

INDEX

- AAS. *See* atomic absorption spectroscopy
- Abu Hureyra site, 223–224
- accelerator mass spectroscopy (AMS), 409
- aDNA. *See* ancient DNA
- alleles, 26
- allometry, in GMM techniques, 207
- amino acids, 35–37
- asparagine, 39
 - chirality of, 37
 - complex structure of, 37
 - glutamine, 39
 - peptide, 35, 38
 - racemisation, 37, 246–247
- AMS. *See* accelerator mass spectroscopy
- Anatomically Modern Humans, 416–417
- ancient DNA (aDNA)
- analyses of, 20–23
 - with genomic data, 22
 - with mitochondrial data, 22
 - modern DNA analyses compared to, 20
 - multiregional (MRE) hypotheses, 21
 - recent African origins (RAO) hypothesis, 21
 - serial founder effect and, 20–21
 - capture data for, 19
 - case studies
 - for incomplete lineage sorting and human evolution, 23
 - for mitochondrial capture at Sima de los Huesos, 19–20
 - for serial founder effect (in human evolution), 20–21
 - for woolly mammoth genomes, 25–26
 - contamination of, 16
 - in laboratories, 17
 - definition of, 13–14
 - degradation of, 15–17
 - demographic inference from, 24–26
 - coalescent theory and, 24–25
 - coalescent-based approaches, 25
 - with nuclear genetic markers, 24
 - phylogeographic inference, 24
 - in Denisovan hominins, 23
 - High Throughput Sequencing of, 17–19
 - in humans, 23
 - from mitochondria
 - in case studies, 19–20
 - data analysis of, 22
 - inheritance mechanisms, 22–23
 - in Neanderthals, 23
 - Next Generation Sequencing of, 17–19
 - See also* High Throughput Sequencing
 - reconstruction of genomes in, 18
 - Sanger sequencing compared to, 18
 - from nuclear genomes
 - data analysis of, 22
 - recombination processes, 22
 - preservation of, 15–16
 - purpose and function of, 13–14
 - for establishing of biological sex, 13–14

- ancient DNA (aDNA) (*cont.*)
 reconstruction of past diets, 13–14
 for species identification, 13–14
 retrieval of, challenges for, 14–16
 degradation issues, 15–16
 environmental factors for, 15
 hydrolysis of DNA, 15
 Sanger sequencing for, 17–19
 NGS compared to, 18
 PCR method in, 17
 at Sima de los Huesos site, 19–20
 source materials for, 14–15
 whole genome sequences in, 19
 baits in, 19
- ancient proteins
 recovery of, 36–37
 survival of, 39–40
- animals. *See also* invertebrate
 zooarchaeology; vertebrate
 zooarchaeology
- bioapatites in, oxygen isotopes and,
 107–109
- diet studies for
 with carbon isotopes, 132–133
 with nitrogen isotopes, 135–136
- extinct
 genomes of, 25–26
 proteins of, 39–40
- in human dietary studies, as baselines,
 135–136
- movement of, 100
- reconstruction of, from bones, 221–222
- strontium in, 103
- anthracology, 276–277
- anthropogenesis, in palaeoethnobotany, 277
- apical root translucency method, 154
- archaeobotany, 276. *See also*
 palaeoethnobotany
- archaeological science
 dataset integration in, 7
 definition of, 3–4
 future of, 6–8
 history of, 5–6
 mainstream sciences and, 5–6
 multi-faceted approach, scope of, 3
 New Archaeology and, 5
 stratigraphy as framework of, 5
 technologies and techniques in, 4
- archaeomalacology, 242
- archaeometallurgy, 377–381
 analytical practice of, 378–379
 artefact reconstruction, 380
 composition identification, 379
 compositional groups, of metals, 380
 data interpretation through, 381
 provenancing in, 380–381
 theoretical approach to, 381–382
- Archaeometry* (journal), 6
- artefacts. *See also* ceramics; glass; lithic
 analysis
 animal bones as, 225
 reconstruction of, through
 archaeometallurgy, 380
 residue analysis from, 71–75
 formation of, 71
 in visible deposits, 80–81
 shells as, 257–260
- ascertainment bias, 26–27
- asparagine, 39
- atomic absorption spectroscopy (AAS), 393
- baits, in whole genome sequences, 19
- baselines, in human dietary isotope studies,
 135–136
- bioapatites
 diagenesis of, 103–104
 isotope analysis of, 100
 carbonate components, 109–110
 oxygen, 109
 phosphate components, 109
 strontium, 103–105
- bioavailability
 chemical weathering and, 101–102
 estimation of, 101–103
 mixing in, 102
 outputs in, 102
 in strontium studies, 101–103
- bone collagen, isotope analysis for, 130–138

- carbon isotopes, 130–133
 - with EDTA, 127
 - extraction methods, 126–127
 - with HCl acid, 127
 - for measurements of, 126–127
 - nitrogen isotopes, 128–129
 - quality control methods, 126–127
- bones
 - diagenesis, 103–104
 - proteomes, 57
 - in vertebrate zooarchaeology, 219–222
 - as data source, 222–227
 - identification protocols, 219–220
 - preservation protocols, 218
 - quantification and calculation protocols, 220–221
 - reconstruction of living animals from, 221–222
 - recording protocols, 219–220
 - sources of, 218–219
- braincase measurement, GMM techniques for, 206
- calcium antimonate, in glass, 356
- canonical variant analysis (CVA), 204
- carbon isotopes, for diet studies
 - in animals, 132–133
 - in bone collagen, 130–133
 - with elemental analysers, 128–129
 - in humans, 137–138
 - in plants, 131–132
 - ratio measurements, 128–129
- carbon reservoirs, 408
- Çayönü Tepesi site, 224
- ceramics
 - analysis of, 338–344
 - chemical approaches, 342–343
 - fabric, 338–339
 - isotopic approaches, 343
 - mineralogical approaches, 340–342
 - definition of, 335–336
 - global abundance of, 335
 - lipid residue analysis of, 74–75, 77–78
 - for dairying, 85–86
 - for marine resource use, 86–87
 - methodological techniques for, 342–343
 - with hand lens, 338–340
 - with polarising light microscopy (PLM), 340–341
 - with scanning electron microscopy (SEM), 341
 - pottery vessels, proteomics for, 56
 - production technology for, 336–342
 - source materials as influence on, 337–338
 - purpose and function of, 337
 - source materials, 336
 - production based on, 337–338
 - unusual, 343–344
 - as wares, 340
- ceremonies, ritual uses of plants in, 295–296
- charring, of macrobotanical remains, 281–283
- chemical weathering, strontium and, 101–102
- cheniers* (natural shell mounds), 248–249
- chirality, of amino acids, 37
- chromosomes, 26
- Clovis people, parasite transmission by, 263
- CNV. *See* copy number variation
- coalescent theory, 24–25
- collagen, proteomics of, 35, 54. *See also* bone collagen; non-collagenous proteins
- copper, 366–367
 - smelting of, 373–374
- copy number variation (CNV), 26
- cortical bone surface, in skeletal inventory, 148–149
- crustaceans, 264
- CVA. *See* canonical variant analysis
- DAGs. *See* diacylglycerols
- dairying, origins of, 85–86
- Daltons, in MS, 42
- datasets, integration of, in archaeological science, 7
- dating. *See also* luminescence dating; radiocarbon dating
 - amino acid racemisation (AAR), 37

- dating. (*cont.*)
 of lithics, 394–395
 optically stimulation luminescence (OSL)
 dating, 426
 thermoluminescence (TL) dating, 426
 demineralisation, of bone in diet studies, 127
 Denisovans, 23
 dental calculus, proteomics for, 57
 dental health, 159–162
 dental disease and, 162
 infectious disease history, 160
 lesions and, analysis of, 159–160
 metabolic disease and, 161
 trauma history, 160–161
 dental histology. *See also* tooth development
 archaeological applications of, 179–185
 age estimation at time of death, 179–183
 crown formation time, 179–183
 for developmental stress, 183–185
 case study for, 185–187
 dentine production, 171
 Andresen lines, 171–172
 cementum annulations, 171
 periradicular lines, 171
 tubules, 171
 von Ebner lines, 171–172
 developmental stress
 accentuated lines, on tooth roots,
 183–184
 accentuated rings, on tooth roots,
 183–184
 archaeological applications for, 183–185
 hypoplasias, on crowns, 183–185
 for *Scladina* juvenile Neanderthal, 186
 methods of study, 173–179
 impressions and casts, 173–176
 microscopic imaging, 179–181
 physical sectioning, 176–178
 with SEM, 179
 in *Scladina* juvenile Neanderthal, 185–187
 developmental stress for, 186
 serial sampling and isotope analysis, 108,
 112–115
 theoretical approach to, 170–173
- dentine
 diagenesis in, 103–104
 production of, 171
 Andresen lines, 171–172
 cementum annulations, 171
 periradicular lines, 171
 tubules, 171
 von Ebner lines, 171–172
 proteomics for, 57
 deoxyribonucleic acid (DNA), 26. *See also*
 ancient DNA
 archaeological residues from, 76
 endogenous, 27
 exogenous, 27
 hydrolysis of, 15
 modern analysis of, compared to aDNA
 analysis, 20
 residue analysis of, 79
 extraction methods, 79
 sequencing of proteins, 39
 developmental stress, in dental histology
 accentuated lines, on tooth roots, 183–184
 accentuated rings, on tooth roots, 183–184
 archaeological applications for, 183–185
 hypoplasias, on crowns, 183–185
 for *Scladina* juvenile Neanderthal, 186
 diacylglycerols (DAGs), 75
 diet studies, isotope analysis for
 for bone collagen, 130–138
 with carbon isotopes, 130–133
 extraction methods, 126–127
 for measurements of, 126–127
 with nitrogen isotopes, 128–129
 quality control methods, 126–127
 with carbon
 in animals, 132–133
 in bone collagen, 130–133
 with elemental analysis, 128–129
 in humans, 137–138
 isotope ratio measurements, 128–129
 in plants, 131–132
 with nitrogen
 in animals, 135–136
 in bone collagen, 133–137

- from dietary protein, 133–135
 - with elemental analysers, 128–129
 - in humans, 136–138
 - in plants, 133–134
 - ratio measurements, 128–129
 - theoretical approach to, 125
- diets, reconstruction of, through aDNA, 13–14
- direct bonding, of proteins, 75
- direct temperature resolved mass spectrometry (DTMS), 76
- Discoveries in the Ruins of Ninevah and Babylon* (Layard), 5
- DNA. *See* deoxyribonucleic acid
- DTMS. *See* direct temperature resolved mass spectrometry

- EA-IRMS. *See* isotope ratio mass spectrometry
- echinoderms, 264
- EDMA. *See* Euclidean Distance Matrix Analysis
- Edman degradation sequencing, 38
- EDTA. *See* ethylenediaminetetraacetic acid
- electron microprobe analysis (EMPA), 392
- Electron Probe Micro-Analyser (EPMA), 350–351
- electrospray ionisation (ESI), 41–42
- elemental analysers, 128–129
- EMPA. *See* electron microprobe analysis
- enamel. *See also* tooth development
 - diagenesis in, 103–104
 - growth of, 171
 - isotope analysis of, 103–105, 109–110
 - sequential sampling of, 103–104, 108, 111–115
 - structure of, 171
- enamel prisms, in tooth development, 171
- enamels (material culture), 349
- endogenous DNA, 27
- endoparasites, 262
- epitopes, 38
 - antibodies, 38
- epitopes antibodies, 38

- EPMA. *See* Electron Probe Micro-Analyser
- Ertebølle
 - culture, 223–224
 - site of, 248
- escargotières* sites, 243
- ESI. *See* electrospray ionisation
- ethylenediaminetetraacetic acid (EDTA), 127
- Euclidean Distance Matrix Analysis (EDMA), 201
- exogenous DNA, 27
- extraction methods
 - of ancient DNA, 14–16, 79
 - in diet studies, for bone collagen, 126–127
 - of DNA, in residue analysis, 79
 - of lipids, in residue analysis, 77–78
 - of proteins, in residue analysis, 78–79

- fabric analysis, of ceramics, 338–339
- flotation, 286–289
- food residues, for proteomics, 56–57
- Fourier transform infrared spectroscopy (FTIR), 76
- fractionation
 - in carbon isotopes, 130
 - in nitrogen isotopes, 130, 133–134
 - in oxygen isotopes, 106
 - analysis of, 107–108
 - in radiocarbon dating, 409–410
- fracture mechanics, 388–389
 - controlled experimentation in, 388–389
 - methodological approaches to, 388
- freshwater molluscs, 242–244
 - palaeoenvironmental reconstructions of, 244–245
- FTIR. *See* Fourier transform infrared spectroscopy

- GC-c-IRMS, lipid residue analysis with, 81–83
- gender, in human osteology, 154
- genes, 26
- genetic locus, 27
- genetic markers, 26
 - nuclear, aDNA demographic inference from, 24

- genomes, 27
 - de novo reconstruction of, 18
 - mitochondrial, 27
 - Denisovans, 23
 - Neanderthals, 23
 - Sima de los Huesos, 19–20
 - next generation sequencing, 17–19
 - nuclear, aDNA from
 - data analysis of, 22
 - recombination processes, 22
 - whole sequences for, with aDNA, 19
 - baits in, 19
 - woolly mammoth, 25–26
- genotypes, 27–28
- geoarchaeology
 - definition of, 314
 - landscape, 315–319
 - burial site location prediction, 316–317
 - human impact studies, 318–319
 - landform changes in, 317–318
 - objectives of, 315–319
 - site reconstruction in, 317
 - at Makri site, 322–323
 - methodologies of, 319
 - on-site, 320–324
 - cultural deposits in, 320–321
 - methodological techniques for, 320
 - natural sedimentary features, 322
 - non-sedimentary processes, 318–321
 - theoretical approach to, 314–315, 324
 - at Wilson-Leonard site, 321
- Geological Evidences of the Antiquity of Man* (Lyell), 314
- geometric morphometric (GMM)
 - techniques
 - allometry and, 207
 - applications of, 206–210
 - for braincase measurement, 206
 - for change in body size, 207
 - for *Homo sapiens*, 207–209
 - for tooth development, 209–210
 - case studies, 205
 - data sources in, 200
 - estimation of missing data, 204–206
 - measurement points in, 200
 - function of, 198–199
 - homology, 199–200
 - landmarks, 199–200
 - methods of, 199–206
 - core, 201–206
 - CVA, 204
 - EDMA, 201
 - procrustes superimposition, 199, 201–202
 - semilandmarks, 202–203, 207–209
 - statistical analysis in shape space, 203–204
 - statistical significance tests, 204–205
 - thin-plate spline interpolation, 202
 - for Neanderthal newborn, virtual reconstruction of, 205
 - purpose of, 198–199
 - theoretical approach to, 198–199
- glass
 - analysis of, 349–351, 359
 - chemical, 350–351
 - with EPMA, 350–351
 - isotopic, 357–358
 - with LA-ICPMS, 357
 - with micrographs, 351
 - through provenance, 356–358
 - with SEM-EDS, 350–351
 - beads, for trade, 354
 - composition of, 352–356
 - calcium antimonate in, 356
 - colouring elements in, 355–356
 - geographic factors in, 353–355
 - lead, 355
 - natron in, 353
 - plant ash in, 353
 - potash, 353
 - silica, 352–353
 - trace elements in, 356–358
 - early production of, 347
 - raw materials in, 348
 - technologies in, 358
 - in enamels, 349
 - formation processes, 347–348
 - raw materials in, 348

- in glazes, 349
- human-made, 352–353
- mass commodification of, 349–353
- provenancing of, 356–358
- raw materials
 - composition of, 352–356
 - in early production, 348
 - in formation processes, 348
- glass beads, 354
- glazes, 349
- glutamine, 39
- GMM techniques. *See* geometric morphometric techniques
- gold, 374–375

- habitus* practice theory, 292
- HBE. *See* human behavioural ecology
- HCl. *See* hydrochloric acid
- heirloom parasites, 263
- Hermopolis Magna* site, 226
- High Throughput Sequencing, 17–19. *See also* Next Generation Sequencing
- hominins, 19–20. *See also* Denisovans; Neanderthals; Sima de los Huesos
- Homo sapiens*, GMM techniques for, 207–209
- human behavioural ecology (HBE), 291–292
- human-made glass, 352–353
- humans
 - aDNA in, 23
 - Anatomically Modern Humans, 416–417
 - diet studies for
 - with carbon isotopes, 137–138
 - with nitrogen isotopes, 136–138
 - genetic evidence for evolution of, 20–21
 - mobility studies for
 - with oxygen isotopes, 110
 - with strontium isotopes, 103
- hydrochloric acid (HCl), use of in collagen extraction, 127
- hydrolysis, of peptides, 39
- hypoplasias, on tooth crowns, 183–185

- ICP-MS. *See* inductively coupled mass spectrometry
- incomplete lineage sorting, 23
- inductively coupled mass spectrometry (ICP-MS), 392
 - with laser ablation (LA-ICPMS), 357
 - with laser ablation (LA-MC-IP-MS), 105
 - with multi-collector (MC-ICP-MS), 104–105
- infectious disease, 160
- inheritance mechanisms, in aDNA, 22–23
- insects, zooarchaeology for, 234–242
 - advanced studies of, 241–242
 - archaeoentomology and, 237–241
 - at Coppergate site, 238–239
 - MCR method, 236
 - palaeoentomology and, 235–237
 - parasitic species, 240–241
 - synanthropic species, 239–240
- invertebrate zooarchaeology, 260–264. *See also* insects; molluscs
 - aquatic invertebrates, 264
 - crustaceans, 264
 - echinoderms, 264
 - sponges, 264
 - for mites, 263–264
 - for parasitic worms, 261–263
 - Clovis people and, 263
 - endoparasites, 262
 - heirloom parasites, 263
 - human populations and, 262–263
 - preservation protocols in, 233–234
 - for protozoans, 260–261
 - quantification protocols in, 233–234
 - recovery protocols in, 233–234
 - theoretical approach to, 233
- ionisation, 41–42
 - ESI, 41–42
 - MALDI, 41–42
- iron, metallurgy with, 375–376
 - alloys and, 376
- Iron Age, 375–376
- isoscapes. *See* bioavailability; oxygen isotopes

- isotope analysis. *See also* diet studies
 of animals, as baselines, 135–136
 of bioapatites, 100
 in carbonate components, 109–110
 with oxygen, 109
 in phosphate components, 109
 with strontium, 103–105
 carbon
 in animals, 132–133
 basic principles of, 130–133
 in bone collagen, 130–133
 with elemental analysers, 128–129
 in humans, 137–138
 in plants, 131–132
 ratio measurements, 128–129
 in carbonate components, 109–110
 in case studies, 111–115
 of dietary change with agriculture, 125
 migration studies of caribou/reindeer,
 111–115
 of ceramics, 343
 of glass, 357–358
 at Jonzac site, 112, 114
 lead isotope analysis (LIA), in
 archaeometallurgy, 380–381
 nitrogen
 in animals, as baselines, 135–136
 basic principles of, 136
 in bone collagen, 133–137
 breastfeeding and, 136
 from dietary protein, 133–135
 with elemental analysers, 128–129
 in humans, 136–138
 in plants, 133–134
 ratio measurements, 128–129
 oxygen, 105–110
 basic principles of, 105
 of bioapatites, 109–110
 fractionation in, 107–108
 of obligate drinkers, in palaeoclimate
 reconstruction, 107
 sampling approach, 108
 standards (V-PDB, VSMOW),
 105–110
 with strontium, in mobility studies, 110
 tissue offsets, 107
 standards, 128–129
 Ambient Inhalable Reservoir (AIR), 134
 V-PBD, 130–131
 V-SMOW, 105–110
 strontium, 101–105
 basic principles of, 101
 in bioapatites, 103–105
 bioavailability of, 101–103
 diagenesis and, 103–104
 in migration studies of caribou/
 reindeer, 111–115
 with oxygen, in mobility studies, 110
 theoretical approach to, 99–100
 transhumance and, 99–100
 isotope ratio mass spectrometry (EA-IRMS),
 76
 joint disease, skeletal health and, 161
 Jonzac site, 112, 114
Journal of Archaeological Science (journal), 6
 Kamid el-Lo site, 217
 keratins, 53
 LA-ICPMS. *See* inductively coupled mass
 spectrometry
 landmarks, in GMM techniques, 199–200
 landscape geoarchaeology, 315–319
 burial site location prediction, 316–317
 human impact studies, 318–319
 landform changes in, 317–318
 objectives of, 315–319
 site reconstruction in, 317
 Layard, Austen Henry, 5
 lead
 in glass, 355
 metallurgy with, 374–375
 Lead Isotope Analysis (LIA), 380–381
 Leeuwenhoeck, Anthony, 170
 lesions, dental health and, 159–160
 LIA. *See* Lead Isotope Analysis
 lineage sorting. *See* incomplete lineage sorting

- lipids
 as archaeological residue, 76
 DAGs, 75
 degradation of, 74–75
 MAGs, 75
 TAGs, 74–75
 residue analysis of, 77–78
 with GC-c-IRMS, 81–83
 methodological approaches to, 77
 from plants, 84
 for species identification, 83
 Liquid Scintillation Counters, 408–409
 lithic analysis
 fracture mechanics, 388–389
 controlled experimentation in, 388–389
 methodological approaches to, 388
 function of, 396–398
 for tool shape analysis, 399–400
 in use-wear studies, 396–398
 of raw materials, 389–396
 geochemical analysis of, 391–393.
 See also specific techniques
 heat treatment of, 393–396
 quality factors for, 390–391
 sourcing of, 391
 theoretical approach to, 387
 thermoluminescence dating, 394–395
 luminescence dating
 applications of, 424–425
 in archaeological contexts, 433–434
 future, 434
 daylight resetting complications, 431–432
 dose rates in, 432
 maximum age range with, 431
 in natural environments, 426–427
 optically stimulated luminescence (OSL)
 dating, 426
 physical mechanisms for, 425–426
 post-depositional mixing, 432–433
 practical applications of, 427–430
 environmental dose rate estimation,
 429–430
 laboratory preparation in, 429
 sampling of materials, 427–429
 theoretical approach to, 424–425
 thermoluminescence (TL) dating, 394–395
 Lyell, Charles, 314
 macrobotanical remains, 276–279
 charring of, 281–283
 flotation as extraction method for,
 286–289
 taphonomy of, 279–282
 water recovery methods, 287
 MAGs. *See* monoacylglycerols
 Makri site, geoarchaeology at, 322–323
 MALDI. *See* Matrix Assisted Laser
 Desorption Ionisation
 marine foods, identification of, 86–87
 marine molluscs, 247–254
 archaeological shell assemblages, 250–251
 cheniers and, 248–249
 midden formation processes, 247–250, 252
 shell morphometrics, 251–254
 shell taphonomy, 247–250
 thanatocoenosis, 249
 mass spectrometry (MS), 40–48
 AMS, 409
 archaeological applications of, 49–58
 CF-IRMS, 128
 Daltons in, 42
 detection, 42–46
 of targeted single proteins, 52–53
 DTMS, 76
 EA-IRMS, 76
 essential principles of, 40–41
 GC-c-IRMS, 81–83
 ICP-MS, 392
 interpretation of, 45–48
 LA-ICPMS, 357
 LA-MC-ICP-MS, 105
 MC-ICP-MS, 105
 PyMS, 76
 tandem (MS/MS), 43–56
 theoretical background for, 35–40
 thermal ionisation mass spectrometry
 (TIMMS), 104
 ZooMS, 54

- Matrix Assisted Laser Desorption Ionisation (MALDI), 41–42
- MCR method. *See* Mutual Climactic Range method
- Meehan, Betty, 247
- metabolic disease, 161
- metallurgy, 368–377. *See also* archaeometallurgy
 definition of, 368–369
 early, 366–367, 370
 with gold, 374–375
 with iron, 375–376
 alloys and, 376
 with lead, 374–375
 LIA, 380–381
 mining and
 archaeology of, 371
 in primary production, 370–371
 multiple origins of, 369
 as practice, 370–377
 primary production in, 370–373
 beneficiation, 370–371
 mining, 370–371
 with silver, 374–375
 smelting, 372–374
 copper, 373–374
 slag from, 373
- metals. *See also* archaeometallurgy
 copper, 366–367
 cultural fascination with, 365–366
 during Iron Age, 375–376
 native, as stones, 366–367
 Neolithic technology for, 367
 purpose and function of, 377–378
 quantification of production of, 377
- microbotanical remains, 276–286
 of starches, 284
 taphonomy of, 281–282
- migration studies of caribou/reindeer, 111–115
- Minimum Number of Individuals (MNI)
 method, 221
- mining, metallurgy and
 archaeology of, 371
 in primary production, 370–371
- mites, 263–264
- mitochondria
 aDNA from
 in case studies, 19–20
 data analysis of, 22
 inheritance mechanisms, 22–23
 genomes, 27
 M/MS sequence series, 46–48
- MNI method. *See* Minimum Number of Individuals method
- molecular clock, 26–27
- molluscs, zooarchaeology for, 242–260
 archaeomalacology, 242
 freshwater, 242–244
 palaeoenvironmental reconstructions of, 244–245
 marine, 247–254
 archaeological shell assemblages, 250–251
 cheniers and, 248–249
 middens formation processes, 247–250, 252
 shell morphometrics, 251–254
 shell taphonomy, 247–250
 thanatocoenosis, 249
- sclerochronology, 254–257
- shells
 carbonate geochemistry for, 254–257
 in marine molluscs, 247–254
 as ornaments and tools, 257–259
 provenance studies of, 259–260
 shape of, environmental data from, 254
 size studies for, 253–254
- terrestrial, 242–244
escargotières sites, 243
 ethnoarchaeological investigations of, 243–244
 geochemical studies on, 245–247
 palaeoenvironmental reconstructions of, 244–245
 taphonomic studies, 243
- monoacylglycerols (MAGs), 75
- Moundville chiefdom, 294

- MRE hypotheses. *See* multiregional evolution hypotheses
- MS. *See* mass spectrometry
- MS/MS. *See* tandem mass spectrometry
- multiregional evolution (MRE) hypotheses, 21
- mummified remains, proteomics for, 58
- mutations, 27
- Mutual Climactic Range (MCR) method, 236
- Mycenae (Schliemann), 5
- NAA. *See* neutron activation analysis
- native metals, as stones, 366–367
- natron glass, 353
- natural shell mounds. *See* *cheniers*
- NCPs. *See* non-collagenous proteins
- NCT. *See* Niche Construction Theory
- Neanderthals
- aDNA from, 23
 - GMM techniques for, in virtual reconstruction of newborns, 205
 - Jonzac site, 112, 114
 - Sladina juvenile, dental histology for, 185–187
 - developmental stress for, 186
- Neolithic technology, for metals, 367
- neutron activation analysis (NAA), 392
- New Archaeology, 5
- Next Generation Sequencing (NGS), 17–19
 - reconstruction of genomes in, 18
 - Sanger sequencing compared to, 18
- NGS read, 27
- Niche Construction Theory (NCT), 291–293
 - processing of plants as food, 293
- NISP. *See* Number of Identified Specimens Present method
- nitrogen isotopes, for diet studies
 - in animals, as baselines, 135–136
 - in bone collagen, 133–137
 - breastfeeding and, 136
 - from dietary protein, 133–135
 - with elemental analysers, 128–129
 - in humans, 136–138
 - in plants, 133–134
 - ratio measurements, 128–129
- NMR spectroscopy. *See* nuclear magnetic resonance spectroscopy
- non-collagenous proteins (NCPs), 40
- nuclear genetic markers, aDNA
 - demographic inference from, 24
- nuclear magnetic resonance (NMR) spectroscopy, 76
- Number of Identified Specimens Present (NISP) method, 220–221
- numerical skeletal inventory, 151
- on-site geoarchaeology, 320–324
 - cultural deposits in, 320–321
 - methodological techniques for, 320
 - natural sedimentary features, 322
 - non-sedimentary processes, 318–321
- osteology, human
 - apical root translucency method, 154
 - dental health, 159–162
 - dental disease, 162
 - infectious disease history, 160
 - lesions and, analysis of, 159–160
 - metabolic disease and, 161
 - trauma history, 160–161
 - gender and, 154
 - palaeodemographic data, 152–156
 - age in, 152–154
 - gender factors, 154
 - human life cycle stages, 152–154
 - minimum number of individuals, 152
 - sex in, 154–156
 - population health, 162
 - sex determination, 154–156
 - female skull and pelvis, 155
 - male skull and pelvis, 155
 - skeletal health, 159–162
 - infectious disease history, 160
 - joint disease, 161
 - lesions and, analysis of, 159–160
 - metabolic disease, 161
 - trauma history, 160–161
 - skeletal inventory in, 147–149

- osteology, human (*cont.*)
 cortical bone surface, 148–149
 numerical, 151
 skeleton. *See* skeletal inventory
 theoretical approach to, 147
- oxygen isotopes
 in animal bioapatites, 107–109
 basic principles of, 105
 of bioapatites, 109–110
 fractionation, 106–108
 in human bioapatites, 107–109
 in hydrosphere, 105–106
 evaporation processes, 106
 in migration studies of caribou/reindeer,
 111–115
 naturally-occurring isotopes, 105
 sampling approach, 108
 standards (V-PDB, VSMOW), 105–110
 with strontium, in mobility studies, 110
- palaeobotany. *See* palaeoethnobotany
- palaeodemographic data, 152–156
 age in, 152–154
 gender and sex in, 154
 human life cycle stages, 152–154
 minimum number of individuals, 152
 sex in, 154–156
- palaeoethnobotany
 anthracology and, 276–277
 anthropogenesis in, 277
 case studies for, 293–296
 in ceremonial and ritual uses of plants,
 295–296
 in early urban environments, 294–295
 domestication of species in, 277
 equipment for, 279–291
 macrobotanical remains, 276–279
 charring of, 281–283
 flotation as extraction method for,
 286–289
 taphonomy of, 279–282
 water recovery methods, 287
 methodologies in, 279–291
 field sampling, 285–286
 identification procedures, 289–291
 sample processing procedures, 286–289
 microbotanical remains, 276–286
 of starches, 284
 taphonomy of, 281–282
 Moundville chiefdom, 294
 palynology, 283–285
 phytoliths, 283
 processual archaeological framework,
 291–293
habitus practice theory, 292
 HBE and, 291–292
 NCT and, 291–293
 seed reference collections, 291
 starches, 282–283
 microbotanical remains of, 284
 taphonomy
 charring and, 281–283
 of macrobotanical remains, 279–282
 of microbotanical remains, 281–282
 themes of, 278
 theoretical approach to, 276–279
- palynology, 283–285
- parasitic worms, 261–263
 Clovis people and, 263
 endoparasites, 262
 heirloom parasites, 263
 human populations and, 262–263
- particle induced gamma ray emission
 analysis (PIGME), 392
- particle induced X-ray emission analysis
 (PIXIE), 392
- PCR method. *See* polymerase chain reaction
 method
- Pee Dee Belemnite, 110, 130–131
- peptide mass fingerprinting (PMF),
 45–48
- peptides, 38
 Edman degradation sequencing, 38
 false discovery rates for, 48
 hydrolysis of, 39
 M/MS sequence series, 46–48
 PMF, 45–48
- Percy, John, 5

- perikymata, in tooth development, 171
 phenotypes, 27–28
 phylogeographic inference, for aDNA, 24
 phytoliths, 283
 PIGME. *See* particle induced gamma ray emission analysis
 PIXIE. *See* particle induced X-ray emission analysis
 plant ash glass, 353
 plant lipids, 84
 plants. *See also* palaeoethnobotany
 in diet studies
 with carbon isotopes, 131–132
 with nitrogen isotopes, 133–134
 processing of, as food, 293
 PLM. *See* polarising light microscope
 PMF. *See* peptide mass fingerprinting
 polarising light microscope (PLM), 340–341
 pollen, study of. *See* palynology
 polymerase chain reaction (PCR) method
 defined, 28
 in Sanger sequencing, 17
 polymerisation of proteins, 75
 population health, human osteology and, 162
 population history, 26–27
 potash, in glass, 353
 pottery vessels, proteomics for, 56
 procrustes superimposition, in GMM
 techniques, 199, 201–202
 proteins. *See also* proteomics
 amino acids, 35–37
 asparagine, 39
 chirality of, 37
 complex structure of, 37
 glutamine, 39
 ancient
 recovery of, 36–37
 survival of, 39–40
 as archaeological residue, 75–76
 direct bonding of, 75
 polymerisation of, 75
 bone collagen
 extraction of, 127
 for measurements, 126–127
 quality control methods, 126–127
 use of in palaeodietary studies, 126–127
 degradation of, 38–39
 dietary, isotope analysis of, 130–135
 DNA sequencing of, 39
 epitopes and, 38
 antibodies, 38
 keratins, 53
 NCP, 40
 peptides and, 38
 Edman degradation sequencing, 38
 false discovery rates for, 48
 hydrolysis of, 39
 M/MS sequence series, 46–48
 PMF, 45–48
 post-translational modifications of, 38–39
 proteomics for, in protein mixtures, 54–55
 complex mixtures, 55
 simple mixtures, 54–55
 residue analysis of, 78–79
 extraction and separation methods,
 78–79
 silk, 53
 targeted single, 49–53
 case studies for, 50–52
 detection with mass spectrometry,
 52–53
 proteomes, 35, 55
 bone, 57
 proteomics. *See also* mass spectrometry
 for bone proteomes, 57
 for collagen, 35, 54
 for dental calculus, 57
 for dentine, 57
 for food residues, 56–57
 ionisation, 41–42
 ESI, 41–42
 MALDI, 41–42
 for keratins, 53
 for mummified remains, 58
 for pottery vessels, 56
 for protein mixtures, 54–55
 complex, 55
 simple, 54–55

- proteomics. (*cont.*)
 - for seeds, 55–56
 - for silk proteins, 53
 - for targeted single proteins, 49–53
 - case studies for, 50–52
 - detection with mass spectrometry, 52–53
 - through enrichment methods, 52
- protozoans, 260–261
- pyrolysis mass spectrometry (PyMS), 76

- quality assurance, in radiocarbon dating,
 - 416–421
 - for age of sample, 414
 - contamination protocols, 414–415
 - procedures for, 415–416
- quality control methods, for diet studies,
 - 126–127

- radiocarbon dating
 - age modelling, 412–413
 - aging through, 408
 - calibration of, over time, 410–413
 - carbon reservoirs, 408
 - case studies for, 416–418
 - for Anatomically Modern Humans, 416–417
 - in Palaeolithic sites, 417–418
 - counting errors, 409
 - fractionation correction, 409–410
 - half-life, 407
 - as measurement tool, 408–409
 - with AMS, 409
 - Liquid Scintillation Counters, 408–409
 - pre-treatment processes, 416–421
 - principles of, 407–408
 - quality assurance in, 416–421
 - for age of sample, 414
 - contamination protocols, 414–415
 - procedures for, 415–416
 - recent African origins (RAO) hypothesis, 21
- residue analysis
 - from artefacts, 71–75
 - formation of, 71
 - in visible deposits, 80–81
 - case studies, 84–87
 - for identification of marine foods, 86–87
 - for origins of dairying, 85–86
 - of DNA, 79
 - extraction methods, 79
 - DTMS, 76
 - EA-IRMS, 76
 - equipment for, 76–79
 - FTIR, 76
 - function and purpose of, 70–71
 - of lipids, 77–78
 - with GC-c-IRMS, 81–83
 - methodological approaches to, 77
 - from plants, 84
 - for species identification, 83
 - NMR spectroscopy, 76
 - of proteins, 78–79
 - extraction and separation methods, 78–79
 - PyMS, 76
 - theoretical background for, 70–71
- residues, archaeological
 - composition of, 73–74
 - classifications in, 73
 - preservation mechanisms in, 74
 - stabilisation mechanisms in, 74
 - from DNA, 76
 - lipids, 74–75
 - DAGs, 75
 - degradation of, 74–75
 - MAGs, 75
 - TAGs, 74–75
 - preservation of, 74–76
 - mechanisms of, 74
 - proteins, 75–76
 - direct bonding of, 75
 - polymerisation of, 75
 - visible, 80–81
- Retzius lines, in tooth development, 171–172
- rocks. *See* lithic analysis

- Sanger sequencing, 17–19
 - NGS compared to, 18
 - PCR method in, 17

- Scanning Electron Microscope (SEM), 341
 SEM-EDS, 350–351
- Scanning Electron Microscope with attached
 Energy Dispersive Spectrometer
 (SEM-EDS), 350–351
- scanning electron microscopy, for dental
 histology, 179
- Schiemann, Heinrich, 5
- Scladina juvenile Neanderthal, dental
 histology of, 185–187
 developmental stress for, 186
- sclerochronology, 254–257
- seeds
 proteomics for, 55–56
 reference collections, 291
- SEM. *See* Scanning Electron Microscope
- SEM-EDS. *See* Scanning Electron
 Microscope with attached Energy
 Dispersive Spectrometer
- semilandmarks, in GMM techniques,
 202–203, 207–209
- separation methods, of proteins, in residue
 analysis, 78–79
- serial founder effect, 20–21
- sex, palaeodemographic data influenced by,
 154–156
 determination in osteoarcheology, 155
- Shell bed to Shell Midden* (Meehan), 247
- shells, mollusc
 carbonate geochemistry for, 254–257
 in marine molluscs, 247–254
 as ornaments and tools, 257–259
 provenance studies of, 259–260
 shape of, environmental data from, 254
 size studies for, 253–254
- silica, in glass, 352–353
- silk proteins, 53
- silver, 374–375
- Sima de los Huesos, 19–20
- Sindos cemetery site, 217
- site geoarchaeology. *See* on-site
 geoarchaeology
- skeletal health, 159–162
 infectious disease history, 160
 joint disease and, 161
 lesions and, analysis of, 159–160
 metabolic disease and, 161
 trauma history, 160–161
- skeletal inventory, 147–149
 cortical bone surface, 148–149
 numerical, 151
- slag, from smelting, 373
 smelting, 372–374
 of copper, 373–374
 slag from, 373
- soft ionisation. *See* electrospray ionisation;
 ionisation; Matrix Assisted Laser
 Desorption Ionisation
- spectroscopy. *See specific types*
- sponges, 264
- spores, study of. *See* palynology
- starches, 282–283
 microbotanical remains of, 284
- stone tools. *See* lithic analysis
- stratigraphy, in archaeological science, 5
- strontium isotopes, 101–105
 in animals, 103
 basic principles of, 101
 in bioapatites, 103–105
 bioavailability of, 101–103
 chemical weathering and, 101–102
 estimation of, 101–103
 mixing in, 102
 outputs in, 102
 diagenesis and, 103–104
 in humans, 103
 of migration studies of caribou/reindeer,
 111–115
 naturally-occurring isotopes of, 101
 with oxygen, in mobility studies, 110
- TAGs. *See* triacylglycerols
- tandem mass spectrometry (MS/MS),
 43–56
- taphonomy, in palaeoethnobotany
 charring and, 281–283
 of macrobotanical remains, 279–282
 of microbotanical remains, 281–282

- terrestrial molluscs, 242–244
escargotières sites, 243
 ethnoarchaeological investigations of, 243–244
 geochemical studies on, 245–247
 palaeoenvironmental reconstructions of, 244–245
 taphonomic studies, 243
- thanatocoenosis, 249
- thermoluminescence dating, 394–395
- thin-plate spline interpolation, in GMM techniques, 202
- tooth development, 171
 cross-striations in, 171
 enamel prisms, 171
 GMM techniques and, 209–210
 perikymata in, 171
 periodicity in, 171
 Retzius lines, 171–172
 vertebrate zooarchaeology and, 222
- transhumance, 99–100
- trauma, 160–161
- triacylglycerols (TAGs), 74–75
- unusual ceramics, 343–344
- use-wear studies, lithic analysis in, 396–398
- vertebrate zooarchaeology
 at Abu Hureyra site, 223–224
 animal remains, sources of, 216–219
 bone recovery, 218–219
 from killing and cooking, 216–218
 preservation of bones, 218
 bones, 219–222
 as data source, 222–227
 identification of, 219–220
 preservation of, 218
 quantification and calculation of, 220–221
 reconstruction of living animals from, 221–222
 recording protocols for, 219–220
 sources of, 218–219
 at Çayönü Tepesi site, 224
 at Coppergate site, 225
 for craft and industry data, 225
 domestication of species data, 224
 at *Hermopolis Magna* site, 226
 at Kamid el-Lo site, 217
 MNI method in, 221
 NISP method in, 220–221
 for religious ceremonies, 226–227
 at Ringkloster site, 223–224
 for ritual activities, 226–227
 settlement reconstruction from, 223–224
 at Sindos cemetery site, 217
 for social status and identity data, 225–226
 theoretical approach to, 215–216
 tooth development and, 222
- wares, ceramics as, 340
- water recovery methods, in palaeoethnobotany, 287
- Wilson-Leonard site, geoarchaeology at, 321
- wood charcoal, study of. *See* anthracology
- woolly mammoth genomes, 25–26
- X-ray diffraction (XRD), 393
- X-ray fluorescence (XRF), 392
- XRD. *See* X-ray diffraction
- XRF. *See* X-ray fluorescence
- zooarchaeology, 215–216. *See also* insects; invertebrate zooarchaeology; molluscs; vertebrate zooarchaeology
 definition of, 216
 Zooarchaeology by Mass Spectrometry (Zooms), 54