crust. Not all, however, are of this kind, for a few are artificial, like the crushed tailings produced in the extractions of metals from their ores; there are also volcanic sands which have originated by explosions of steam in the craters of active volcanoes.

A great part of the surface of the globe is covered by sand. In fertile regions the soil is very often of a sandy nature; though most soils are mixtures of sand with clay or stones, and may be described as loams rather than as sands. Pure sandy soils are found principally near sea-coasts where the sand has been blown inwards from the shore, or on formations of soft and friable sandstone like the Greensand. The soil of deserts also is often arenaceous, but there the finer particles have been lifted and borne away by the wind. Accumulations of sand are found also in some parts of the courses of our rivers, very often over wide stretches of the seashore, and more particularly on the sea bottom, where the water is not very deep, at no great distance from the land.

Of the rock-making minerals which are common on the earth’s crust only a limited number occur at all frequently in sand deposits. For several reasons quartz is by far the commonest ingredient of sands. It is a very abundant mineral in rocks and is comparatively hard, so that it is not readily worn down to a very fine muddy paste. It also possesses practically no cleavage, and does not split up naturally into thin fragments. If we add to this that it is nearly insoluble in water and that it does not decompose, but preserves its freshness unaltered after long ages of exposure to weathering, we can see that it has all the properties necessary for furnishing a large portion of the sandy material produced by the detrition of rock masses. With quartz there is often a small amount of felspar (principally micro­cline, orthoclase and oligoclase),'but this mineral, though almost as common as quartz in rocks, splits up readily on account of its cleavage, and decomposes into fine, soft, scaly aggregates of mica and kaolin, which are removed by the sifting action of water and are deposited as muds or clays. Small plates of white mica, which, though soft and very fissile, decompose very slowly, are often mingled with the quartz and felspar. In addition to these, all sands contain such minerals as garnet, tourmaline, zircon, rutile and anatase, which are common rock-forming minerals, both hard and resistant to decomposition. Among the less common ingredients are topaz, staurolite, kyanite, andalusite, chlorite, iron oxides, biotite, horn- blende and augite, while small particles of chert, felsite and other fine-grained rocks appear frequently in the coarser sand deposits.

Shore sands and river sands, which have not been transported for any great distance from their parent rocks, often contain minerals that are too soft or too readily decomposed to persist. In the Lizard district of Cornwall the sands at the base of cliffs of serpentine are rich in olivine, augite, enstatite, tremolite and chromite. Near volcanic islands such minerals as biotite, hornblende, augite and zeolites may form a large portion of the local sand deposits. In marine sands also organic substances are almost universally present, either fragments of plants or the debris of calcareous shells, in fact many sands consist almost entirely of such fragments (shell sands). Around coral islands there are often extensive deposits of comminuted coral (coral sands), mixed with which there is a varying proportion of broken skeletons of calcareous algae, sponge-spicules and other debris of organic origin. The Greensands which are widely distributed over the floor of the oceans, in places where the continental shelf merges into the greater depths, owe their colour to small rounded lumps of glauconite.

Among the accessory ingredients of sands which are of great value and interest are the precious metals, especially gold ana platinum. These are found usually in the lower parts of the sand deposits resting on the bed-rock, because of their high specific gravity, and have been derived from the destruction of the rocks in which they originally occurred either in quartzose veins or as disseminated particles. Tinstone occurs also in this way (“ stream-tin ”), and in Ceylon, Burma, Brazil, South Africa, &c., precious stones such as the diamond, ruby, spinel, chrysoberyl and tourmaline are found in beds of sand and gravel (gym sands).

In general the sand grains have a rounded or oviform shape due to mutual attrition during transport. Those which have been carried farthest are most rounded; sands deposited at no great distance from their parent rock often consist largely of angular grains. The smaller fragments may be carried along in suspension in water, and may travel for many miles without being sensibly worn; but coarse sands and fine gravels are swept along the bottom and are subjected to an intense grinding action. Something depends also on the hardness of the minerals present in the sands, yet even the diamonds and other gems found in sand deposits have often their corners worn and smoothed. Minerals with very perfect cleavage, such as mica, split up into thin plates under the shock of impact with adjacent grains, and are never rounded like quartz or tourmaline. In deserts the transport of the sands is effected by the wind, and owing to the low viscosity of air even the smallest grains are not held in suspension but are rolled along the ground; hence very fine quartzose sands are sometimes met with in arid regions with every particle smoothed and polished. These sands flow almost like a liquid and are used in hour-glasses. Similar

“ desert sands ” occur among the sandstones of the Trias and were doubtless formed in the manner described.

In addition to river sands, shore sands, marine sand deposits and desert sands, there are many other types of sand deposits. Blown sands are usually found near the seashore, but occur also at the margin of some great lakes like those of N. America; desert sands belong in great part to this category. These sands have been blown into their present position by the wind, and unless fixed by vege- tation are constantly though slowly in movement, being in consequence a menace to agricultural land on their leeward sides. They may be shell sands, quartz sands or mixed sands, and often show very marked oblique stratification or “ current bedding.” The surface of blown sand deposits is generally marked by dunes. Glacial sands, are common in districts like Britain and those parts of N. America which have been covered by an ice-sheet. They are really water-borne and have been deposited by streams, though they occur in situations where rivers no longer flow. The waters produced by the melting of the ice-sheets flooded extensive tracts of country, laying down sand and mud deposits in temporary lakes. These sands are usually angular, because they have not been transported to any great distance. The old high-level terraces which border the lower courses of many rivers, though usually consisting of gravel, are often accompanied by considerable sand deposits.

Many of the Tertiary and some of the Secondary sandstone rocks are so incompletely consolidated by cementation that they are essentially sand rocks, and especially when weathered may be used as sources of sand. Thus in Britain there are Pliocene sands (St Erth, Cornwall, &c.), Eocene sands (Bagshot sands and Thanet sands) ; and the Lower and Upper Greensand (Cretaceous) are often dug in pits, though sometimes firmly coherent and more properly described as sandstones (*q.v.*).

The economic uses of sands are very numerous. They are largely employed for polishing and scouring both for domestic and manufacturing purposes. “ Bath bricks" are made from the sand of the river Parrett near Bridgwater. Sand for glass-making was formerly obtained at Alum Bay in the Isle of Wight and at Lynn in Norfolk, but must be very pure for the best kinds of glass, and crushed quartz or flint is often preferred on this account. One of the principal uses of sand is for making mortar and cement: for this any good clean quartzose sand free from salts is suitable; it may be washed to remove impurities and sifted to secure uniformity in the size of the individual grains. Moulding sands, adapted for foundry purposes, generally contain a small admixture of clay. Sands are also em­ployed in brick-making, in filtering, and for etching glass and other substances by means of the sand blast. J. S. F.)

SANDAL (from the Latinized form of Gr. *σανδάλιον* or *σάνδαλον:* this probably represents the Persian *sandal,* slipper; it is not to be referred to Gr. *σαvls,* board), the foot-covering which consists of a sole of leather or other material attached to the sole of the foot by a thong of leather passing between the great and second toe, crossed over the instep and fastened round the ankle (see Shoe and Costume, section *Greek* and *Roman*). Sandals are only worn regularly among the peoples of Western civilization by friars, though forms of them are found among the peasants in Spain and the Balkans. They have in recent times been adopted by the extreme advocates of hygienic dress, especially for young children. In the early part of the 19th century a form of low, light slipper fastened by a ribbon crossed over the instep and round the ankle, and worn by women, was known as a sandal.

SANDALWOOD (from Fr. *sandal, santal,* Gr. *σάνταλον, σάνδαλον,* Pers. *sandal, chandan,* Skt. *chandana,* the sandal tree; the form “sanders” is probably an English corruption), a fragrant wood obtained from various trees of the natural order Santalaceae, and principally from *Santalum album,* a native of India. The use of sandalwood dates as far back at least as the 5th century b.c. It is still extensively used in India and China, wherever Buddhism prevails, being employed in funeral rites and religious ceremonies. Until the middle of the 18th century India was the only source of sandalwood. The discovery of a sandalwood in the islands of the Pacific led to difficulties with the natives, often ending in bloodshed, the celebrated missionary John Williams (1796-1839), amongst others, having fallen a victim to an indiscriminate retaliation by the natives on white men visiting the islands. The loss of life in this trade was at one time even greater than in that of whaling, with which it ranked as one of the most adventurous of callings. In India sandalwood is largely used in the manufacture of boxes, fans and other ornamental articles of inlaid work, and to a limited extent in medicine as a domestic remedy for all kinds of pains and aches.