 176
Thermobacteriaceae, positioning mechanisms, 31
thickness of biofilms, 20
Thioacides ferroxidans
mineral surface colonization, 148–70
initiation, 150–3
physiological differences in surface- vs liquid-grown, 83–4
subspecies, identification, 154
time lapse video studies of growth on semi-solid media, 85
Tis5271, 189, 190
tobramycin susceptibility, S. epidermis, 124, 125
tongue, caries, 222–3
tooth, see caries; plaque
toothpastes, 296
toposomerase I, 90
touch sensors/receptors, 126
toxins in rhizosphere, degradation, 211
transmission electron microscopy, 113, 114
biliary brown pigment stones, 254
transport of solutes, 104–7
tricarboxylic acid cycle, oxygen gradients and, 100
Trichosan, 296
turbulent flow, 56–7, 57, 58, 59–60
biofilm dynamics in, 59–60
ulcerative gingivitis, acute necrotizing, 295
ultraviolet sterilization systems, 138
urease, bacterial
ruminants and, 224, 227
struvite urolithiasis and, 264
urinary tract, 9, 261–81
flora, 274–81
in disease prevention, 277–9
disruption, 276
probiotics and, 274–81
recovery (post-antimicrobial therapy), 277
lower, 261–73
host defence mechanisms, 261–2
urinary tract infection, 9, 261–3, 276–9
lower, 261–73, 276, 276–9
management, 277–9
upper, 261
urogenital tract, female, 9, 274–81
uterus, biofilm formation, 9
vaccination, see immunization
vadose zone, 149, 150, 153
vaginal infection, 277
Van der Waals forces, dental plaque formation and, 288
Veillonella spp., nutritional interactions with other bacteria, 292
Vibrio DW1, surface colonization strategies, 28–9
Vibrio fischeri, luminescence genes, regulation, 89
Vibrio harveyi, surface colonization strategies, 26–7
Vibrio parahaemolyticus
laf gene, 84, 126
surface colonization strategies, 25–6, 27–8, 29
swarming ability on agar surfaces, 84
viscosity, gene expression and, 89
viscous forces, boundary layers and, 58
viscous sublayer, 105
washout, resistance to, 31
wastewater treatment, 183–95
consoriza in, 183–95
water
availability in rhizosphere, 210
drinking/potable, see drinking water
hot/high temperature, see hot water
purified/contaminant-free, see purified water
systems/supplies
fluoridation, 296
pathogens in, 196–204
water activity, gene expression and, 89
Xantimonas maltophilia colonization, 37
zoospores in rhizosphere, 212