

INDEX

- Acclimatization: *see* Ventilatory acclimatization to hypoxia
- Adaptive self-tuning controllers, 75, 76, 78–79
- Adrenoceptors
- α -adrenoceptors, peripheral dopaminergic mechanisms and, 8, 11, 13
 - β -adrenoceptors
 - hypoxic response and, 25–27
 - peripheral dopaminergic mechanisms and, 8, 11, 13
- Age, oxygen uptake slow component and, 219–222
- AHVR (acute hypoxic ventilatory response), *see also* Hypoxia
- definition of, 36, 173
 - glutamergic component of, 61, 64
 - hyperventilation and, 21–23
 - hypocapnia and, 21–23, 33–34
 - low-dose anaesthetics and, 35–38, 40
 - peripheral dopaminergic activity and, 29–31, 173–177
- Airway constriction, rapidly adapting receptors and, 97, 159–165
- Airway resistance
- CPAP and, 97
 - in flow limited inspiration, 119–125
- Alkalosis, hypocapnic, 21, 22
- Alpha-adrenoceptors, peripheral dopaminergic mechanisms and, 8, 11, 13
- Anaerobic threshold, pulmonary training and, 231, 232–233
- Anesthetics, low-dose
- hypoxic response and, 35–38, 40, 155
 - ventilatory response to CO₂ and, 35, 36, 37, 39–40, 155–157
- Aortic bodies, heart rate and, 173, 176; *see also* Chemoreceptors, peripheral
- Area postrema, dopaminergic ventilatory depression and, 14
- Artificial ventilation
- CPAP, expiratory flow pattern and, 96–98
 - proportional assist mode for, 148, 149, 150–152
- Asthma, *see also* COPD
- rapidly adapting receptors and, 159
- Autonomic control of respiration, 181–183
- failure of, in Ondine's curse, 179–184
 - parasympathetic: *see* Vagus nerves
 - sympathetic, in isocapnic hypoxia, 25–27
- Basal ventilatory drive, 185, 186
- Beta-adrenoceptors
- hypoxic response and, 25–27
 - peripheral dopaminergic mechanisms and, 8, 11, 13
- Bicuculline, phrenic temporal correlation and, 112, 115, 117
- Blood pressure, dopaminergic ventilatory inhibition and, 9, 10, 11–12, 13
- Bötzing complex
- phrenic motoneurons and, 52, 57, 58
 - pontine projections to, 67–71
- Brain stem, *see also* Medulla; Pons; Respiratory control system
- infarction of, in inverse of Ondine's curse, 181–184
 - synaptic plasticity in, 73–74, 75–76, 81
- Breathing pattern: *see* Respiratory rhythm
- Breathlessness, voluntary hyperventilation and, 167–172
- Bronchoconstriction, rapidly adapting receptors and, 97, 159–165
- Carbon dioxide, *see also* Hypercapnia; Hypocapnia
- body stores of, posture and, 134, 137, 138
 - as dyspnoegenic agent, 171
 - output of
 - head up tilt and, 133–138
 - in non-steady-state exercise, 207–211
 - ventilatory response to
 - chemoreflex model of, 185–192
 - exercise kinetics of, 209–211
 - Hebbian model of, 79, 80, 81–82
 - hyperoxic, after sustained hypoxia, 17–19
 - low-dose anaesthetics and, 35, 36, 37, 39–40, 155–157
- Cardiac rhythm, *see also* Heart rate
- coupling to locomotor rhythm, 199–206

- Carotid bodies, *see also* Chemoreceptors, peripheral dopaminergic inhibition in
 hypoxic sensitivity and, 31, 173–177
 vs. non-CB mechanisms, 7–14
 heart rate and, 173, 176–177
 phrenic temporal correlation and, 111, 112, 114, 115, 117
 respiratory fluctuations and, 76
 Carotid sinus nerve, respiratory memory and, 75
 Central alveolar hypoventilation syndrome, 181–183
 Cerebral blood flow
 in euoxic hypocapnia, 43–44
 in head up tilt response, 138
 hyperoxic hyperpnea and, 5
 Cervical inspiratory neurons, in rat, 54–56, 57–58
 C-fibers, 159
 bronchoconstriction and, 163, 165
 cough and, 165
 Chaotic dynamics, in respiratory oscillator, 76, 81, 116
 Chemoreceptors, central
 low-dose anesthetics and, 155–157
 in respiratory control model, 185–192
 Chemoreceptors, peripheral, *see also* Aortic bodies; Carotid bodies
 central glutamergic mechanisms and, 64
 hypoxic ventilatory decline and, 36, 40
 low-dose anesthetics and, 39, 40, 155–157
 nucleus tractus solitarii and, 46
 in respiratory control model, 185–192
 Chemoreflex model, parameters measurement for, 185–192
 Chi, 235
 Children, oxygen uptake slow component in, 219
 Chronic obstructive pulmonary disease: *see* COPD
 Cold water, ventilatory response to, 127–131
 Control of ventilation: *see* Autonomic control of respiration; Cortical control of respiration; Respiratory control system
 COPD (chronic obstructive pulmonary disease)
 asthma, rapidly adapting receptors and, 159
 automatic oxygen supply for, 85–91
 Cortical control of respiration, 181–183
 dysfunction of, in inverse of Ondine's curse, 179–184
 in exercise under hypnosis, 196
 in hyperventilation, breathlessness and, 167–172
 in non-steady-state exercise, 207–208, 211
 Corticospinal tract, dysfunction of, 181–184
 Cough, rapidly adapting receptors and, 159–165
 Covariance learning: *see* Hebbian covariance learning
 CPAP (continuous positive airway pressure), expiratory flow pattern and, 96–98
 Critical power point, 232–233
 Desflurane, ventilatory response to CO₂ and, 35
 Detrended fluctuation analysis (DFA), 112–114
 Diving reflex, 127
 Domperidone antagonism of dopamine
 hypoxic response and, 29–31
 ventilatory depression and, 8, 10, 12–14
 Dopamine
 central excitatory effects of, 14
 hypoxic response and, 29–31, 173–177
 ventilatory depressant effects of, 7–14
 Dopamine D₂ receptors, ventilatory depression and, 8, 10, 12–14
 Dynamic end-tidal forcing technique, 186, 187–188
 Dyspnea, exertional, pulmonary training and, 231–236
 End-tidal forcing technique, 186, 187–188
 Enflurane, hypoxic response and, 35, 39–40, 155
 Exercise, *see also* Movement
 breathlessness during, 167–172
 coupling of cardiac and locomotor rhythms, 199–206
 electrically induced vs. voluntary, 207, 209, 211
 fatigue tolerance, pulmonary training and, 231–236
 hyperpnea, Hebbian model of, 74, 79, 80, 81
 under hypnosis, 195–197
 imagined, 195–197
 intensity measurement, by voice or breathing, 223–229
 non-steady-state
 oxygen uptake slow component, 219–222
 transients in ventilation and CO₂ output, 207–211
 Expiratory flow pattern, model vs. cat data, 95–100
 Facial immersion, ventilatory response to, 127–131
 Fast twitch muscle fibers, oxygen uptake slow component and, 219, 221–222
 Flow limited inspiration, 119–125
 Flow profiles
 expiratory model of, 95–100
 phase angle approach, 93–94
 Fractal scaling, in phrenic activity, 111–117
 GABA (gamma-aminobutyric acid)
 phrenic temporal correlation and, 112, 115
 as respiratory depressant, 61
 Glutamate
 medullary NMDA receptors and, 46, 61–65
 phrenic temporal correlation and, 112, 114, 115
 post-hyperoxic hypoxic response and, 1–6
 Haldane effect, hyperoxic hyperpnea and, 5
 Haloperidol, dopamine antagonism by, 13
 Halothane, low-dose
 hypoxic response and, 35, 40
 ventilatory response to CO₂ and, 35, 155, 157
 Head up tilt, ventilatory response to, 133–138
 Heart rate, *see also* Cardiac rhythm
 exercise intensity and, 223–227
 pulmonary training and, 231–236
 in sustained isocapnic hypoxia, 173–177

- Hebbian covariance learning
 general principles of, 73–75
 respiratory model using, 74, 76–79
 CO₂ inhalation and, 79, 80, 81–82
 exercise hyperpnea and, 74, 79, 80, 81
- High altitude: *see* Ventilatory acclimatization to hypoxia
- Histamine
 expiratory flow pattern and, 96–98, 100
 rapidly adapting receptors and, 159, 161
- HVD: *see* Hypoxic ventilatory decline (HVD)
- Hypercapnia
 breathing pattern in
 coupling to finger movement, 213–218
 coupling to limb movement, 101–109
 in Ondine's curse, 180, 183
 ventilatory drift with, 35, 38, 39
 ventilatory response to
 low-dose anaesthetics and, 35–40
 prior oxygen breathing and, 1–6
- Hyperoxia
 CO₂ response in, post-hypoxic, 17–19
 dopaminergic ventilatory depression in, 7, 8, 9, 11, 12
 during hypoxic exposure, β -blockade and, 25–27
 prior, ventilatory response and, 1–6
- Hyperventilation
 breathlessness and, 167–172
 cold water facial immersion and, 129–131
 in hyperoxia, 5
 in hypoxia
 glutamergic receptors and, 64
 post-hyperoxic, 1–6
 hypoxic sensitivity and, 21–23
 posture and, 133, 137
 for pulmonary training, 233–235
- Hypnosis, exercise under, 195–197
- Hypocapnia
 cerebral blood flow response to, 43–44
 hyperventilation and, 168, 171, 172
 hypoxic response and, 21–23, 33–34
- Hypothalamus, CO₂ chemosensitivity in, 5
- Hypoventilation, central alveolar, 181–183
- Hypoxemia, in Ondine's curse, 180
- Hypoxia
 heart rate in, dopamine and, 173–177
 hyperoxic response to CO₂ and, 17–19
 ventilatory response to
 biphasic character of, 36, 173
 glutamergic component of, 61, 64
 hyperventilation and, 21–23
 hypocapnia and, 21–23, 33–34
 low-dose anaesthetics and, 35–38, 40, 155
 peripheral dopaminergic activity and, 29–31, 173–177
 prior oxygen breathing and, 1–6
 protein kinase C in, 45–48
 respiratory memory and, 75
 sympathetic activity and, 25–27
- Hypoxic ventilatory decline (HVD), 36
 dopamine and, 173
 low-dose anaesthetics and, 36, 38, 40
- Imagination of exercise, 195–197
- Impedance, respiratory, in flow limited inspiration, 119–125
- Inspiratory muscle activity, model of, 95–100
- Inspiratory off-switch, 67
- Isoflurane, hypoxic response and, 35, 155
- Isoproterenol, in carotid body denervated goats, 8, 11, 13
- Kölliker–Fuse nucleus, 67–71
- Learning: *see* Hebbian covariance learning
- Lung compliance, rapidly adapting receptors and, 97, 160, 161
- Mechanical ventilation
 CPAP, expiratory flow pattern and, 96–98
 proportional assist mode for, 148, 149, 150–152
- Mechanoreceptors
 muscle, in nonsteady-state exercise, 207–208, 211
 pulmonary
 airway constriction and, 97, 159–165
 respiratory fluctuations and, 76
- Medulla, *see also* Brain stem
- Bötzing complex of
 phrenic motoneurons and, 52, 57, 58
 pontine projections to, 67–71
 glutamergic receptors in, 61–65
 infarction of, in inverse of Ondine's curse, 183
 nucleus raphe magnus of
 pontine projections to, 67
 respiratory memory and, 75
 nucleus tractus solitarius (NTS) of
 protein kinase C in, 46–48
 synaptic plasticity in, 75, 78, 81
 ventral medullary connections of, 64
 phrenic motoneuron connections to, in rat, 51–58
 phrenic temporal correlation and, 112, 114, 115
 in respiratory control system, 181–183
 respiratory memory and, 75
 in volitional breathing, 171
- Memory, respiratory, 73–76, 78, 81
- MK-801
 phrenic depression by, 61–65
 temporal correlation and, 112, 114, 115
- Morphine, respiratory pharmacology of, sex differences in, 141–144
- Movement, *see also* Exercise
 coupling to breathing pattern, 101–109, 213–218
- Muscle mechanoreceptors, in non-steady-state exercise, 207–208, 211
- Muscles, respiratory, training of, 231–236
- Nitric oxide, in hypoxic response, 5, 46–47
- Nitrous oxide, ventilatory response to CO₂ and, 35

- NMDA receptors
 in NTS, protein kinase C and, 46–48
 respiratory memory and, 73, 75
 in ventral medulla, phrenic output and, 61–65
- Nonlinear systems
 in coupling of cardiac and locomotor rhythms, 199
 Hebbian covariance learning and, 74, 75, 77, 81
 long-term correlation in, 116
- NPB-KF (parabrachial-Kölliker–Fuse) complex, 67–71
- NTS: *see* Nucleus tractus solitarius
- Nucleus raphe magnus
 pontine projections to, 67
 respiratory memory and, 75
- Nucleus tractus solitarius (NTS)
 protein kinase C in, 46–48
 synaptic plasticity in, 75, 78, 81
 ventral medullary connections of, 64
- Obesity, in pigs, airway resistance and, 119–125
- Ondine's curse, and its inverse, 179–184
- Opioids, respiratory pharmacology of, sex differences in, 141–144
- Optimal controller model, ventilatory assist and, 147–153
- Oxygen: *see* Hyperoxia; Hypoxia
- Oxygen therapy, adaptive control for, 85–91
- Oxygen uptake, slow component of
 age and, 219–222
 mechanism of, 219–220, 221–222
- Parabrachial-Kölliker–Fuse (NPB-KF) complex, 67–71
- Pattern of breathing: *see* Respiratory rhythm
- PBL (lateral parabrachial nucleus), 69–71
- Phentolamine, in carotid body denervated goats, 8, 11, 13
- Phrenic-driven servo respirator, 150–152
- Phrenic neural activity
 dopaminergic mechanisms and, 7–14
 medullary glutamergic receptors and, 61–65
 motoneuron trajectories, in rat, 51–58
 pontine modulation of, 68–71
 respiratory memory and, 75
 temporal correlation in, 111–117
- PKC, in hypoxic response, 45–48
- Pons, projections to Bötzing complex from, 67–71
- Posture, head up tilt response, 133–138
- Power spectral analysis, of phrenic temporal correlation, 113–114, 117
- Prana, 235
- Proportional assist ventilation, 148, 149, 150–152
- Propranolol, hypoxic response and, 25–27
- Protein kinase C, in hypoxic response, 45–48
- PSRs: *see* Pulmonary stretch receptors
- Pulmonary mechanoreceptors
 airway constriction and, 97, 159–165
 respiratory fluctuations and, 76
- Pulmonary stretch receptors (PSRs), 159, 160
 histamine and, 97
- Pulmonary training, 231–236
- Pyramidal tract, dysfunction of, 181–184
- Raphe nucleus
 pontine projections to, 67
 respiratory memory and, 75
- Rapidly adapting receptors (RARs), 97, 159–165
- Rebreathing technique, 186–187
- Resistive pressure, in flow limited inspiration, 119–125
- Respiratory control system, 181–183; *see also* Autonomic control of respiration; Cortical control of respiration
 adaptive self-tuning model of, 75, 76, 78–79
 chemoreflex model of, 185–192
 in non-steady-state exercise, 207–208, 211
 optimal controller model of, 147–153
 reflex models of, 74, 81, 147
- Respiratory flow profiles
 expiratory model of, 95–100
 phase angle approach, 93–94
- Respiratory impedance, in flow limited inspiration, 119–125
- Respiratory memory, 73–76, 78, 81
- Respiratory rate
 coupling to limb movements, 101–109
 in non-steady-state exercise, 207–211
- Respiratory rhythm
 cardiac cycle and, 201, 206, 235
 chaos in, 76, 81, 116
 coupling with finger movement, 213–218
 coupling with limb movement, 101–109
 metabolic CO₂ production and, 211
 phrenic temporal correlations, 111–117
- Respiratory sensation, reporting of, 172
- Rohrer equation, 124–125
- Serotonin, in respiratory memory, 73, 75
- Sevoflurane, chemoreflex effects of
 in cats, 155–157
 in humans, 35–40
- Sex differences, in opioid respiratory pharmacology, 141–144
- Sleep
 apnea during, pig model of, 119
 hypoventilation during, in Ondine's curse, 181, 183
- Sympathetic activity, in isocapnic hypoxia, 25–27
- Synaptic plasticity: *see* Hebbian covariance learning
- Synaptic weight, 74–75
- Training effect
 of exercise, 223–229
 of pulmonary training, 231–236
- Trigeminal nerve, cold water ventilatory response and, 130
- Vagus nerves
 bronchoconstriction and, 159, 160, 161
 cough reflex and, 161

Vagus nerves (*cont.*)

- expiratory flow pattern and, 96, 100
- heart rate and
 - in hypoxia, 173
 - respiratory rhythm and, 235
 - respiratory fluctuations and, 76
- VAH: *see* Ventilatory acclimatization to hypoxia
- Ventilation–perfusion ratio, posture and, 134, 137

Ventilatory acclimatization to hypoxia (VAH), *see*

- also* AHVR
- hyperventilation and, 21–23
- hypocapnia and, 21–23, 33–34
- peripheral dopaminergic activity and, 29–31
- sympathetic activity and, 25–27
- Voice, exercise intensity and, 223–229
- Voluntary respiration: *see* Cortical control of respiration