nitine in relieving complications of HIV infection and adverse effects of antiretroviral drugs,[2] notably toxic neuropathy.[3,4]

1. Vilaseca MA, *et al.* Low serum carnitine in HIV-infected children on antiretroviral treatment. *Eur J Clin Nutr* 2003; **57:** 1317–22.
2. Ilias I, *et al.* -Carnitine and acetyl- -carnitine in the treatment of complications associated with HIV infection and antiretroviral therapy. *Mitochondrion* 2004; **4:** 163–8.
3. Herzmann C, *et al.* Long-term effect of acetyl-L-carnitine for antiretroviral toxic neuropathy. *HIV Clin Trials* 2005; **6:** 344–50.
4. Osio M, *et al.* Acetyl-l-carnitine in the treatment of painful antiretroviral toxic neuropathy in human immunodeficiency virus patients: an open label study. *J Peripher Nerv Syst* 2006; **11:** 72–6.

MALE INFERTILITY. Increases in sperm motility have been reported in some infertile men treated with carnitine,[1-3] although clinical benefit needs to be further evaluated.[4]

1. Lenzi A, *et al.* Use of carnitine therapy in selected cases of male factor infertility: a double-blind crossover trial. *Fertil Steril* 2003; **79:** 292–300.
2. Lenzi A, *et al.* A placebo-controlled double-blind randomized trial of the use of combined -carnitine and -acetyl-carnitine treatment in men with asthenozoospermia. *Fertil Steril* 2004; **81:** 1578–84.
3. Vicari E, Calogero AE. Effects of treatment with carnitines in infertile patients with prostato-vesiculo-epididymitis. *Hum Reprod* 2001; **16:** 2338–42.
4. Agarwal A. Carnitines and male infertility. *Reprod Biomed Online* 2004; **8:** 376–84.

NEUROLOGICAL DISORDERS. A meta-analysis of 21 studies concluded that acetylcarnitine improved mild cognitive impairment and prevented deterioration in patients with mild *Alzheimer's disease*.[1] However, a systematic review of 11 of these trials concluded that, although some evidence of benefit on clinical global impression exists, use of acetylcarnitine could not be routinely recommended in the treatment of Alzheimer's disease.[2]

Although no differences were found in serum carnitine concentrations in *multiple sclerosis* patients with or without disabling fatigue,[3] there is some suggestion of benefit with acetylcarnitine treatment for those patients with fatigue.[4] Carnitine has been reported to be of benefit in other cases of fatigue (see above).

In *Rett syndrome*, a severe neurodevelopmental disorder, supplementation with levocarnitine led to improvements in sleep efficiency, energy levels, and communication skills.[5] Parental and medical assessment of patient well-being improved in another study;[6] girls with classical Rett syndrome also improved in motor behaviour as assessed medically.

1. Montgomery SA, *et al.* Meta-analysis of double-blind randomized controlled clinical trials of acetyl- -carnitine versus placebo in the treatment of mild cognitive impairment and mild Alzheimer's disease. *Int Clin Psychopharmacol* 2003; **18:** 61–71.
2. Hudson S, Tabet N. Acetyl-l-carnitine for dementia. Available in The Cochrane Database of Systematic Reviews; Issue 2. Chichester: John Wiley; 2003 (accessed 08/11/05).
3. Fukazawa T, *et al.* Serum carnitine and disabling fatigue in multiple sclerosis. *Psychiatry Clin Neurosci* 1996; **50:** 323–5.
4. Tomassini V, *et al.* Comparison of the effects of acetyl -carnitine and amantadine for the treatment of fatigue in multiple sclerosis: results of a pilot, randomised, double-blind, crossover trial. *J Neurol Sci* 2004; **218:** 103–8.
5. Ellaway CJ, *et al.* Medium-term open label trial of L-carnitine in Rett syndrome. *Brain Dev* 2001; **23** (suppl): S85–S89.
6. Ellaway C, *et al.* Rett syndrome: randomized controlled trial of -carnitine. *J Child Neurol* 1999; **14:** 162–7.

Preparations

USP 31: Levocarnitine Injection; Levocarnitine Oral Solution; Levocarnitine Tablets.

Proprietary Preparations (details are given in Part 3)
Arg.: Albicar; Fertilix; Neurex; Neuroactil; ***Braz.:*** Levocarnin†; ***Canad.:*** Carnitor; ***Chile:*** Actigeron; Carnicor; ***Fr.:*** Levocarnil; ***Ger.:*** Biocarn; L-Carn; Nefrocarnit; ***Gr.:*** Aveptol; Bitobionil; Carnidose; Carnil; Corubin; Ensial; Frutenor; Growart; Inestom; Intelecta; Koptilan; Levalastine; Levamin; Levars; Levocarnil; Levosan; Lisefor; Listover; Lofostin; Maledrol; Merlit; Mevamyst; Minartine; Minoa; Oskana; Phacovit; Soludamin; Superamin; Tonovit; Trian; Trinalin; ***Hong Kong:*** Carnitene; Carnitor; ***India:*** Carnitor; L-Tine†; ***Ital.:*** Branigen; Branitil; Cardiobil†; Cardiogen†; Carnitene; Carnitolo; Carnitop†; Carnovis†; Carnum†; Carrier†; Dromos; Elleci; Eucar; Eucarnil; Farnitin; Karrer†; Kernit; Lefcar; Levocarvit; Medocarnitin; Megavis; Metina†; Miocardin; Miocor; Miotonal; Neo Cardiol; Nicetile; Normobren; Transfert†; Zibren; ***Mex.:*** Cardispan; Provicar; ***Neth.:*** Nefrocarnit; ***Philipp.:*** Carnicor; ***Pol.:*** Carnivit; ***Port.:*** Cartine; Disocor; Lacetilina; ***Rus.:*** Carniten (Карнитен); Elcar (Элькар); ***Spain:*** Carnicor; Secabiol; ***Turk.:*** Carnitene; ***UK:*** Carnitor; ***USA:*** Carnitor; VitaCarn; ***Venez.:*** Carnisin; Kativil; Lixi; Provicar.

Multi-ingredient: ***Arg.:*** Enlinea†; Garcinol Max; Herbaccion Diet; Metabolic; Reductase; Silueta Plus; Tonekin Plus†; ***Braz.:*** Pepsivit†; ***Chile:*** Grisetin Con Carnitina†; ***Indon.:*** Car-Q; Corsel; Naturica DFM; Procardio; Vitaslim; ***Ital.:*** Biocarnil†; Carfosid; Carpantin†; Co-Carnetina B12; Memorandum; ***Mex.:*** Lipovitasi-Or; Redumed; Slim-D; ***Philipp.:*** Fitrum; Godex; Nutrafit; ***Spain:*** Hepadif; Malandil; Pranzo.

Casein

Kazeina.
CAS — 9000-71-9.

Profile

Casein is a protein found in milk and has been used as a source of protein in preparations for enteral and parenteral nutrition; it may be used in the production of protein hydrolysate injection. Calcium caseinate has also been used.

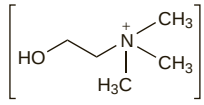
Preparations

Proprietary Preparations (details are given in Part 3)
Arg.: Secalbum; ***Canad.:*** Casec†; ***Israel:*** Casec; ***Mex.:*** Calsein; Caseincal†; K-Sein; ***USA:*** Casec.

Multi-ingredient: ***Mex.:*** Calciyodina; ***Switz.:*** Cicafissan; Fissan†; Vitafissan N.

Choline Bitartrate

Bitartarato de Colina; Choline Acid Tartrate; Choline Hydrogen Tartrate; Cholinii Tartras; Colina, bitartrato de. 2-Hydroxyethyltrimethylammonium hydrogen tartrate.
$C_9H_{19}NO_7$ = 253.2.
CAS — 87-67-2.



(choline)

Pharmacopoeias. In *US*.
USP 31 (Choline Bitartrate). A white, hygroscopic, crystalline powder; odourless or with a faint trimethylamine odour. Clear and colourless in solution. Freely soluble in water; slightly soluble in alcohol; insoluble in chloroform and in ether. pH of a 10% solution in water is between 3.0 and 4.0.

Choline Chloride *(rINN)*

Choline, Chlorure de; Cholini Chloridum; Cholinii Chloridum; Choliny chlorek; Cloruro de colina; Koliinikloridi; Kolinklorid. 2-Hydroxyethyltrimethylammonium chloride.

Холина Хлорид
$C_5H_{14}ClNO$ = 139.6.
CAS — 62-49-7 (choline); 67-48-1 (choline chloride).

Pharmacopoeias. In *Fr.* and *US*.
USP 31 (Choline Chloride). Hygroscopic, colourless or white crystals or crystalline powder, usually having a slight odour of trimethylamine. Clear and colourless in solution. Soluble in water and in alcohol. pH of a 10% solution in water is between 4.0 and 7.0.

Profile

Choline is an acetylcholine precursor. It is involved in lipid metabolism and acts as a methyl donor in various other metabolic processes. Choline has traditionally been considered to be a vitamin B substance although its functions do not justify its classification as a vitamin. Choline can be synthesised in the body. However, its absence in total parenteral nutrition causes hepatic steatosis, and it is also thought to be a requirement in the diet of neonates. Sources of choline, which occurs mostly as lecithin, include egg-yolk and vegetable and animal fat.

Choline is used as a dietary supplement and has been used to treat liver disorders such as fatty liver and cirrhosis. It has been tried in the management of Alzheimer's disease (see Dementia, p.362) but without success. Choline is used as the dihydrogen citrate, and orotate salts as well as the bitartrate and the chloride.

Human requirements. In the USA, an adequate intake (see p.1925) of 550 mg daily in men and 425 mg daily in women has been determined for choline.[1] The tolerable upper intake level for adults is 3.5 g daily.[1]

1. Standing Committee on the Scientific Evaluation of Dietary Reference Intakes of the Food and Nutrition Board. *Dietary Reference Intakes for thiamin, riboflavin, niacin, vitamin B , folate, vitamin B , pantothenic acid, biotin, and choline*. Washington, DC: National Academy Press, 2000. Also available at: http://www.nap.edu/openbook.php?isbn=0309065542 (accessed 21/07/08)

Preparations

Proprietary Preparations (details are given in Part 3)
Ger.: neurotropan†.

Multi-ingredient: ***Arg.:*** Bil 13; GB 100; ***Austral.:*** Gingo A†; Liv-Detox†; ***Austria:*** Orocholin; ***Braz.:*** Alcafelol†; Aminotox†; Anekron; B-Vesil; Betaliver†; Biohepax; Enterofigon; Epativan; Epocler; Extrato Hepatico Composto; Extrato Hepatico Vitaminado†; Hecrosine B12†; Hepacitron†; Hepalin; Hepatobe†; Hepatotris†; Hepatox; Hormo Hepatico†; Jurubileno†; Lisotox; Metiocolin B12; Metiocolin Composto; Necro B-6; Olocynan†; Olohepat†; Panvitrop; Xantina B12†; Xantinon B12; Xantinon Complex; ***Chile:*** Hepabil; ***Cz.:*** Lipovitan†; ***Fr.:*** Citrocholine; Desintex-Choline; Hepacholine†; Hepagrume; ***Ger.:*** Lipovitan†; ***Hong Kong:*** Bilsan; Hepatofalk; ***India:*** Delphicol; Livocip; Mecolin; Sorbiline; Sorliv; ***Indon.:*** Curliv; Curliv Plus; Hepatin; Lipagent; Methicol; Methioson; Naturica DFM; ***S.Afr.:*** Hepavite; Prohep; ***Spain:*** Hepato Fardi†; ***Thai.:*** Liporon; ***UK:*** Lipotropic Factors.

Chondroitin Sulfate–Iron Complex

Chondroitin Sulphate–Iron Complex; Ferropolichondrum; Hierro y sulfato de condroitina, complejo de.
CAS — 54391-57-0.
ATC — B03AB07.
ATC Vet — QB03AB07.

Profile

Chondroitin sulfate-iron complex is used as a source of iron (p.1949) for iron-deficiency anaemia (p.1951). It is given orally in doses of up to 900 mg daily, equivalent to up to 90 mg of iron daily.

Preparations

Proprietary Preparations (details are given in Part 3)
Ital.: Condrofer†; Isairon.

Chromium

Chrom; Chrome; Cromo.
Cr = 51.9961.

Chromium Trichloride

Chromic Chloride; Cromo, tricloruro de.
$CrCl_3,6H_2O$ = 266.4.
CAS — 10025-73-7 (anhydrous chromium trichloride); 10060-12-5 (chromium trichloride hexahydrate).

Pharmacopoeias. In *US*.
USP 31 (Chromic Chloride). Dark green, odourless, slightly deliquescent crystals. Soluble in water and in alcohol; slightly soluble in acetone; practically insoluble in ether. Store in airtight containers.

Chromium Tripicolinate

Chromium Picolinate; Cromo, tripicolinato de.
$C_{18}H_{12}N_3O_6Cr$ = 418.3.

Pharmacopoeias. In *US*.
USP 31 (Chromium Picolinate). Store in airtight containers.

Adverse Effects

Trivalent salts of chromium, such as chromium trichloride, are generally considered to produce few adverse effects. However, hexavalent forms of chromium are notably toxic (see under Chromium Trioxide, p.2281).

Effects on the kidneys. Two cases of renal failure were attributed to ingestion of excessive doses of chromium tripicolinate in women with no history of renal dysfunction.[1,2] Acute renal failure with features of acute tubular necrosis, and requiring haemodialysis, has been reported after ingestion of a chromium picolinate-containing supplement. The amount of chromium in the supplement could not be determined.[3] For mention of decreases in glomerular filtration rate in children receiving chromium-supplemented total parenteral nutrition, see Supplementation, below.

1. Wasser WG, *et al.* Chronic renal failure after ingestion of over-the-counter chromium picolinate. *Ann Intern Med* 1997; **126:** 410.
2. Cerulli J, *et al.* Chromium picolinate toxicity. *Ann Pharmacother* 1998; **32:** 428–31.
3. Wani S, *et al.* Acute tubular necrosis associated with chromium picolinate-containing dietary supplement. *Ann Pharmacother* 2006; **40:** 563–6.

Effects on the skin. There have been rare reports[1,2] of cutaneous reactions to oral chromium tripicolinate, including one of acute generalised exanthematous pustulosis.

1. Young PC, *et al.* Acute generalized exanthematous pustulosis induced by chromium picolinate. *J Am Acad Dermatol* 1999; **41:** 820–3.
2. Fowler JF. Systemic contact dermatitis caused by oral chromium picolinate. *Cutis* 2000; **65:** 116.

Uses and Administration

Chromium is an essential trace element that potentiates insulin action and thus influences carbohydrate, lipid, and protein metabolism. Dietary sources rich in chromium include brewers' yeast, meat, whole grains, and nuts. Chromium trichloride has been given as a chromium supplement in total parenteral nutrition. Chromium tripicolinate is used as a chromium supplement, and is being investigated for improving glycaemic control in patients with diabetes mellitus.

Diabetes mellitus. A review[1] of trivalent chromium in the management of diabetes mellitus (p.431) concluded that it may have an adjunctive role. A meta-analysis[2] found no effect of chromium on glucose or insulin concentrations in non-diabetic subjects; data for diabetic patients were inconclusive. A systematic review[3] found no significant effect with chromium supplementation on lipid or glucose metabolism in non-diabetic subjects, but it may have a modest beneficial effect on glycaemia and dyslipidaemia in those patients with diabetes. Meta-analysis was hampered by the overall poor quality and heterogeneity of available studies,[3] and further research was considered necessary.[1-3]

1. Ryan GJ, *et al.* Chromium as adjunctive treatment for type 2 diabetes. *Ann Pharmacother* 2003; **37:** 876–85.
2. Althuis MD, *et al.* Glucose and insulin responses to dietary chromium supplements: a meta-analysis. *Am J Clin Nutr* 2002; **76:** 148–55.
3. Balk EM, *et al.* Effect of chromium supplementation on glucose metabolism and lipids: a systematic review of randomized controlled trials. *Diabetes Care* 2007; **30:** 2154–63.

Human requirements. In the UK neither a reference nutrient intake (RNI) nor an estimated average requirement (EAR—see p.1925) has been set for chromium although a safe and adequate

intake was believed to be above 25 micrograms daily for adults.[1] Similarly, in the USA a recommended dietary allowance has not been published but the adequate intake was estimated to be 35 micrograms daily for young men and 25 micrograms daily for young women.[2] WHO considers that the minimum population mean intake likely to meet normal needs for chromium might be about 33 micrograms daily, and that supplementation of this element should not exceed 250 micrograms daily until more is known.[3]

1. DoH. Dietary reference values for food energy and nutrients for the United Kingdom: report of the panel on dietary reference values of the committee on medical aspects of food policy. *Report on health and social subjects 41*. London: HMSO, 1991.
2. Standing Committee on the Scientific Evaluation of Dietary Reference Intakes of the Food and Nutrition Board. *Dietary Reference Intakes for vitamin A, vitamin K, arsenic, boron, chromium, copper, iodine, iron, manganese, molybdenum, nickel, silicon, vanadium, and zinc*. Washington DC: National Academy Press, 2001. Also available at: http://www.nap.edu/openbook.php?isbn=0309072794 (accessed 21/07/08)
3. WHO. Chromium. In: *Trace elements in human nutrition and health*. Geneva: WHO, 1996: 155–60.

Supplementation. Although a daily chromium intake of 200 nanograms/kg has been suggested in children given total parenteral nutrition (TPN), a study in 15 children[1] given long-term parenteral nutrition found that supplementation at about this level was associated with serum-chromium concentrations 4 to 42 times higher than the mean value in 15 children not receiving TPN. Raised serum-chromium concentrations were associated with a decrease in glomerular filtration rate; one year after stopping chromium supplementation, which reduced intake to 50 nanograms/kg daily (as contaminants of water and TPN solutions), chromium concentrations, although lower, were still higher than controls and renal function had not altered. The authors subsequently ceased chromium supplementation in both children and adults, since chromium contamination of TPN solutions appeared adequate to prevent deficiency, although it was acknowledged that signs of chromium deficiency might take some years to appear. Chromium contamination in various preparations used in paediatric parenteral nutrition has been studied.[2]

1. Moukarzel AA, *et al*. Excessive chromium intake in children receiving total parenteral nutrition. *Lancet* 1992; **339:** 385–8.
2. Hak EB, *et al*. Chromium and zinc contamination of parenteral nutrient solution components commonly used in infants and children. *Am J Health-Syst Pharm* 1998; **55:** 150–4.

Preparations

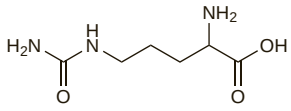
USP 31: Chromic Chloride Injection; Chromium Picolinate Tablets.

Proprietary Preparations (details are given in Part 3)
Arg.: NH4 Silhouette; Ripped Max; Sigmar Lipo; Tonekin; ***Austral.:*** Chrome; ***Chile:*** Edul K-200; ***Fr.:*** Chromasvelt; ***Ital.:*** Croben; ***Mex.:*** Cromifusin†; Ifa Slim†; ***USA:*** Chroma-Pak.

Multi-ingredient: ***Arg.:*** Centellacrom; Cholesterol Reducing Plan†; Garcinia Cambogia Compuesta; Herbaccion Diet; IP-6; Metabolic; Novosual†; Tonekin Plus†; Top Life Diet†; ***Austral.:*** Bioglan 3B Beer Belly Buster; Citri Slim+Trim; Digestaid; Pro-Shape†; ***Indon.:*** Biocholes; Kitoles; Vitaslim; ***Mex.:*** Lipo Slim N†; Slim-D; ***Philipp.:*** Liposorb; Nutrafit.

Citrulline

N^5-(Aminocarbonyl)-L-ornithine; N^δ-Carbamylornithine; Citrulina; L-citrulline; NSC-27425. α-Amino-δ-ureidovaleric acid.
$C_6H_{13}N_3O_3$ = 175.2.
CAS — 372-75-8.



Profile

Citrulline is a non-essential amino acid that is involved in the urea cycle. Citrulline and citrulline malate are used as dietary supplements.

Hyperammonaemia. Citrulline has been given as an alternative to arginine in the management of hyperammonaemia (p.1929) due to **urea cycle disorders**.

Lysinuric protein intolerance is another condition associated with hyperammonaemia and similar neurological sequelae. In this condition there is no deficiency of urea-cycle enzymes but a deficiency of urea-cycle substrate, such as ornithine, which results in reduced synthesis of citrulline. Patients are treated with dietary protein restriction and citrulline supplementation, which improves protein tolerance and nutrition but only slightly ameliorates growth retardation. Osteoporosis may be severe in children with this disorder.[1] A child presenting with osteopenia and diagnosed with lysinuric protein intolerance was given large oral doses of citrulline (up to 5.7 g daily). Aside from a substantial increase in protein tolerance, a striking acceleration in linear growth and bone mass was reported.[2] Lysine deficiency may be implicated in growth retardation,[1] but lysine supplementation may precipitate diarrhoea and malabsorption.[2] Six patients with lysinuric protein intolerance and receiving oral citrulline were supplemented with oral lysine. Larger lysine doses of 0.55 mmol/kg and 1.1 mmol/kg given consecutively, caused profuse diarrhoea, but smaller doses of 0.05 mmol/kg, given three times daily (up to a maximum dose of 2.5 mmol) were well tolerated. Plasma lysine concentrations were normalised with no adverse effects on the urea cycle.[1]

1. Lukkarinen M, *et al*. Oral supplementation corrects plasma lysine concentrations in lysinuric protein intolerance. *Metabolism* 2003; **52:** 935–8.
2. Carpenter TO, *et al*. Lysinuric protein intolerance presenting as childhood osteoporosis: clinical and skeletal response to citrulline therapy. *N Engl J Med* 1985; **312:** 290–4.

Preparations

Proprietary Preparations (details are given in Part 3)
Fr.: Stimol; ***Indon.:*** Stimol; ***Port.:*** Dynergum; ***Rus.:*** Stimol (Стимол); ***Spain:*** Stimol; ***Switz.:*** Biostimol.

Multi-ingredient: ***Braz.:*** Ornihepat†; Ornitargin; ***Fr.:*** Epuram†; ***Ger.:*** Polilevo N†; ***Ital.:*** Ipoazotal Complex; Ipoazotal†; Polilevo†.

Cod-liver Oil *(BAN)*

Aceite de hígado de bacalao; Baliık yağı; Cod Liver Oil; Csukamájolaj; Foie de morue, huile de; Huile de Foie de Morue; Iecoris aselli oleum; Kalanmaksaöljy; Lebertran; Menkių kepenų taukai; Ol. Morrh.; Óleo de Bacalhau; Oleum Jecoris Aselli; Oleum Morrhuae; Olio di Fegato di Merluzzo; Rybí olej; Torskleverolja.

Тресковый Печёночный Жир
CAS — 8001-69-2.

Pharmacopoeias. In *Chin., Eur.* (see p.vii), *Jpn,* and *US.*
Ph. Eur. 6.2 (Cod-liver Oil (Type A) and Cod-liver Oil (Type B)). Purified fatty oils obtained from the fresh livers of *Gadus morhua* and other species of Gadidae, solid substances being removed by cooling and filtering. The oils contain not less than 600 units (180 micrograms) and not more than 2500 units (750 micrograms) of vitamin A per g and not less than 60 units (1.5 micrograms) and not more than 250 units (6.25 micrograms) of vitamin D_3 (colecalciferol) per g. Authorised antoxidants in concentrations not exceeding those prescribed by the competent authority may be added.
Clear yellowish viscous liquids. Practically insoluble in water; slightly soluble in alcohol; miscible with petroleum spirit. Store in well-filled airtight containers. Store under an inert gas if no antoxidant is added. Protect from light.
USP 31 (Cod Liver Oil). The partially destearinated fixed oil obtained from the fresh livers of *Gadus morrhua* and other species of Gadidae. It contains not less than 600 units (180 micrograms) and not more than 2500 units (750 micrograms) of vitamin A per g and not less than 60 units (1.5 micrograms) and not more than 250 units (6.25 micrograms) of vitamin D per g. It may be flavoured by the addition of not more than 1% of a suitable flavour or a mixture of flavours. A suitable antoxidant may be added.
A thin, oily liquid, having a characteristic, slightly fishy but not rancid odour. Slightly soluble in alcohol; freely soluble in carbon disulfide, in chloroform, in ether, and in ethyl acetate. Store in airtight containers. It may be bottled or packaged in containers from which air has been expelled by the production of a vacuum or by an inert gas.

Profile

Cod-liver oil is a rich source of vitamin D (p.1986) and a good source of vitamin A (p.1971). It also contains several essential fatty acids.

Cod-liver oil dressings or ointment have been advocated to accelerate healing in burns, ulcers, pressure sores, and superficial wounds, but controlled observations have failed to substantiate claims of their value.

Preparations

USP 31: Cod Liver Oil Capsules.

Proprietary Preparations (details are given in Part 3)
Austral.: Hypol†; ***Austria:*** Adecaps; Vitapan; ***Ger.:*** Gelovital; Unguentolan; ***Hong Kong:*** Scott's Emulsion; ***India:*** Seaking†; ***Ital.:*** Dermovitamina; ***Pol.:*** Letin-Tran; Masc Tranowa; Naturkaps Tran; Tran; ***Spain:*** Aceite Geve Concentrado; ***Switz.:*** Morrhulan; ***Turk.:*** Seven Seas Pulse; ***Venez.:*** North Sea†; Scott Tradicional; Supercod.

Multi-ingredient: ***Arg.:*** Abanta; Atomoderma A-D; Atomoderma Plus; Eryteal; Hipoglos con Hidrocortisona; Klorane Bebe Eryteal; ***Austral.:*** Covitol; Desitin Nappy Rash Ointment; Hypol; ***Austria:*** Dermilon; Dermowund; Desitin; Leukichtan; Mirfulan; Nuri-Kapseln; Pudan-Lebertran-Zinksalbe; Vulpuran; ***Belg.:*** Mitosyl; Newderm†; Polyseptol; ***Braz.:*** Blumen†; Calciumvit Infantil†; Hiposan; Oxizinco; Topiglos; ***Canad.:*** Desitin; ***Chile:*** Cikavit; Deltisan; Dulinas†; Neneglos; Pediaderm†; Vatanal; ***Cz.:*** Desitin†; ***Fr.:*** Eryteal†; Halivite†; Magalite; ***Ger.:*** Dermilon; Desitin; Leukona-Wundsalbe†; Mirfulan; Mirfulan Spray N; Mitosyl N; Zinksalbe; ***Gr.:*** Fissan-Pate†; Fissan†; ***Hong Kong:*** Desitin; Scott's Emulsion Orange; ***India:*** Seaking Plus†; ***Indon.:*** Co-Q-10; Scott's Emulsion; ***Irl.:*** Caldease; Morhulin; ***Israel:*** Desitin; Rekasitin; Zincod; ***Ital.:*** Fosfarsile Junior; Neo-Ustiol; Steril Zeta; Trofo 5; ***Mex.:*** Bacnutri; Capent; Desitin; Emulsion de Scott; Glossderm; Sutin†; ***Norw.:*** Aselli; ***Pol.:*** Dehalid†; Rectosec; Tran z Olejem Wiesiolkowym†; Tranvit; ***Port.:*** Mitosyl; ***S.Afr.:*** Achromide; Daromide; SB Universal Ointment; Ung Vernleigh; ***Singapore:*** Seven Seas JointCare High Strength; ***Spain:*** Avril; ***Switz.:*** Keroderm†; Leucen; Radix†; Unguentolan; Vita-Hexin; ***UK:*** Arheumacare; Clogar; JointCare Max; M & M; Morhulin; ***USA:*** A and D Medicated; Caldesene; Clocream; Desitin; Diaper Rash; Dyprotex; ***Venez.:*** Wampole†.

Copper

Cobre; Cuivre; Cuprum; Koppar; Kupari; Kupfer; Miedź.
Cu = 63.546.
CAS — 7440-50-8.

Pharmacopoeias. *Eur.* (see p.vii) includes Copper for Homoeopathic Preparations.
Ph. Eur. 6.2 (Copper for Homoeopathic Preparations; Cuprum ad Praeparationes Homoeopathicae). A reddish-brown powder. Practically insoluble in water and in alcohol; soluble in hydrochloric acid and in nitric acid.

Calcium Copperedetate

Cuproedetato cálcico. Calcium [ethylenediaminetetra-acetato{4–}-*N,N′,O,O′*]copper (II) dihydrate.
$C_{10}H_{12}CaCuN_2O_8,2H_2O$ = 427.9.
CAS — 66317-91-7 (anhydrous calcium copperedetate).

Pharmacopoeias. In *BP(Vet).*
BP(Vet) 2008 (Calcium Copperedetate). A blue crystalline powder. It contains 9.1 to 9.7% of Ca and 14.4 to 15.3% of Cu. Freely soluble in water, the solution gradually precipitating the tetrahydrate; practically insoluble in alcohol.

Copper Chloride

Cobre, cloruro de; Cupric Chloride; Miedzi chlorek.
$CuCl_2,2H_2O$ = 170.5.
CAS — 7447-39-4 (anhydrous copper chloride); 10125-13-0 (copper chloride dihydrate).

Pharmacopoeias. In *US.*
USP 31 (Cupric Chloride). Bluish-green, deliquescent crystals. Freely soluble in water; soluble in alcohol; slightly soluble in ether. Store in airtight containers at a temperature of 25°, excursions permitted between 15° and 30°.

Copper Gluconate

Cobre, gluconato de. Copper D-gluconate (1:2); Bis(D-gluconato-O^1,O^2) copper.
$C_{12}H_{22}CuO_{14}$ = 453.8.
CAS — 527-09-3.

Pharmacopoeias. In *US.*

Copper Sulfate

Cobre, sulfato de; Copper Sulph.; Copper Sulphate; Cuivre (Sulfate de); Cuivre, sulfate de; Cupri sulfas; Cupri Sulphas; Cupric Sulfate; Kopparsulfat; Kuparisulfaatti; Kupfersulfat; Miedzi(II) siarczan; Réz(II)-szulfát; Síran měďnatý; Sulfato de Cobre; Vario sulfatas. Copper (II) sulphate pentahydrate.
$CuSO_4,5H_2O$ = 249.7.
CAS — 7758-98-7 (anhydrous copper sulfate); 7758-99-8 (copper sulfate pentahydrate).
ATC — V03AB20.
ATC Vet — QV03AB20.

NOTE. Crude copper sulfate is sometimes known as 'blue copperas', 'blue stone', and 'blue vitriol'.

Pharmacopoeias. In *Eur.* (see p.vii), *US,* and *Viet.*
Eur. and *Viet.* also include anhydrous copper sulfate.
Ph. Eur. 6.2 (Copper Sulphate Pentahydrate). A blue crystalline powder or transparent blue crystals. Freely soluble in water; practically insoluble in alcohol; soluble in methyl alcohol.
Ph. Eur. 6.2 (Copper Sulphate, Anhydrous). A greenish-grey, very hygroscopic, powder. Freely soluble in water; practically insoluble in alcohol; slightly soluble in methyl alcohol. Store in airtight containers.
USP 31 (Cupric Sulfate). Deep blue, triclinic crystals, or blue, crystalline granules or powder. It effloresces slowly in dry air. Soluble 1 in 3 of water, 1 in 0.5 of boiling water, 1 in 500 of alcohol, and 1 in 3 of glycerol. Its solutions are acid to litmus. Store in airtight containers at a temperature of 25°, excursions permitted between 15° and 30°.

Adverse Effects and Treatment

Adverse effects from copper have tended to arise after absorption of the metal from cooking utensils and during dialysis. Ingestion of copper from cooking utensils is associated mainly with hepatotoxicity. Dialysis procedures may supply copper through the water supply or from parts of the equipment and when this happens patients may suffer haemolysis and other haematological reactions, kidney involvement, and hepatotoxicity; the toxicity is generally a result of poor equipment maintenance.

Adverse effects attributed to copper have been reported in women with copper-containing intra-uterine devices. There have been isolated case reports of various effects such as allergy and endometrial changes. However, it is difficult to separate those adverse effects that are due to the device from those due solely to the copper.

The symptoms of Wilson's disease (hepatolenticular degeneration) (see p.1459) are due to an accumulation of copper in various parts of the body.

Copper salts if ingested can produce severe gastrointestinal effects and there may be systemic absorption of copper leading to the effects discussed above. The use of sprays of copper salts in agriculture has been associated with lung changes. Treatment of copper poisoning is symptomatic and may involve the use of a chelating agent to remove any absorbed metal. Dialysis has been tried.