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Geraniales

The Geraniales, or geranium order, is an order of flowering plants comprising 20 families that include approximately 143 genera and about 4,000 species. Half of the families contain 50 species or less, but the two largest families (Malpighiaceae and Oxalidaceae) each have about 900 species. These two large families have predominantly tropical distributions, although the Oxalidaceae has some temperate-region representatives. The families Geraniaceae and Balsaminaceae each have over 500 species with worldwide distributions. The remaining families are mostly tropical, and two (Dirachmaceae and Lepidobotryaceae) are monotypic (*i.e.*, they contain only one genus and one species); the former is confined to the island of Socotra, where it appears to be very rare, and the latter to tropical Africa.

GENERAL FEATURES

Size range and diversity of habitat. With representatives in both the tropics and in temperate regions, the order shows considerable variation in life form, from small annual herbs—nonwoody plants with short life cycles—to trees (*e.g.*, *Lepidobotrys*) of the tropical rain forest that have leathery leaves furnished with the drip tip (a sharp point at the end of the leaf) characteristic of this habitat. The families Zygophyllaceae, Nitrariaceae, and Peganaceae are adapted to dry or saline habitats and contain numerous desert or subdesert species. Certain genera of the family Zygophyllaceae, such as *Zygophyllum* and *Tetradiclis*, show adaptations to the environment in their succulent—thick, fleshy, water-storing—vegetative parts; these are sometimes coupled with an annual habit and abundant seed production. Several *Zygophyllum* species are characteristic of the desert regions of the Near and Middle East and Central Asia, as well as Africa and Australia. *Tetradiclis*, which also grows in the Asian deserts, resembles some of the fleshy species of the family Chenopodiaceae (order Caryophyllales, *q.v.*) encountered in the same regions and can easily be mistaken for them. The genus *Sarcocaulon* (South Africa) is the only species of the family Geraniaceae adapted to desert life, although many species of *Erodium* and *Monsonia* occur in desert regions. The species of *Nitraria*, conversely, are highly salt-tolerant, deep-rooted perennials. Spines or thorns frequently develop in desert plants, presumably as a protection against grazing; two genera of the Zygophyllaceae (*Fagonia* and *Plectrocarpa*) exhibit these features markedly.

Desert adaptations

A succulent form is sometimes found in plants growing in damp ground or, particularly, in shallow water; these species commonly have translucent stems, often much branched and either sprawling or supported by the stronger waterside vegetation among which they grow. The families Limnanthaceae and Balsaminaceae provide good examples of such plants.

Certain plants in disturbed ground exhibit a feature useful in aiding distribution by vegetative means—the production of bulbils (small buds, or bulbs) on the roots, in clusters at the stem base, or in the leaf axils (angles between the leafstalks and the plant stem). Each, if broken off, is capable of growing into a new plant. This feature occurs in several species of *Oxalis*, certain of which (*e.g.*, *O. corymbosa* and *O. latifolia*), although tropical in origin, have now spread widely by this means to become troublesome weeds of cultivated areas even in temperate regions.

Perhaps one of the most striking and obvious anatomical features in the order is that of the very characteristic single-celled plant hairs (trichomes) of the family Malpighiaceae—so widespread in the family that botanists frequently refer to these two-armed hairs as malpighian hairs when describing their presence in other families. They are very diverse in form, sometimes almost without a stalk below the branching point, sometimes in a more or less elongated stalk, with the branch arms spreading or ascending, and from nearly equal to very unequal in length. Sunken, cushion-shaped, or sometimes stalked glands also occur in this family.

Economic importance. The economic importance of the order is not great, with the exception of flax (*Linum usitatissimum*), the source of a valuable fibre that has been used by man since prehistoric times. It is grown in most temperate regions, especially in central and western Europe, not only for its fibre, from which linen is made, but also for its seed, the source of linseed oil.

Timber sources

A few timber trees occur in the order, the most famous being guaiacum wood (or lignum vitae), yielded by *Guaiacum officinale* (family Zygophyllaceae). The wood —very hard, durable, and heavy in weight—is used in shipbuilding and for mallets. The heartwood of *G. sanctum* produces a resin used for making small objects that require weight, hardness, and strength. *Bulnesia arborea* is Maracaibo lignum vitae, and the timber is used as for the *Guaiacum* product. Some species of the family Malpighiaceae are locally employed as timber sources, particularly *Ctenolophon parvifolium*, the durable wood of which is employed for house construction in Malaysia. The timber of *Klainedoxa gabonensis* is tough and hard wearing. *Houmiria balsamifera* is the source of a good timber, easily polished and used for furniture, house framing, and general carpentry. *Sacoglottis gabonensis*, from western Africa, produces an easy-to-work white wood.

Three species of *Balanites* are used locally. *B. aegyptiaca* seeds yield Betu oil, employed in soap manufacture. The wood is hard and used in Africa for clubs, plows, sticks, turnery, and general carpentry. *B. maughamii* yields a clear oil similar to olive oil, and *B. orbicularis* is the source of hanjigoad, a gum resin. *Irvingia gabonensis* (family Ixonanthaceae) is the wild mango (not to be confused with the true mango, *Mangifera indica*), the fruit of which is edible; the fat from the seeds yields dika bread and dika butter, staple foods in West Africa. The tough, hard wood has been used for street paving and in houses. The seeds of *I. oliveri* are the source of cay cay fat, used in candle manufacture.

Bulnesia sarmienti (family Zygophyllaceae), the source of guaiac wood oil, which has a roselike scent, is used in soaps and perfumery. Geranium oil for perfumery is obtained from *Pelargonium radula*, *P. odoratissimum*, *P. capitatum*, and other species of this genus.

A few plants of the order have been used medicinally. The root of *Hugonia mystax*, for example, has been used locally in India as a snakebite remedy and to reduce fever. *Linum catharticum* has laxative properties similar to those of senna (*Cassia*). *Geranium maculatum* is an American species known as alumroot from the styptic and astringent properties—ability to control bleeding and draw together soft tissues—of a liquid extract from the roots. The only species of widespread true medical significance, however, is the coca, *Erythroxylum coca*. From this species the local anesthetic cocaine is prepared. The leaves of *E. coca*, the coca tree, act as a nerve stimulant, and tribal peoples of South America

Use of coca leaves

chew them so that they can perform feats of endurance without fatigue. The components of the leaves act on the gastric nerves, eliminating the sense of hunger and allowing the user to go for a long period without food. As with most stimulants, however, the use of coca is followed by depression. *Banisteriopsis caapi* (family Malpighiaceae) contains the hallucinogenic alkaloid harmine.

The fruits of some *Malpighia* species (*e.g.*, *M. punicifolia*, the Barbados, or West Indian, cherry) are edible either fresh, as preserves, or as flavouring for jellies. The gooseberry-like fruits of *Averrhoa carambola* (family Oxalidaceae) are also edible, and those of *Nitraria* species are sometimes eaten. *Klainedoxa gabonensis* and *Desbordesia glaucescens* have edible seeds; those of the former are eaten fresh or roasted, and those of the latter are used in sauces. The outer layers of the fruit are edible in several *Houmiria*, *Sacoglottis*, and *Vantanea* species; both fruit and seeds contain a fatty oil.

The families Geraniaceae and Tropaeolaceae produce many well-known decorative plants. The Geraniaceae contains not only handsome species of *Geranium* itself but also the cultivated varieties and hybrids (crosses between different species) of the genus *Pelargonium*, to which the well-known pot and bedding geraniums of gardeners belong. The garden nasturtium is *Tropaeolum majus*, and some others of this genus also appear in gardens—notably *T. peregrinum*, the canary creeper. Species of the family Tropaeolaceae contain a hot mustard oil similar to that found in certain members of the mustard family (Cruciferae), a fact that no doubt explains the name "nasturtium" as applied to the garden *Tropaeolum majus*—botanically, the genus *Nasturtium* is the watercress. Some herbaceous *Oxalis* species have been grown as ornamentals, as have one or two trees of the genus *Averrhoa*, also of the Oxalidaceae. The nuisance value of several weedy species of *Oxalis* that spread by means of readily detached bulbils is far greater than the aesthetic value of their relatives, however.

The dye Turkey red is prepared from the seeds of *Peganum harmala* (family Peganaceae), a common plant of arid regions in southwestern and Central Asia.

NATURAL HISTORY

Seed dispersal. Within the Geraniales, the family Geraniaceae is perhaps the most interesting from the point of view of seed dispersal; the genus *Erodium* (storksbill), particularly well represented in desert and subdesert areas, shows adaptation to this environment. The fruit is furnished with a long beak formed from the fused tissues of the styles, the narrow upper parts of the ovary segments, or carpels. The beak segments of all the carpels of each flower remain fused until the fruit is ripe. When the fruit ripens and dries, these segments spring apart and become spirally shaped; each seed-bearing carpel falls to the ground. With rain or increase in humidity, the beak segments absorb water and straighten, driving the carpels into the ground. In some species the inner surface of the beak segments have feathery hairs that aid in wind dispersal. In *Geranium* and some other genera, such as *Pelargonium*, the beak segments separate from the base and curl but remain attached at their tips. This abrupt dehiscence—splitting open—may either catapult the seeds away or leave them hanging by slender threads, from which they are easily dislodged.

Self-planting fruits

Within the family Zygophyllaceae is the genus *Tribulus*, which derives its name from the Latin name of an instrument of warfare—the caltrop, a four-pronged device that served as a horse-crippling spike. The fruit of *Tribulus* is similarly formed; the carpels become hard and are heavily covered with sharp spines and bumps. They are

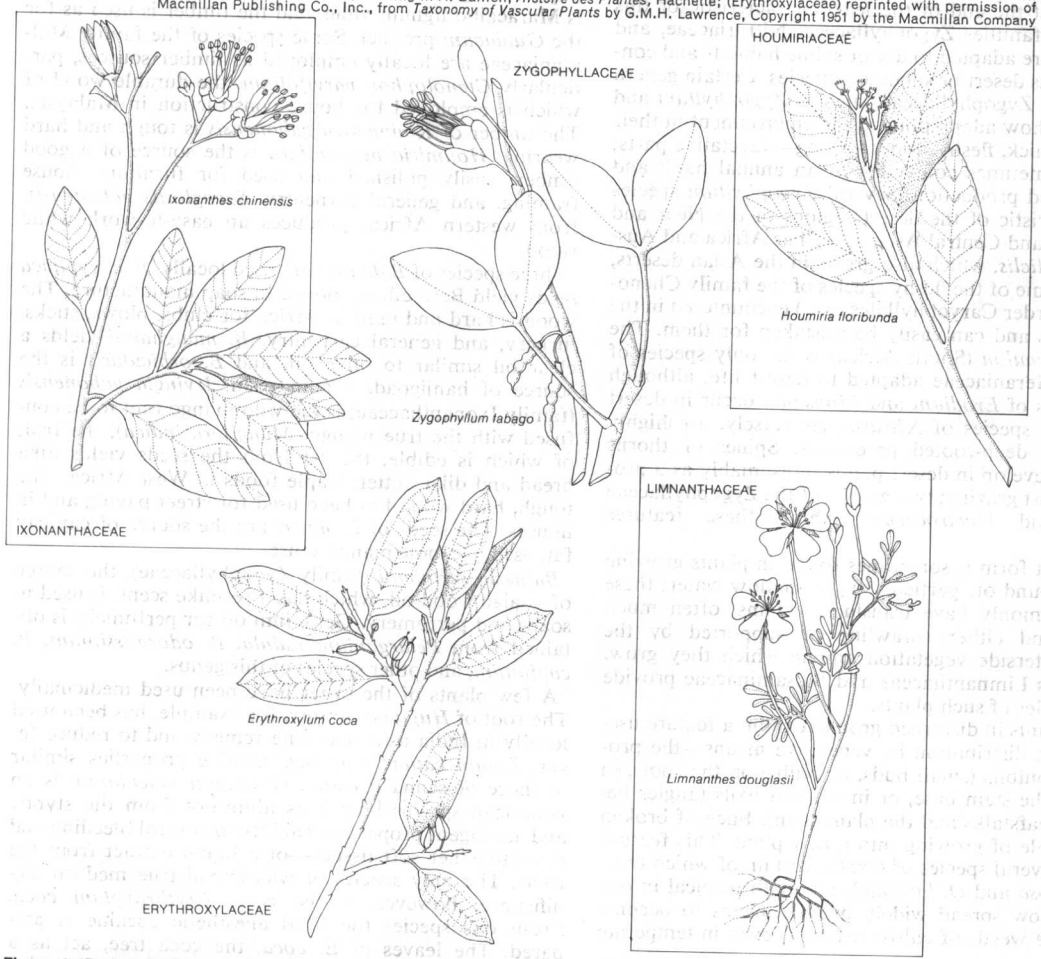

Figure 1: Representative plants of five of the smaller families of the geranium order.

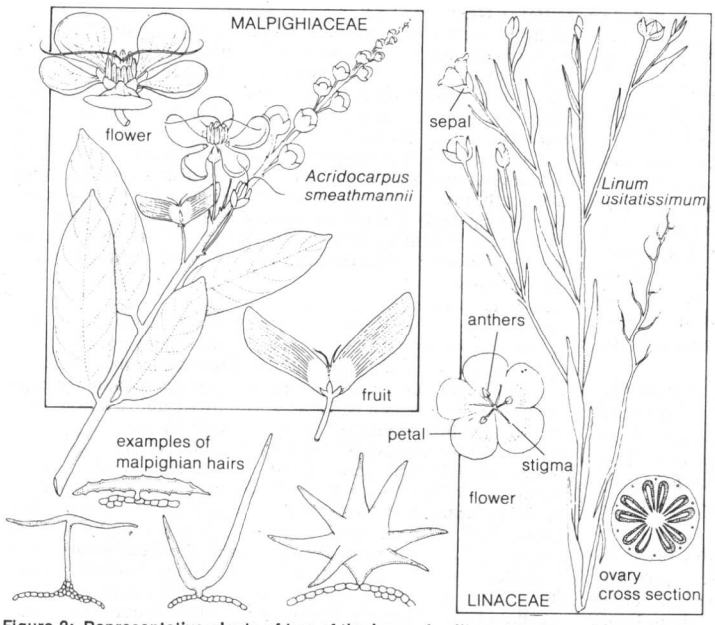

Figure 2: Representative plants of two of the larger families of the geranium order.
From (Malpighiaceae) Crown copyright. Reproduced with permission of the Controller of Her Majesty's Stationery Office and of the Director, Royal Botanic Gardens, Kew, (malpighian hairs) Engler, *Das Pflanzenreich*, (Linaceae) J. Hutchinson, *The Families of Flowering Plants;* The Clarendon Press, Oxford

picked up by grazing animals that disperse them to other parts of the arid regions. A further specialized form of distribution occurs in the genus *Impatiens* (family Balsaminaceae); the fleshy, five-valved capsule opens explosively. The valves remain attached at the base and apex when ripe but split along the joints, their elastic nature drawing base and apex together so that the seeds are shot, often for a considerable distance, through the spaces thus created between the valves. When the fruit is ripe, this explosive rupturing may be set off by a very light brush with the fingers—hence the name of a well-known European species, *Impatiens noli-tangere*, or touch-me-not. A Himalayan species, *I. glandulifera*, has spread widely along waterways in Europe and in North America by this means in a comparatively short space of time. Explosive dehiscence—opening of seed-bearing fruits—also occurs occasionally in the family Oxalidaceae, in this case activated by the elastic separation of the aril, an appendage on the seed, from the seed coat. Wind-distributed samaras, winged one-seeded fruits, as in the maples, occur in the family Malpighiaceae. Otherwise, dehiscent dry capsules, schizocarps, berries, and drupes are prevalent, with distribution by birds in the last two cases. Some (*e.g.*, *Vantanea* in the family Houmiriaceae) are distributed by flowing water.

Pollination. Pollination is almost universally by insects—generally by bees, wasps, and flies, but also by beetles and butterflies. Some North American species of *Impatiens*, however, are pollinated by hummingbirds. In the family Linaceae, floral dimorphism, the existence of two forms of flowers, has long been known. At least 29 species of *Linum* have been shown to exhibit long- and short-styled flowers. (The style is the narrow, upper part of the ovary, bearing the pollen-receiving surface, or stigma.) Fertility is greatest when the long-styled form is fertilized with pollen from the short-styled form and vice versa. The long-styled form is almost self-sterile, but the short-styled form is not; when both kinds of pollen are put on one kind of stigma, only that from the opposite kind of flower is capable of fertilization. Several species of *Linum* are self-fertilizing in the absence of insect visitors; the filaments bend inward, and the style branches spread with age.

Pollination mechanism in the flax family

In *Geranium* both self-sterility and self-fertility are known; it is well established that the more inconspicuous the flower, the more advanced the ability for selfing by movement of the styles and filaments, as in *Linum*. In the allied genus *Erodium*, the flowers may be radially symmetrical (regular or actinomorphic) or strongly bilaterally symmetrical (zygomorphic) in forms of the same species. Apparently, forms with regular flowers tend to be self-fertilizing, and those with zygomorphic flowers to be insect fertilized, the enlarged lower petals serving as a landing platform for visiting insects.

Flowers of the remaining large genus of the Geraniaceae, *Pelargonium*, are odorous at night and are visited by nocturnal insects. Such genera as *Tropaeolum* and *Impatiens* have bee-pollinated flowers with nectar secreted at the end of a spur formed by the sepals. The anthers shed their pollen shortly after the flowers open, the stigma of the same flower remaining immature. Insect visitors, dusted with pollen, transfer it to the mature stigmas of older flowers in which the anthers have fallen, thus ensuring cross-pollination. Insect-pollinated genera often have nectar guides in the form of dark blotches or streaks at the base of the petals. One member of the family Malpighiaceae, *Bunchosia gaudichaudii*, has bee-attracting glands on the outside of the calyx (sepals).

EVOLUTION

Fossil record. Fossils of the order are not of great quantity, and older records, such as those for *Balanites* and *Zygophyllum* from the Tertiary Period (about 65,000,000 to 2,500,000 years ago) of Europe, are considered suspect. The remains have been mostly as fruit or pollen. About 12 or 13 fossil plant groups have been placed in the family Houmiriaceae, and fruits of three different species of *Houmiria* have been found in Tertiary deposits in South America. A fruit of a *Sacoglottis* has been found in Tertiary deposits in Germany. *Wetherellia* fossils occur abundantly as fruits in the London Clay (Eocene Epoch—38,000,000 to 54,000,000 years ago) at the Isle of Sheppey, Kent, as do those of *Decaplatyspermum*. Fossil remains of *Erodium* and *Geranium* have been recorded from Baltic amber, as well as fruiting pedicels (stalks) of *Oxalidites* and a *Linum* fruit. *Linum* seed has been found in the Russian Pliocene Epoch (about 7,000,000 to 2,500,000 years ago), and pollen of *Geranium* in the Miocene Epoch (26,000,000 to 7,000,000 years ago).

Phylogeny. The order Geraniales is considered to have its closest affinity with the order Rutales; indeed, the general relationship is so close that it is difficult to distinguish the two orders. It is also very difficult to plot phylogenetic (evolutionary) relationships between the families included within the order Geraniales. Both the

Geraniales and the Rutales are among the many orders believed to have arisen from the order Saxifragales.

Uncertain relationships of order and families

Within the Geraniales, the families Tropaeolaceae and Balsaminaceae, with their specialized floral structure, are probably the most advanced families. The Balsaminaceae presents certain problems, however. It differs from the Geraniaceae in anatomy and pollen structure, and the disposition of the ovules is similar to that found in the Sapindaceae (order Sapindales, *q.v.*); on this basis, some authorities have included it in that family. It has also been placed near the family Vochysiaceae in the order Polygalales—an opinion given some weight by the similarity in development of the embryo in *Impatiens* and *Polygala*. Overall resemblances with the remaining families in the order Geraniales, however, outweigh these contradictory features.

The tropical family Hugoniaceae is considered to be the most primitive in the order; from it the family Linaceae probably arose. The families Ixonanthaceae, Houmiriaceae, and Erythroxylaceae may also be derivatives. The family Malpighiaceae, however, is close to the Erythroxylaceae and Nitrariaceae, and through the latter, a transitional family, to the Zygophyllaceae.

Two families are of particular interest for the form of their pollen grains. Those of the Limnanthaceae are unique and serve to emphasize its isolated position. They appear to be asymmetrically bicolpate (*i.e.*, they have two unequal germination pores or furrows). In the family Balsaminaceae the grains are very strongly flattened, with three or four germination furrows and a reticulate (netted, ridged) surface pattern. This strong compression clearly differentiates them from the Geraniaceae, with which they are most commonly allied, and all other families of the order. The closest resemblance is with *Jollydora* in the Connaraceae (order Connarales).

The order Geraniales is as diverse in anatomy as in pollen structure, particularly the family Linaceae and the small families that have been separated from it. Diversities within this group are so complex in pattern as to render difficult any phylogenetic interpretation based on anatomy. Similarly, anatomy provides no clues on the separation of the family Oxalidaceae or the Biebersteiniaceae from the Geraniaceae, all of which have the same basic vascular structure—the system of internal water- and food-conducting tubes, the vessels—and the same characteristic ring of thick-walled cells (sclerenchyma cells) in the pericycle, a layer of cells surrounding the central vascular cylinder in roots. This ring, however, is absent in other families that have been closely linked with the Geraniaceae, notably the Tropaeolaceae, Balsaminaceae, and Limnanthaceae. The family Balsaminaceae also differs from the Geraniaceae in the presence of raphide (needle-like crystals) sacs in the leaf and stem, which are sometimes visible as transparent dots. In addition, the vascular bundles in the leafstalks (petioles) are arranged in an arc, not a full ring.

The woods of the Zygophyllaceae are very specialized, showing this family to be a natural group. The family Balanitaceae differs from it in having high, wide wood rays; nevertheless, the general anatomy suggests affinity with the Zygophyllaceae rather than the family Simaroubaceae. The anatomy of the family Erythroxylaceae differs considerably from that of the Linaceae, with which it was formerly believed to be united. The wood structure in Malpighiaceae, more highly specialized than in the Linaceae, Houmiriaceae, and Erythroxylaceae, differs also from that of the Zygophyllaceae.

Thus, relationships within the order follow a confusing pattern because so many anomalous members are included, and no clear phylogenetic conclusions are possible.

CLASSIFICATION

Annotated classification. The geranium order is very heterogeneous, consisting of a number of families united by apparent general relationship rather than by a readily defined common group of characters. It is thus difficult to define by features that do not break down at some point or other.

ORDER GERANIALES

Leaves commonly alternate. Flowers hypogynous (*i.e.*, sepals, petals, and stamens arise at the base of the ovary), usually bisexual and radially symmetrical (actinomorphic). Sepals overlapped (imbricate) or rarely merely touching at the edges (valvate), free or more or less fused. Petals generally free, contorted (twisted), or imbricate, rarely valvate or convolute (rolled up, lengthwise). Anthers (pollen sacs) open by longitudinal slits. Nectar-producing disk or disk glands frequently present. Ovary of fused carpels with ovule attachment along central axis near base or apex of ovary chambers, ovules mostly solitary to few in each locule (chamber). Seeds mostly without endosperm (starch nutrient tissue for developing embryo).

Family Hugoniaceae

Trees, shrubs, or woody lianas with hooked prickles on the branchlets or flower stalks. Leaves alternate, simple, with entire or toothed margins, with deciduous (falling) stipules. Flowers actinomorphic, bisexual, in terminal or axillary (the upper angle between a leafstalk and stem) cymes (flower clusters that mature from the top downward) or panicles (many-branched flower clusters); more rarely in axillary clusters of spikes, or solitary, often yellow. Sepals and petals 5, free. Sepals generally imbricate, petals contorted. Stamens fused into a short tube at the base, almost invariably 10, except in the genus *Indorouchera* (5–7 stamens). Stamen filaments frequently with nectar-producing glands at the base. Ovary 3- to 5-locular, each locule with 2 ovules. Styles free or slightly fused at the base, with capitate—headed, with enlarged ends—stigmas. Fruit a slightly fleshy or berrylike drupe, the stones woody or bony, seed usually with scanty endosperm. Six genera and about 60 species distributed in the tropics of both hemispheres.

Family Linaceae (flax family)

Entirely shrubs, subshrubs, and herbs—no trees. Leaves alternate (rarely opposite), simple (entire or toothed). Stipules commonly absent or represented by stipular glands; if present, then falling early or, rarely, persisting and becoming conspicuous (in *Anisadenia*). Flowers actinomorphic, bisexual, disposed in cymes, racemes (spikelike flower clusters that mature from the bottom upward), or corymbs (flat-topped flower clusters), or very rarely solitary and lateral. Sepals and petals sometimes 4, usually 5; sepals sometimes fused at their bases, imbricate; petals free and contorted. Stamens equal in number to the petals, but between each pair of stamens a minute to conspicuous and bristle-like staminode (sterile stamen) frequently occurs. Stamen filaments more or less expanded at the base and fused into a short tube that usually bears small nectar-producing glands. Ovary occasionally 2- but usually 3- to 5-locular, each locule with 2 ovules. Styles free or shortly fused at the base, with capitate or more rarely linear stigmas. Fruit a capsule, rarely breaking up into 1-seeded segments twice as numerous as the styles (*Reinwardtia*) or not opening (indehiscent; *Anisadenia*). Endosperm usually scanty. About 6 genera and 240 species with nearly worldwide distribution.

Family Ixonanthaceae

Trees or shrubs with simple, alternate leaves that can be entire, toothed, or crenate. Stipules usually present, sometimes small and early deciduous; sometimes conspicuous, very long and convolute, leaving a conspicuous ring-shaped scar on the twig when they fall. Inflorescence an axillary or terminal raceme, cyme, or panicle. Flowers small, bisexual or rarely with male and female flowers on separate plants (dioecious), actinomorphic. Sepals and petals 5 or sometimes 4; sepals free or fused at the base, imbricate; petals free, imbricate, sometimes persistent and becoming firm in texture. Stamens 5 to 20, the filaments slender, free, inserted on or below the conspicuous annular or cup-shaped nectar-producing disk; anthers short and small. Ovary normally 4- or 5-locular, more rarely with only 2 locules, with a single simple or shortly divided style; ovules 1 or 2 in each locule. Fruit variable in form from large, fleshy (and edible) drupes, to winged samara, and 2- to 5-locular septicidal capsule. Arils (fleshy appendages on the seeds) present and variable, from vestigial to large organs completely enveloping the seed. Eight genera and about 45 species, exclusively tropical in distribution.

Family Houmiriaceae

Trees or shrubs with simple, entire- or lobe-margined, opposite leaves. Stipules either absent or small and early deciduous. Inflorescences axillary or rarely terminal, cymose or paniculate. Flowers hermaphroditic and actinomorphic. Sepals 5, imbricate, fleshy at the base and persistent, shortly fused at the base or united almost throughout their length into 5-toothed cup. Petals 5, contorted or imbricate, deciduous and membranous or persistent and of thick texture. Stamens variable in number, mostly 10 to 30 in 1 or 2 series, sometimes very numerous (50–180) and then in several rows. Stamen filaments slender or thick, more or less fused below;

staminodes sometimes also present. Nectar-producing disk present, annular and often toothed, or divided into separate scales. Ovary typically 5-locular but sometimes 4-, 6-, or 7-locular, with a single simple style. Ovules 1 to 3 in each locule, pendulous. Fruit a drupe, the outer layers slightly to distinctly fleshy, the inner layer hard and woody and often with resin-bearing cavities, usually with only 1 or 2 seeds developing; endosperm of seeds fleshy and oily. Eight genera and about 50 species distributed in tropical regions of the New World and 1 species in tropical West Africa.

Family Erythroxylaceae

Trees and shrubs with simple, entire, alternate leaves often showing 2 persistent longitudinal folds (leaves opposite in the genus *Aneulophus*, however). Flowers bisexual, actinomorphic, small, disposed in axillary fascicles, or solitary. Sepals 5, fused into bell-shaped calyx with valvate or imbricate teeth. Petals 5, free, deciduous, convolute or imbricate, frequently with a tonguelike appendage within. Stamens 10 in 2 whorls, more or less fused into a tube below, persistent. Ovary 2- or 3-locular, usually only 1 locule fertile. Ovules 1 or 2 pendulous. Styles free or fused, with oblique stigmas. Fruit drupaceous. Seeds usually with fleshy endosperm. Four genera and more than 200 species distributed in the tropics of both hemispheres, mostly in Africa, however; only the genus *Erythroxylum* is found in America.

Family Lepidobotryaceae

Small tree with alternate, single-bladed leaves with stipules, the single leaflet subtended by stipels—appendages similar to stipules—which, like the stipules, are deciduous. Petioles (leafstalks) and petiolules (the petiole, or stalk, of a leaflet in a compound leaf) jointed. Flowers actinomorphic, small, dioecious, the male flowers in short, sessile, catkin-like axillary inflorescences; female flowers in fasciculoid racemes. Sepals 5, imbricate, shortly fused at the base. Petals 5, free. Male flowers with 10 stamens on the margin of a flesh disk and a rudimentary ovary. Female flowers similar but with sterile stamens and a 3-chambered ovary with 2 collateral ovules in each locule. Styles 3, fused at the base. Fruit a single-seeded capsule. Seeds partly covered by a fleshy aril. One genus and species (*Lepidobotrys staudtii*), native to tropical Africa.

Family Malpighiaceae

Small trees, shrubs, or very frequently woody lianas. Malpighian hairs—characteristic 1-celled, 2-branched plant hairs—present. Leaves normally opposite and entire-margined (though occasionally alternate or in whorls of 3 or with wavy, toothed, or lobed margins), and frequently dotted with glands. Stipules usually present and deciduous, rarely absent, sometimes large, conspicuous, fused together, and persistent. Inflorescence in terminal or axillary raceme. Flowers usually large, bisexual or rarely polygamous (with male, female, and bisexual flowers on the same plant), commonly yellow or red (sometimes white or blue), obliquely zygomorphic, some cleistogamous (closed, self-pollinated) flowers often occurring. Sepals 5, imbricate, free or slightly fused at the base, some or all frequently with a large sessile (stalkless) or stalked gland on the lower outer surface. Petals also 5, free, imbricate, usually distinctly clawed and often toothed or fimbriate (ragged or fringed) along the margin. Stamens 10, in 2 whorls, usually fused into a ring at the base, all fertile or frequently with some reduced to staminodes; disk inconspicuous. Ovary asymmetrically disposed, carpels usually 3 (rarely 2 or 4), free or more or less fused, each with 1 ovule. Styles equal in number to the carpels, free or rarely fused, or very rarely only 1 carpel with a style. Fruit typically a schizocarp breaking up into 3 frequently winged mericarps, but sometimes nutlike or drupaceous. Seeds without endosperm. Sixty genera and 800 to 900 species distributed exclusively in tropical regions of the world, especially in South America.

Family Nitrariaceae

Stiff shrubs, often armed with spines or rigid leafstalks. Leaves alternate or clustered, thick and fleshy, simple, entire or with a few teeth at the apex, and furnished with small stipules. Flowers small, yellowish or white, actinomorphic, bisexual, in short lax cymes in the axils of the bracts. Sepals considerably fused below, imbricate, persistent. Petals 5, free and valvate, concave. Stamens 10 to 15 with 5 opposite the sepals and the remainder opposite the petals singly or in pairs. Stamen filaments subulate (awl-shaped), without appendages; disk absent. Ovary of 3 carpels, rarely of 6, gradually narrowing above into 3 decurrent stigmas; each carpel with a single pendulous ovule. Fruit berrylike, with a fleshy exocarp and a thin, bony, grooved endocarp. Seeds without endosperm. One genus (*Nitraria*) with about 10 species occurring in saline deserts, mostly from the Sahara to Central Asia and Siberia, with 1 species in Australia.

Family Zygophyllaceae

Mostly woody perennials; if annual they are sometimes very succulent (some *Zygophyllum* species); rarely trees (*Guaiacum*). Branches often jointed at the nodes in the more fleshy species. Leaves usually (but not invariably) opposite, mostly pinnately compound (with small leaflets on both sides of a central axis), sometimes simple or with 2 leaflets (these also jointed to the leafstalks in fleshy *Zygophyllum* species. Stipules present, often persistent, sometimes in the form of spines. Flowers in cymes or solitary and terminal, actinomorphic or rarely zygomorphic, bisexual. Sepals 5 (rarely 3 or 4), free or sometimes fused at the base, imbricate or rarely valvate. Petals equal in number to the sepals (or rarely none), free, usually imbricate or contorted. Stamens in 1 or 2 whorls, each whorl containing the same number as the sepals and petals. Stamen filaments frequently furnished with straplike appendages at the base. Nectar-producing disk usually present between the stamens and the ovary. Ovary usually with 4 or 5 carpels, sometimes as few as 2 or up to 12, each carpel with 1 or many pendulous ovules. Ovary narrowed above into a single unparted or shortly divided style. Fruit a capsule, frequently angled or even broadly winged, or rarely dividing into single-seeded mericarps. Seeds with or without endosperm. About 23 genera and 225 species distributed almost entirely in arid or semi-arid areas of the tropics and subtropics of the world.

Family Balanitaceae

Similar to the Zygophyllaceae in most respects, but leaves totally without stipules; spines in leaf axils, not modified stipules. Disk thick. Fruit drupaceous with a very thick, bony, 5 angled endocarp but only a thin fleshy mesocarp. One genus (*Balanites*) with 25 species in tropical Africa and Asia.

Family Peganaceae

Perennial herbs or subshrubs. Leaves alternate, deeply divided into narrow segments, with stipules. Flowers solitary, leaf opposed, actinomorphic, and bisexual. Sepals 4 or 5 valvate, sometimes pinnately divided. Petals 4 or 5, free, imbricate. Stamens 12–15, in alternating rows, the filaments thicker below but without appendages, inserted on an annular or angular nectar-producing disk. Ovary 2-, 3-, or occasionally 4-locular, each locule with numerous ovules disposed along the central axis. Style simple, 2- or 3-keeled above with the stigmatal surfaces on the keels. Fruit a many-seeded capsule (*Peganum*) or a 2-loculed berry (*Malacocarpus*). Seeds with a fleshy endosperm. Two genera with about 6 species distributed in dry places from the Mediterranean area to Mongolia and in the southern U.S. and Mexico.

Family Oxalidaceae

Mostly herbs (sometimes fleshy), sometimes shrubs, rarely trees. Fleshy axillary or underground tubers or bulbils frequently produced. Leaves alternate, palmately or pinnately divided (often trifoliolate—3 leaflets—in *Oxalis*), rarely simple by suppression of all but 1 leaflet; stipules absent. Flowers actinomorphic, bisexual, solitary or in umbels, more rarely in cymes or racemes, minute, nonpetalled, cleistogamous flowers sometimes present. Sepals usually fused below and imbricate. Petals 5, free or only shortly fused below and contorted. Stamens 10, in 2 alternating rows, basally fused, 5 of them sometimes reduced to antherless staminodes. Ovary 5-locular, each locule with 1 or more axile ovules. Styles 5, distinct; stigmas capitate or shortly divided. Fruit a capsule. Five genera with more than 900 species distributed predominantly in the tropics, particularly in southern Africa, South America, and Mexico.

Family Geraniaceae (geranium family)

Plants chiefly herbaceous but sometimes suffrutescent (woody at the base only) or shrubby, the leaves alternate or opposite, mostly lobed or palmately or pinnately divided, and generally with stipules. Flowers large and showy to small, radially or bilaterally symmetrical, bisexual, solitary to umbellate. Sepals 4 or 5, free or fused to the midpoint, imbricate with valvate tips, a series of bracts resembling sepals (epicalyx) sometimes present. Petals five, rarely 4 or none, free, imbricate or contorted, usually with alternating nectar-producing glands. Stamens mostly 10, usually fused at the base, in 2 rows (but the row opposite the petals sometimes reduced to staminodes), or more rarely 15 and fused in bundles of 3. Ovary of 3 to 5 carpels with 1 or 2 ovules in each locule (many in *Balbisia*). Style simple or very short, with 5 stigmas. Fruit of 3 to 5 separating mericarps, each commonly bearing a water-absorbing awn of hardened tissue ("beak"), rarely a capsule. Seeds without or with scanty endosperm. Eight genera and about 800 species with worldwide distribution, especially in temperate regions.

Family Vivianiaceae

Woody herbs or subshrubs. Leaves opposite, simple, entire to toothed, lacking stipules. Flowers radially symmetrical, bisexual, in loose clusters or laxly cymose in the upper leaf axils. Calyx (sepals) tubular or bell-like with 4 or 5 "teeth." Petals 4 or 5, free, contorted, alternating with nectar-producing glands. Stamens sometimes 8, usually 10, free. Ovary 2- or

3-locular with 2 ovules in each locule. Styles 2 or 3, fused or almost free. Fruit a 3-lobed, 3-valved capsule. Seeds with a fleshy embryo. One genus (*Viviania*) with 30 species, confined to Brazil and Chile.

Family Biebersteiniaceae

Perennial herbs with multicellular glandular hairs. Leaves pinnate or pinnatipartite, alternate, with stipules. Flowers radially symmetrical, bisexual; disposed in terminal racemes or panicles. Sepals 5, free, imbricate. Petals 5, free, frequently with "teeth" at the tip, and alternating with nectar-producing glands. Stamens 10, filaments shortly fused into a ring at the base. Ovary of 5 carpels, deeply lobed, set on a short stalk. Styles 5, arising from the base of the lobes and fused into a capitate stigma. Ovules solitary in each locule, pendulous. Fruit of 5 indehiscent, 1-seeded mericarps. Seeds with scanty endosperm. One genus (*Biebersteinia*) with 5 species occurring in arid places from southeastern Europe to Central Asia.

Family Dirachmaceae

Shrubs with long and short shoots bearing alternate, simple, serrate leaves and persistent stipules. Flowers solitary in the leaf axils of the long shoots, bisexual, and subtended by an epicalyx of 4 small bracts. Sepals 8, free, valvate. Petals 8, contorted. Stamens 8, opposite the petals, with large anthers. Ovary of 8 carpels, deeply lobed, each locule containing 1 ascending ovule. Style solitary with 8 linear stigmas. Fruit a capsule, with 8 ventrally opening sections, woolly within. Seeds with scanty endosperm. One genus and species (*Dirachma socotrana*) occurring on the island of Socotra.

Family Tropaeolaceae

Succulent herbs climbing by prehensile leafstalks. Leaves alternate, entire (often shield-shaped) or variously lobed or palmate, with stipules (stipules, however, sometimes rudimentary). Flowers bilaterally symmetrical, bisexual, often showy in shades of red or yellow, solitary in the leaf axils. Sepals 5, fused below, the dorsal sepal modified and produced into a long spur, imbricate or valvate. Petals 5, the upper 2 often different from the lower 3 (which may be absent), clawed, inserted on the calyx, imbricate. Stamens 8 in 2 rows of 4, curved downward, with slender filaments. Ovary 3-locular, 1 pendulous ovule in each locule. Fruit of 3 finally hardening indehiscent carpels separating from a central axis. Seeds without endosperm. Two genera, *Magallana* (2 species) and *Tropaeolum* (about 90 species), confined to Central and South America from Mexico to Chile.

Family Balsaminaceae (balsam family)

Weak herbs with juicy, frequently translucent stems and alternate or opposite simple leaves. Stipules indicated by small glands. Flowers solitary or in umbel-like clusters, strongly bilaterally symmetrical, frequently showy in shades of pinks, purple, yellow, and orange. Sepals 5 (but 2 frequently reduced or aborted), the lowest prolonged into a spur, coloured. Petals 5, corolla 2-lipped, the upper petal large and ascending, the laterals fused in pairs. Stamens 5, with short, broad filaments fused at the tip; anthers fused around the ovary. Ovary 5-locular with numerous ovules in each locule. Styles short, or the 1 to 5 stigmas almost sessile (set directly on the ovary). Fruit a succulent capsule opening elastically by action of fleshy arils attached to seeds, rarely a berrylike capsule (*Hydrocera*). Seeds with scanty endosperm or none. Two genera with more than 450 species mostly in tropical Asia and Africa but some in Europe and North America.

Family Limnanthaceae

Succulent annual marsh plants. Leaves alternate, much divided, without stipules. Flowers solitary on long stalks in the leaf axils, radially symmetrical, bisexual. Sepals and petals 3 to 5, the former valvate and the latter contorted. Stamens 6 or 10 in 2 rows, the outer row alternate with the petals, frequently with basal glands. Carpels 3 or 5, almost free, with a single common enlarged gynobasic style and 1 ovule in each locule. Fruit of free indehiscent carpels. Seed without endosperm. Two genera and 11 species confined to North America.

Family Hypseocharitaceae

Stemless perennial herbs. Leaves in a rosette, pinnately divided, without stipules. Flowers bisexual, radially symmetrical, either sessile (no stalks) or with short stalks in few-flowered cymes. Sepals and petals 5, the former imbricate, the latter contorted. Stamens 15 in a single series, with persistent slender filaments. Ovary 5-locular, lobed, with a single style and numerous axile ovules in each locule. Fruit an irregularly loculicidal capsule, opening late. Seeds numerous, lacking endosperm. One genus (*Hypseocharis*) with 8 species occurring in the Andes.

Critical appraisal. Above the generic level, it seems unlikely that orthodox taxonomic methods based on external morphology will shed much more light on classification within the order or between the Geraniales and allied orders—particularly the Rutales, Sapindales, and Polygalales. In addition, many conclusions based on other plant disciplines, such as palynology and phytochemistry, are still founded on inadequate sampling of the families concerned, and more complete information may shed the necessary light, particularly if species showing primitive characters are first selected. At the generic level and below, taxonomic revisions of such large and troublesome genera as *Oxalis* and *Impatiens* are still much needed.

BIBLIOGRAPHY. J. HUTCHINSON, "Malpighiales," in *The Genera of Flowering Plants*, vol. 2, pp. 568–621 (1967); E.F. WARBURG, "Taxonomy and Relationship in the Geraniales in the Light of Their Cytology," *New Phytol.*, 37:130–159, 189–210 (1938), an interesting and useful paper dealing with the families Linaceae, Zygophyllaceae, Geraniaceae, Limnanthaceae, Oxalidaceae, Tropaeolaceae, and Balsaminaceae; O. WARBURG and K. REICHE, "Balsaminaceae," in A. ENGLER and K. PRANTL (eds.), *Die natürlichen Pflanzenfamilien*, 3: 383–392 (1897), a brief conspectus—more recent literature is extensive but scattered; O.E. SCHULZ, "Erythroxylaceae," in A. ENGLER (ed.), *Das Pflanzenreich IV*, 134:1–176 (1907), a very competent monograph, still the only general account of the family; R. KNUTH, "Geraniaceae," and "Oxalidaceae," *ibid.*, vol. 129–130 (1912, 1930) not of outstanding taxonomic merit, but the only general treatments of these families available; J. CUATRECASAS, "A Taxonomic Revision of the Humiriaceae," *Contr. U.S. Natn. Herb.*, 35:25–214 (1961), a very fine revision including an account of the relationships and evolution of the family, with an invaluable bibliography; H. WINKLER, "Linaceae," in *Die natürlichen Pflanzenfamilien*, 2nd ed., 19a:82–130 (1931), a now rather dated but still useful account, including in subordinate rank the Houmiriaceae, Ixonanthaceae, and Hugoniaceae; J. LEONARD, "*Lepidobotrys* Engl., type d'une famille nouvelle de Spermatophytes: les Lepidobotryaceae," *Bull. Jard. Bot. État. Brux.*, 20:31–40 (1950), the case for the separation of this genus into a new family; C.T. MASON, "A Systematic Study of the Genus *Limnanthes* R. Br.," *Univ. Calif. Publs. Bot.*, 25:455–506 (1952), a sound taxonomic revision of the genus, containing most of the Limnanthaceae, with information on cytology and experimental genetics; F. NIEDENZU, "Malpighiaceae," in *Pflanzenreich IV*, 141:1–870 (1928), of average taxonomic merit, marred by the fact that little or no use was made of the great British or American herbaria in its preparation but still quite invaluable; F. BUCHENAU, "Tropaeolaceae," *ibid.*, 131:1–36 (1902), competent, but of limited value since the number of species recognized has now almost doubled; A. ENGLER, "Zygophyllaceae," *ibid.*, 2nd ed., 19a:144–184 (1931), a brief conspectus of the family.

(C.C.T.)

German Democratic Republic

The most developed and prosperous of the Communist countries of eastern Europe and one of the major industrial nations of the world, the German Democratic Republic (often referred to as the GDR and called East Germany in the West) lies in a vital strategic region. The nation was established on October 7, 1949, as one of the two Germanys that emerged from the ruins of the Nazi period, a circumstance that molded much of the character of the young state during the years of the Cold War, as it attempted to construct a new and emphatically Communist society. By the 1970s the republic had attained a strong position economically and politically; its location in the continental heartland gives it a significant place—symbolized by the annual trade fair at Leipzig—in trade between eastern and western and between northern and southern Europe.

Boundaries

The country also derives trade advantages from the Baltic Sea coastline, its northern boundary. On the east the Oder and Neisse rivers form a long and important frontier with Poland; this boundary, part of the post-World War II Potsdam agreement, was confirmed in the Treaty of Zgorzelec of 1950. On the south the boundary with Czechoslovakia corresponds to an earlier boundary of 1918, renewed by treaty in 1945. On the west another long and major boundary separates the republic from the Federal Republic of Germany; it is based on the lines of demarcation, agreed upon at the Yalta Conference of 1945, separating the then Soviet occupation zone of Germany from the zones occupied by the Western allies, on whose territory the German Federal Republic subse-

quently emerged. Situated within the republic's territory, the 185 square miles of West Berlin form a unique political unit based on the three sectors of the city originally held by the Western powers; long a major potential source of conflict during the Cold War era, the western part of the city faded somewhat in international significance following a settlement by the major powers, announced in the summer of 1971. The republic's frontiers have thus had more than usual significance in determining the course of internal events.

The German Democratic Republic has an area of 41,768 square miles (108,178 square kilometres) and by the mid-1970s was the home of nearly 17,000,000 people. East Berlin ("Democratic Berlin") is the capital.

The following article covers various aspects of the land, people, and society of the contemporary republic. For related historical information, see GERMANS, ANCIENT; and GERMANY, HISTORY OF. See also BERLIN; LEIPZIG; ELBE RIVER; and ODER RIVER.

THE LAND

Topography. The German Democratic Republic lies across two major European topographic zones: a northern lowland belt, which narrows from east to west, and the smaller but rugged strip of the Mittelgebirge, or Mid-German Highlands, which borders it to the south. This basic division has had great influence on many aspects of the contemporary nation.

The northern lowlands. The northern lowlands of the republic consist mainly of wide, flat, and rolling plains, with the Elbe and the Oder river systems cutting only slightly into the terrain. Only the east–west ridges of the Nördlicher and Südlicher Landrücken rise to some 330 feet (100 metres) above the level plains.

The rocks underlying the plains are young Pleistocene sediments (less than 2,500,000 years old), thickening northward. Underlying older rocks include lignite (brown-coal) deposits in the south, but they lie too deep for easy exploitation. Exceptions include the important limestone quarries northeast of Berlin and the ancient rock-salt and potash deposits, which can be mined because of upthrusts associated with later mountain-building movements.

Effects of the Ice Age

The surface of the plains was shaped largely by Ice Age forces; a line from Wilhelm-Pieck-Stadt Guben, on the Polish frontier, to Brandenburg, west of Berlin, separates a region molded by southward-moving Scandinavian glaciers, which were formed during the Weichsel (or Vistula) Glacial Stage (the last Ice Age advance), from the more southerly belt, affected only by the earlier Saale and Elsterian Glacial stages. The northern portion of the lowlands exhibits the classic features of glacial molding—a lumpy, lake-strewn relief with terminal moraine ridges marking the limit of glacier-carried debris—while the older southern surfaces have been levelled, and their lakes have become dry land.

The plains, which were covered by clay and studded with ice-scoured boulders, thus generating loamy soils, are important agriculturally, but the terminal moraines tend to be heaped with boulders and sand, are much less fertile, and are often forest clad. Trees also cover the dry, sandy valley regions, but prehistoric meltwater valleys are marked by a natural grassland cover.

The southern edge of the lowlands is marked by a loess belt of windblown deposits laid down during the Weichsel Glacial Stage. Given favourable conditions, a rich, black soil developed on this rolling countryside, with less fertile podzol soils developing in the areas of higher rainfall. The whole belt, which stretches from the Harz Mountain foothills as far as Magdeburg (the Magdeburger Börde) in the west and the area of Lusatia, or Lausitz (Lausitzer Gefilde) in the east, has supported agriculture based on wheat, barley, and sugar beets.

The uplands of the south and southwest. South of the loess belt rises the contrasting topography of the Mittelgebirge region. In addition to the Harz mountains and the Erzgebirge (Ore Mountains) and the mountains of the Oberlausitz (Upper Lusatia) and the Thüringer Wald (Thuringian Forest), the region contains the rolling hills of the Thuringian and Erzgebirge basins and, near Dresden, the lowlands of the Elbe Valley. The core of the whole region is hard, crystalline rock associated with the ancient Hercynian mountain-building period (some 300,000,000 years ago), when molten granitic intrusions formed ore deposits. Toward the end of the Paleozoic Era (about 250,000,000 years ago), this eroded mountain range was filling its associated structural depressions with debris, and it was here that the region's valuable hard-coal beds—such as those of the Erzgebirge basin—were formed. Sediments of limestone, clays, and sands were packed into gigantic hardened rock masses during the ensuing Mesozoic Era, and the vast upthrusts associated with the Alpine mountain-building process consolidated them into the ranges seen today, although much of the Mesozoic cover has been worn away.

The highlands are thus a mosaic of many-layered structural blocks, some lifted and some sunk deeper during the Tertiary upheavals. Climatic and soil conditions have stimulated the growth of extensive forests—now largely spruce, as a result of 19th-century planting—above the 2,300-foot mark, whereas the rain-favoured higher meadows are increasingly utilized for cattle raising. The high rainfall is retained by an extensive dam system and is then piped to the industrial cities of the foothills and basins. Bismuth, cobalt, uranium, silver, zinc, lead, and tin ores are still mined in the mountains to which they have given their name, and, although industrialization has left its harsh mark on the regional landscape, the more rural areas retain a considerable scenic charm, which has fostered tourism.

Climate. The climate of the German Democratic Republic reflects the transitional climate of central Europe, which is determined by constantly interchanging air masses of maritime and continental origin. The exposed Baltic coastline enhances the maritime component.

The lowlands. In the lowland belt, precipitation diminishes eastward as the plains open toward the Eurasian interior, and the average temperatures for the warmest and coldest months become more extreme. Schwerin, in the northwest, for example, has an annual rainfall of 24.7 inches (627 millimetres), a mean annual maximum of 63.5° F (17.5° C), and a mean January minimum of 31.8° F (−0.1° C), while for Frankfurt an der Oder the corresponding figures are 21.3 inches (540 millimetres), 65.7° F (18.7° C), and 30.2° F (−1.0° C).

The uplands. To the south the mountains have a wetter and cooler climate, with westward-facing slopes receiving the highest rainfall from maritime air masses. At a station on the Brocken, a mountain in the Harz near the western frontier, annual precipitation reaches 58.4 inches (1,483 millimetres) at an altitude of 3,747 feet (1,142 metres). The sheltered lee slopes and the basins, by contrast, being in a rain shadow, are actually arid. The basins and low-lying tracts also tend to be warmer and hence are especially favourable to agriculture; fruit and grapes for wine, for example, are grown in the Elbe Valley region.

The human imprint. *Traditional regions and modern planning.* The human imprint on the republic's landscape also reflects a basic division, this time between a highly industrialized south and a predominantly rural north. Until 1945 metropolitan Berlin was the only industrial cluster north of a line from Wilhelm-Pieck-Stadt Guben to Magdeburg.

The rural north and the industrialized south

The precious metals of the southern mountains supported a dense population from late medieval times until silver mining declined with the discovery of New World deposits. The people turned to the development of other crafts, trades, and, notably, the textile and metalworking industries. The elaborate transportation network and the lignite- and salt-mining industry, developed in the later 19th century, diversified and enlarged the regional economy to encompass chemicals, heavy machinery, and power plants. In the north, meanwhile, the lack of mineral wealth, poor transport and marketing conditions, a sparse population, and, notably in Mecklenburg and Brandenburg provinces, the presence of a powerful class of landowning Junkers all impeded industrial development.

MAP INDEX

Political subdivisions

The names of the political subdivisions do not appear on the map because they are the same as the names of their capital cities.

Cities and towns

Physical features and points of interest

GERMAN DEMOCRATIC REPUBLIC

Size of symbol indicates relative size of town

• ○ ◉ ▣ ■

0 25 50 100 150 km

0 25 50 100 mi

A major goal of overall Socialist planning has been the development of the national territory as a whole. The southern industrial clusters, centred on, among others, the cities of Dresden, Karl-Marx-Stadt, Halle, and Leipzig, were restructured to diminish the disproportions created by the dismemberment of the Third Reich. With similar goals in mind, the formerly backward northern regions developed such new industries as, for example, shipbuilding, supplied by an industrial hinterland, in the port cities of Rostock, Wismar, and Stralsund. Special efforts were made to modernize agriculture and to develop a coordinated, industrialized food-producing and food-processing system of communes—model, state-owned farms and cooperatives and food-processing plants associated with them—in coordination with an extensive restructuring of the transportation system.

Urban settlement. The GDR considers communities of more than 2,000 persons urban; by this definition, almost three-quarters of the population is urban. Yet the distribution of city dwellers is very uneven; the largest concentration is in a zone beginning in the west, between the Harz and Magdeburg, reaching southeast through Dessau, Halle, and Leipzig, and then penetrating into the Erzgebirge valleys through Karl-Marx-Stadt and Zwickau, continuing eastward to Freiberg and Dresden. To the west the city series Gera–Jena–Weimar–Erfurt–Gotha–Eisenach forms a link to the fringe of the Thüringer Wald. In the north a cluster of urban centres has formed around Berlin, but, apart from that, generally in this region only local and provincial administrative centres are significant, which is directly opposite to the pattern in the industrialized south. Roughly one-third of the country's population still inhabits the great metropolitan complexes of Berlin, Halle, Leipzig, Karl-Marx-Stadt, Zwickau, and Dresden, but this pattern is changing with the accelerating need for new housing outside the old city centres.

Rural settlement. National plans call for the restructuring of villages. Many village communities were established in the 13th century in connection with a feudal eastward expansion policy. They tend to dissolve into smaller settlements with fewer than 100 inhabitants, notably in the Rostock, Schwerin, Neubrandenburg, Frankfurt, and Cottbus districts. The creation of large communal societies and cooperative units has been a catalyst in transforming rural settlement: such villages have multistoried housing blocks and a careful zonation into work areas, schools, and rural shopping, cultural, and service centres. Barns, sheds, haylofts, storerooms, and industrial meat-processing centres are set apart. The process has done away with privately owned farm property and even individual houses.

Changes in village communities

THE PEOPLE

Ethnic, linguistic, and religious divisions. The population of the German Democratic Republic, declining since World War II, dropped below the 17,000,000 mark in 1973 and by the end of 1975 was estimated to have fallen to 16,820,000. The overwhelming majority is made up of Germans who speak the German language. Regional dialects, notably the Plattdeutsch, or Low German, of the northern Mecklenburg region and the Saxon of Saxony in the south, continue to have significance in everyday life. In addition, many thousands (according to Western estimates, 35,000 to 70,000) of Sorbs (or Wends), descendants of early Slavic settlers, live in Lusatia, in Cottbus and Dresden districts. Other Slavs who had settled early in the Elbe and Saale basins and even farther westward retreated or were pushed out or Germanized during the medieval German colonization eastward. The Sorbs have preserved their individuality, and the region is officially bilingual, there are Sorbian schools and theatres, and the Domowina (the official Sorb homeland organization) protects the Sorbian heritage.

In religious affiliation, Protestants outnumber Catholics eight to one; adherence to religious groups is declining, however, especially among the young, although religious affiliations are ostensibly protected by the constitution.

Demographic structure. The German Democratic Republic is virtually unique among the major countries of Europe in that its population in 1976 was less than it was in 1947, when a peak was reached in the chaotic conditions following the collapse of the Third Reich. It declined steeply until 1961 and since then has declined at a slower rate. Distribution, as noted above, is very uneven, with a concentration in the southern industrial belt and in the north around Berlin. Urbanization is greatest in the Karl-Marx-Stadt and Leipzig districts and least in rural, northern Neubrandenburg.

German Democratic Republic, Area and Population

	area		population†	
	sq mi	sq km	1971 census	1975 estimate
Districts (*Bezirke*)				
Berlin, capital city	156	403	1,086,000	1,094,000
Cottbus	3,190	8,262	863,000	872,000
Dresden	2,602	6,738	1,877,000	1,845,000
Erfurt	2,837	7,348	1,256,000	1,247,000
Frankfurt	2,774	7,185	681,000	689,000
Gera	1,546	4,004	739,000	739,000
Halle	3,386	8,771	1,925,000	1,890,000
Karl-Marx-Stadt	2,320	6,009	2,047,000	1,994,000
Leipzig	1,917	4,966	1,491,000	1,458,000
Magdeburg	4,450	11,525	1,320,000	1,298,000
Neubrandenburg	4,167	10,793	638,000	629,000
Potsdam	4,854	12,572	1,133,000	1,125,000
Rostock	2,731	7,074	859,000	868,000
Schwerin	3,348	8,672	598,000	592,000
Suhl	1,489	3,856	553,000	550,000
Total GDR	41,768*	108,178	17,068,000*	16,891,000*

*Figures do not add to total given because of rounding. †De jure.
Source: Official government figures.

The legacy of World War II. As a result of World War II and its aftermath, and also because of emigration, the demographic structure of the republic has been markedly distorted. Such factors as the scarcity of young people, the large surplus of women in middle and older age groups, and, indeed, the general concentration in the older age groups continue to exert an influence. Birth rates and death rates emphasize the significance of these factors. Live births in the mid-1970s were only a low 11 per 1,000 population, and this in spite of the extremely low degree of infant mortality. Similarly, in a population with a predominance of elderly persons the death rate is high (about 14 per 1,000) in spite of a steadily declining mortality rate among younger people and an average life expectancy of 69 years for men and 74 years for women. The highest live-birth figures are found in the rural areas of the north, with a decline southward as urbanization increases.

No other European country has such a high proportion of pensioners—almost 20 percent in 1974, compared with 11 percent for the same areas in 1939. The proportion of the population in the labour force declined from 68 to 50 percent over the same period. Questions concerning automation, the rationalization and mechanization of the national economy, and the problems and potential of the social-welfare resources of the country become much clearer when seen against such a demographic background.

Another peculiarity is the surplus of women. In 1946 there were 135 women for every 100 men as a result of World War II and its aftermath. This disproportionality subsequently improved with the return of prisoners of war and with the death of women who strongly predominate in the older age groups; by 1974 the ratio had fallen to 116 to 100. This female surplus tends to increase with the size of communities; the trend toward equalization of the sex ratio is strongest in places with such male-oriented industries as mining and power plants, as in Halle-Neustadt and the Cottbus district.

The surplus of women

Contemporary trends in the labour force. By the mid-1970s more than 8,309,000 persons were gainfully employed. The increase of more than 500,000 since the early 1950s resulted largely from the entry of women into the labour force; the number of male workers showed a decrease. The fact that almost half the labour force is fe-

male has important consequences, notably in the provision of children's nurseries, kindergartens, play centres, all-day (rather than the usual 8 AM to noon) schools, and so on. A growing number of women are moving into leading professional positions, particularly in Berlin and in the industrial south, where both supply of and demand for trained personnel are highest. The working force is also augmented (to about 7 percent of the total) by persons who have qualified for retirement pensions but prefer to continue working.

More than a third of the working force is now employed in industry, and the proportion is steadily rising. A similar increase is taking place in commerce and service industries, while agriculture takes a declining eighth of the total, still a high figure compared with other countries. The steadily increasing need for workers, especially in industry, has caused planners to consider further automation and rationalization plans. In the geographic distribution of the labour force, the basic north–south contrast again emerges: agricultural workers in 1974 accounted for 29 percent and industrial workers for 17 percent of the total in the Neubrandenburg district, but in the district of Karl-Marx-Stadt the percentages were 6 and 51, respectively.

Declining agricultural employment

Internal migrations also take place in the republic, though to a declining extent; former movements trended from smaller rural settlements to larger towns, especially where these were the focus of new, planned industrial expansion. Men and young persons (18–30 years old) are prominent in this internal migration, causing social and economic changes in both the departure and reception areas. Centres of attraction are Berlin and the Cottbus and Frankfurt regions (both focal points for planned new growth). Karl-Marx-Stadt and Halle, because of a declining mining industry, and rural Neubrandenburg and Magdeburg are the main losers. Before the sealing of the national boundaries (especially around West Berlin) in 1961, a substantial migration, including much trained manpower, to West Germany caused severe problems to the national economy.

The outlook. It is of some significance that the low point of available working people seems likely to occur by the mid-1970s. The disproportionality is expected to diminish through the end of the decade and beyond, with the proportion of older people who are pensioners, to take a key gauge, falling from some 20 percent in 1970 to an estimated 14 percent by 2000. The final working out of the asymmetry introduced by World War II should strengthen immensely the economic and social development of the country. (H.-J.K./R.E.H.M.)

THE NATIONAL ECONOMY

The German Democratic Republic is eastern Europe's most developed and prosperous country. Its national income per person has been estimated by the World Bank to be considerably higher than that in any other European Communist country, with the exception of Czechoslovakia. While its agriculture accounts for a fairly small part of total east European farm production, in industry it occupies a very prominent position. It is an important producer of machinery, especially of advanced equipment, much of which is sold to other eastern European countries. Compared with other countries of the region, however, its overall economic progress has been relatively slow; during 1970–74, for example, its net material product grew by only about 26 percent, a rate that was exceeded in every east European country except Czechoslovakia.

International standing of the country's industry

The extent and distribution of resources. *Mineral resources.* The republic is relatively poor in mineral resources: only lignite, potash, and rock salt are found and produced in significant quantities, although other minerals, such as hard coal, iron ore, copper, bismuth, cobalt, and uranium are mined on a small scale. A small quantity of natural gas is produced, but there are no oil resources to speak of. By 1975, annual output of lignite (brown coal) amounted to about 270,000,000 tons, making the country the world's largest producer. Output grew rapidly up to 1964, but in subsequent years it showed little change. Much of the country's lignite comes from two main fields: Niederlausitz (northeast of Dresden) and the Halle–Leipzig region. There are a number of smaller producing areas, of which that lying near Magdeburg and Stassfurt is the most important. The lignite is easy to extract but has a high water content and a low calorific value; its main use is in the form of briquettes for thermal power stations and as domestic fuel, though large quantities are also used by the chemical industry.

Local supplies of hard coal are not adequate to meet domestic requirements. Production, which is based on two small fields lying, respectively, between Karl-Marx-Stadt and Zwickau and between Freital and Dresden, has been declining, and by 1975 it amounted to scarcely 600,000 tons annually. Hard-coal imports (including coke), mainly from the Soviet Union, Poland, and Czechoslovakia, amounted to about 15 times as much. Potash and salt, which are found in large quantities on the eastern edge of the Harz Mountains, near Halle, play a significant part in the country's chemical industry and are important export products. Iron ore is mined in Thuringia and near Ilsenburg in the Harz, but reserves are small, the ore is of poor quality, and production had virtually ceased by 1975. Copper is found at Mansfeld in Thuringia, and uranium is produced in the Elster Valley and in the Erzgebirge.

Coal, potash, and iron ore

Other resources. More than 60 percent of the country's total land area is agricultural land. Most of it is arable, only about an eighth being classified as meadows and pastures. The quality of the soil varies considerably from area to area, but, with the exception of that in the Thuringian basin and between Leipzig, Halle, and Magdeburg, it is not very productive. More than a quarter of the country's surface is wooded; some 80 percent of the forest area consists of coniferous trees, notably Scotch pine, spruce (especially in the Harz Mountains), and fir. Deciduous forests are made up of beech, oak, and birch. Extensive reforestation has taken place since the country was established. Hydroelectric potential is limited; small amounts are generated in the Erzgebirge and the Sudeten region.

Sources of national income. *Agriculture.* In the mid-1970s GDR agriculture, which is fairly advanced when compared with that of its Communist neighbours, contributed about 11 percent of the country's net material product and occupied about 11 percent of the labour force. There is one 15-horsepower tractor for every 76 acres (31 hectares) of arable land, a figure surpassed only by Czechoslovakia in eastern Europe, and the consumption of chemical fertilizers—at more than 220 pounds per acre (260 kilograms per hectare)—is one of the highest among Socialist and a number of European capitalist countries. As a result, yields are relatively high, but the country is still dependent on imports for a large part of its food.

Farming is organized on the basis of nearly 5,800 cooperatives and a number of state farms. The latter occupy about 7 percent of the socialized land area, which itself takes up all but 5 percent of the total agricultural area. The principal crops include potatoes, followed by sugar beets, barley, wheat, rye, oats, and oilseeds. Livestock raising is also important. Western observers feel that one of the main problems in agriculture has been the relatively slow and uneven growth in output, resulting from the lack of adequate investment funds and the lack of incentive thought to be associated with collectivization. From time to time there have been large shortages of certain commodities, necessitating large-scale imports. The position was particularly difficult in 1969, when, partly as a result of unfavourable weather, the cereal crop was some 12 percent lower than in the previous year, while the output of oil-bearing crops and sugar beets was, respectively, 28 and 26 percent lower than the average of the previous five years.

Industry. The German Democratic Republic is one of the most heavily industrialized Communist countries. Industry contributed more than 67 percent of the total net material product by the mid-1970s—more than in any

other east European country except Czechoslovakia—and engaged more than 38 percent of the total labour force. Industrial development was very rapid, the index of industrial production advancing more than 170 percent during the 1950s, 70 percent during the '60s, and 28 percent in 1970–74. Much of this progress resulted from improvements in labour productivity, which, per person, rose almost 210 percent between 1955 and 1974.

Industrial policy

The main early feature of industrial policy was the disproportionate attention given to heavy industry and a preoccupation with quantitative rather than qualitative progress. By the 1960s it was realized that these and other policy shortcomings were beginning to have an adverse effect on the rate of growth. A more rational economic and industrial policy, involving a limited decentralization of decision making and responsibility and a more equitable distribution of resources among the various sectors of industry, was initiated. The share of industrial investment devoted to energy, fuel, and metallurgy fell by half, to about a quarter of the total, during the early to late 1960s, but the share of light industry and the textile and food industries was expanded from 12 percent to 18 percent. Investment in the electronics industry more than doubled, to about 10 percent; engineering saw a rapid growth, but the share of chemicals remained constant.

The policy of the early and mid-1970s was to improve quality, make greater use of advanced technology, and raise productivity. The main emphasis is placed on fuel and power, engineering, chemicals, and electronics; specialization, especially in the field of sophisticated electronic and complex engineering products, is actively encouraged.

Chemicals, machinery, and electric and electronic products have been among the fastest growing branches of industry. Output in engineering (including vehicles), for example, grew by 90 percent in the 1960s and by the mid-1970s was the largest single branch of industry, accounting for nearly a quarter of total output. Food has a 17 percent share, closely followed by chemicals, light industry, and the rapidly expanding electronics sector. Other important branches include metallurgy and the relatively slowly advancing textile industry.

The output of electricity has been growing rapidly, expanding to more than 84,500,000,000 kilowatt-hours by the mid-1970s, but has failed to keep up with the expansion of demand. Most electricity is generated from lignite and coal. Oil, which is pumped from Kuybyshev in the Soviet Union to Schwedt and Leuna by means of the Comecon (the Communist bloc economic organization) Friendship (Russian Druzhba) pipeline, covers only a very small part of the country's total energy requirements. A similarly small amount (less than 5 percent) of electricity is derived from hydroelectric power stations and from the country's small atomic power plant, which opened in 1966.

The country is eastern Europe's principal producer of plastics and synthetic fibres; other important industrial products are pig iron, crude steel, rolled steel, chemical fertilizers, sulfuric acid, paper, and various passenger and freight vehicles.

Foreign trade. In per capita terms the country is eastern Europe's second largest foreign trader after Czechoslovakia, and foreign trade was about 75 percent higher during 1971–75 than during the previous five years. As it has no significant nontrade sources of foreign revenue, it has had to balance its trade (and sometimes even earn a small surplus) by limiting the growth of its imports to match its exports. In practice, however, exports have often exceeded imports by a fair margin. In contrast to the trend seen in other eastern European countries, the importance of the Communist world in the country's foreign trade has not declined significantly; by the mid-1970s the Communist bloc's share of the total was about 64 percent, only slightly less than in 1960, and among the highest in east Europe. Trade with the capitalist countries, which has grown faster than total trade, constituted about 31 percent of the total, and the remainder (about 5 percent) was made up of trade with the developing world.

Trading partners

The country's largest trading partner, namely, the Soviet Union, accounted for about a third of both exports and imports.

The GDR's principal non-Communist customer and supplier was the Federal Republic of Germany, which accounted for about 8 percent of both exports and imports. Since the mid-1960s the balance of trade between the two Germanys has been in favour of West Germany.

The scarcity of official statistics makes it difficult for Western observers to establish detailed commodity composition of the republic's foreign trade, but it is known that in the mid-1970s one-third of all imports consisted of raw materials (notably hard coal, coke, and crude oil), while another third was made up of the products of the metalworking industries. Products of the food, light, and related industries constituted more than 20 percent of the total, with agricultural produce (including wheat and oilseeds) accounting for roughly one-tenth. On the export side, more than 50 percent was derived from sales of machinery and metalworking products; the remainder was shared, about equally, by basic raw materials and light industrial and related goods. Sales to the republic by the advanced western European countries included machinery and foodstuffs (accounting jointly for just over half the total), manufactured products, and crude materials and chemicals. Exports to those countries included manufactured products and machinery (about half the total), chemicals, and food.

Management of the economy. *The role of the government.* As in other Communist countries, the government plays an all-important role in the economy. Agriculture is in the hands of the collectives and the state farms, while industry and most trading and financial enterprises are owned and controlled by the state. Reforms begun in 1972 and completed by 1975 virtually eliminated private enterprise, although about 14 percent of retail trade was still handled outside the Socialist sector.

Economic plans and the more important production targets are laid down, after discussion at all levels, by the government, as are the detailed economic policies necessary to fulfill these plans. The result, Western observers conclude, is a highly centralized and bureaucratic system of economic management, in which market forces are not allowed to operate to any significant extent. Western observers would, nevertheless, agree with the republic's own economists that, as a result of a gradual process of economic reform embarked on in 1963, the current system of controlling the economy is more flexible and sophisticated than it was at the start of the 1960s. The aim of these reforms was to eliminate some of the worst features of rigid central planning and detailed state supervision without seriously weakening the central control of the economy. As a result, economic plans were less detailed and binding production targets were laid down in respect to fewer goods; although prices were still determined by the state, price-fixing methods had been greatly improved.

Centralized economic management

At the same time, steps have been taken to give at least a limited role to such economic forces and instruments as demand, profit, taxation, and interest. Production targets for individual enterprises are now expressed in terms of profit and sales value rather than in terms of physical volume, and enterprises have been given some independence in deciding such matters as the type of goods produced, incentive payments, and the allocation of investment resources.

Direct control over the larger enterprises is exercised by some 80 industrial associations (Vereinigungen volkseigener Betriebe) that check the performance and coordinate the plans of individual enterprises and are responsible to the appropriate ministry. Smaller firms report to regional economic organizations (*Bezirkswirt-schaftsräte*).

Trade unions. The country's trade unions are organized on the basis of industries and are affiliated with the national group known as the Freier Deutscher Gewerkschaftsbund (FDGB; Free German Trade Union Association), which claims a membership of some 8,000,000. They are not active in social and economic affairs in the

same way as their Western counterparts; as in other Socialist countries, they take part in discussions concerning, and then assist in the implementation of, national planning policies.

They may, in this respect, be considered an important part of the overall state apparatus, with responsibility for such matters as labour discipline.

TRANSPORTATION

The basic geographical division in the republic again may be seen in its transportation network, with a dense pattern of railways and highways in the southern industrialized regions contrasting with a thinner network in the agricultural north. Requirements of internal and foreign trade have strengthened this pattern, and topographic conditions have also played a part; both the rugged topography of the Mittelgebirge and the northern fens, swamps, and lakes have made route construction expensive.

Coastal conditions have strongly influenced the flow of shipping and harbour construction; fogs, low winter temperatures, snow, and the freezing of inland waterways are also important factors affecting costs, performance, and the accident rate.

The railway system. The state railway system, the Deutsche Reichsbahn (DR), still partly suffers from extensive war damage and reparations dismantling, but it is being modernized and rationalized. Uneconomical secondary lines, whose traffic is handled more efficiently by road vehicles, have been closed. Some short, local narrow-gauge lines remain. Added emphasis has been given to fast, modern intercity traffic. Railway tracks are most dense in the southern industrial agglomerations, and important lines connect Berlin to the major regional centres, which are themselves interlinked. Main freight lines in Saxony have been electrified.

A noteworthy feature is the Seddin marshalling yard south of Potsdam, a vast control centre handling international traffic at the very heart of the whole central European railway system.

Roads and highways. Highway traffic is playing an increasing role in transport. Most vehicles are state-owned, but a few private or semiprivate companies survive. Private motorcar ownership is low by western European standards. The road network is dense—thinner in the rural north but very dense and congested in the industrial south. The arterial system dates from the mostly long, straight 19th-century highways, the *Chausseen*. The *Autobahnen* (expressways) system, dating from Nazi times and influenced in design by military considerations, is only partially suited to contemporary traffic needs in the republic. Starting from the incomplete Berliner Ring, expressways radiate to the northeast, east, southeast, southwest, and west. In the south a cross-connection joins Dresden, Karl-Marx-Stadt, Gera, and Erfurt. The Leipzig–Dresden link was completed in the 1970s, the Berlin–Rostock expressway and remaining Berliner Ring are under construction, and plans exist for a Halle–Magdeburg connection.

The *Autobahnen*

Inland waterways. The lowland portions of the republic offer favourable conditions for a part natural, part artificial waterway system. About 80 percent of the total network is made up of regulated or canalized river reaches, while wholly artificial canals make good use of the east–west courses of ancient riverbeds. Main natural thoroughfares are the Elbe and its tributaries, the Saale (navigable up to Halle–Trotha), the Havel (navigable up to Zehdenick), and the Oder. The Elbe–Havel, Havel, Oder–Havel, Hohensaaten–Friedrichsthaler, and Oder–Spree canals and, farther west, a portion of the important Mittelland Kanal as far as the locks at Magdeburg–Rothensee form the main artificial links connecting the rivers; the east–west routes carry the most traffic. As the waterway system does not extend to the industrialized south, insofar as larger vessels are concerned, it carries only a small portion of freight; tourist traffic is of some significance, especially along the Elbe and on the scenic Baltic coast.

In spite of unfavourable natural conditions, the Baltic coast also has a number of commercial shipping port facilities, which are capable of handling all of the republic's overseas trade. In addition to the traditional port cities of Wismar, Rostock, and Stralsund, new deepwater harbour facilities on the Breitling at Rostock–Petersdorf serve as a gateway to the world.

Air traffic. Regular, scheduled air traffic was instituted in 1956 between more than half a dozen internal airfields and to 36 destinations in Europe, Asia, and Africa. The Berlin-Schönefeld Central Airport (Zentralflughafen Berlin-Schönefeld) dominates the system. Interflug is the small domestic airline and the Soviet airline Aeroflot the other major operator.

Pipelines. The important Schwedt refinery is the terminus of the Friendship (Druzhba) pipeline that brings crude oil from Russia. Schwedt also has links to the oil port at Rostock and to the Leuna chemical works near Leipzig, while further links for crude oil and products are planned.

ADMINISTRATION AND SOCIAL CONDITIONS

The structure of government. *The constitutional framework.* Under the terms of a constitution ratified in April 1968, the German Democratic Republic is a Socialist country. According to the prevailing interpretation of Marxist–Leninist theory, all classes of the population belong to an alliance known as the National Front of the German Democratic Republic (Nationale Front der Deutsche Demokratische Republik), an organization that embraces all political parties and mass organizations. This, it is claimed, represents an organizational expression of the principle that each citizen carries a responsibility for the direction of the entire community. Political power is exercised through the People's Delegations (Volksvertretungen), which form the basis of all political, economic, social, and cultural agencies in the republic, according to the principle embodied in the slogan "Work together, plan together, govern together" ("*Arbeite mit, plane mit, regiere mit!*"). Elections to the delegations are open to those who have attained their 18th birthday on the day of the election. Citizens over 21 can participate in elections to the national People's Legislature (Volkskammer). As in other Communist countries, much guided public discussion of basic questions of policy, as well as public examination of the candidates offered, precedes the actual election. The names of all candidates appear on a unified list approved by the ruling SED (see below).

The Volkskammer is the supreme agency of political power, resolving the main principles under which social and political life are to be carried on, both for individuals and for the various agencies and bodies concerned. It consists of 500 delegates elected for four-year terms.

The Council of State (Staatsrat) carries on the function of the legislative body between sessions. The Ministerial Council (Ministerrat), executive of the Staatsrat, carries out administrative and policy decisions that include planned development of the economy. Each council member is responsible for the management of the region assigned to him.

The regional People's Delegations function as elective agencies of the central government, and each produces its own councils and commissions to carry out national policies.

The dominant spearhead of this political movement is the Sozialistische Einheitspartei Deutschlands (SED), a product of the merger in 1946 of the Kommunistische Partei Deutschlands (KPD) and the Sozialdemokratische Partei Deutschlands (SPD). Other political parties tolerated are the Liberal-Demokratische Partei Deutschlands (LDPD, established 1945), the Christlich-Demokratische Union (CDU, established 1945), the Demokratische Bauernpartei Deutschlands (DBD, established 1948), and the Nationaldemokratische Partei Deutschlands (NDPD, also set up in 1948). Mass trade-union, youth, and women's organizations belong to the Demokratischer Block der Nationalen Front.

Political parties

International associations of the republic include adherence to the military Warsaw Pact and to Comecon, the economic organization linking east Europe; economic

ties are particularly close with the Soviet Union. More broadly, the GDR maintains economic and cultural links with many nations and is a member of more than 200 international organizations. The German Democratic Republic was accepted as a member of the United Nations in September 1973, following the signing of a mutual recognition treaty with the Federal Republic of Germany in December 1972.

The legal system. The highest judicial body is the Supreme Court (Oberstes Gericht), and its members (elected for four years), as well as those of the local and regional courts, are selected carefully for their understanding of the Socialist character of the social system. Prosecution for violations of law is handled by a body of public prosecutors, headed by an attorney general.

The armed forces. In 1956 the National People's Army (Nationale Volksarmee) replaced the garrison units of the People's Police (Volkspolizei, or VP), formed in 1952. It cooperates closely with the Soviet armed forces (which have some 300,000 troops stationed in the republic) and those of other Communist countries. There are also armed combat groups and the VP. These forces (equipped with Soviet weapons), along with Soviet troops and Czechoslovak forces periodically stationed in the republic, guard an important western sector of the border of the Communist bloc. Compulsory military service for men has existed since 1962.

Education. The school system of the German Democratic Republic is uniform and carefully structured. Its nucleus is the polytechnic public school (*Oberschule*), which consists of 10 grades and offers a general education. There is also an extensive preschool system of day nurseries and kindergartens. After the 10-year public school education, studies may be continued, first in vocational schools, then, after gaining the skilled workman's certificate known as the *Facharbeiterbrief*, in trade and technical schools and schools for engineering. Apprentices may earn their high school diplomas (*Abitur*) in a special course offered in the vocational school itself, at evening high schools, or at factory schools or then may take a mature student's high school diploma. The *Abitur* enables the student to continue studies at a *Hochschule* or university. Polytechnic high schools offering a general education also confer the *Abitur*. Other specialized institutions include factory schools, village academies, radio and television academies, and bodies specializing in agriculture and health care.

The *Abitur*

The public colleges (*Volkshochschulen*) and factory training schools (*Betriebsoberschulen*), together with other special schools, complete a complex educational system generally acknowledged as having a high level of proficiency though heavily imprinted by Marxist dogmas. Advancement is based on ability; there are no tuition fees.

The well-organized system of public libraries is also part of the educational apparatus; it is focussed on the Deutsche Staatsbibliothek (a significant centre of science collections) in Berlin and the Deutsche Bücherei, the national library based in Leipzig. The latter includes a collection of almost all the literary output in German since 1913. There is an elaborate system of regional, university, and specialist libraries, in addition to some 12,600 public library branches. There are also many valuable museums.

Social conditions and services. The republic possesses an extensive health-care system, administered by a Cabinet office. Financial support and free medical assistance, medicine, and nursing care are available in case of sickness or accident. The scheme, which is available to all citizens, is funded in part by a uniform and obligatory national insurance system, the management of which is part of the national budget responsibility. There is, in addition to the health-care system, a comprehensive preventive medical program and care, including a pension system, for the aged, who form a significant element in the population. Certain occupational groups—including miners, postal and railroad workers, and professionals—receive higher pensions. There are about 170 sanatoriums.

The republic's housing policy allows each citizen and his family the right to adequate quarters insofar as it is consistent with local conditions and the political and economic situation. The concentration on reconstruction, especially the setting up of heavy industry, in the country's early years impeded a successful solution of the gigantic housing problem, although the changed national priorities were alleviating the situation by the 1970s. Within the family women enjoy full equality; families with many children, unwed mothers, and one-parent families receive special attention.

Of the total national income of the republic, about 23 percent is put by for capital accumulation, and the remainder is used for consumption. About 7 percent goes to national educational funds, the same amount to sciences, art, and culture generally, and about 20 percent for the social insurance plan. Even though private home ownership still plays a considerable role in the country, it is slowly declining as a result of state and cooperative housing developments. Rents vary regionally, with Berlin rents running 50 percent higher than those in localities of fewer than 100,000 people.

Changing consumer conditions are reflected in figures that show that between 1955 and 1974 automobile ownership (per 100 households) rose from 0.2 to almost 24, motorcycles from 11 to 20, radios from 77 to 96, television sets from 1.2 to 80, and refrigerators and washing machines from 0.5 to 70.

CULTURAL LIFE AND INSTITUTIONS

Much of the cultural life of the German Democratic Republic has been conditioned by three basic and inescapable factors: the rich German cultural heritage; the dismemberment of Germany and the Cold War era; and the introduction of a new cultural environment as one of the fundamental precepts of the Socialist society. The state now plays a prominent role in all cultural activities, including physical culture, sports, and tourism, all of which are regarded as components of Socialist culture.

The fine arts. Among the organizations founded with the new aim of creating a realistic art closely linked to the people was the Association of Artists (Verband Bildender Künstler) in 1950, while a decree on culture (Kulturverordnung) of the same year endeavoured to assure the material well-being of individual artists. Commissions for the creation of monumental works of art, notably at the former concentration camps of Buchenwald, Ravensbrück, and Sachsenhausen, influenced the development of the plastic arts, and ideological "guidance" has been constantly exercised.

Association of Artists

In the early postwar years, architecture also reflected Socialist ideological influence modelled on Soviet designs; several major showpieces were carried out regardless of cost, but sometimes exaggerated decorations and eclectic designs led to tasteless results, as, for example, the overall appearance of the Karl-Marx-Allee in Berlin. In an attempt to remedy the situation, principles of urban construction closer to contemporary Western forms were laid down to serve as the foundation for ensuing architectural design.

These principles perhaps found best expression in such entirely new planned cities as Eisenhüttenstadt and Hoyerswerda, as well as in the reconstructed parts of some of the older, historic cities such as Berlin, Dresden, and Leipzig.

Literature. Literature plays an important part in the cultural life of the republic. The publishing industry, centred in Berlin and Leipzig, produces many works stemming from the rich classical German tradition and also the works of a good number of modern writers. Representatives of the Communist tradition who are in the first rank internationally include Bertolt Brecht, who died in 1956 and whose austere poetry, sardonic humour, and biting social commentary left their mark on readers in many lands; the social-documentary novels of Anna Seghers, perhaps best illustrated by *Das siebte Kreuz* (1939; *The Seventh Cross*, 1942); and, possibly more significantly, Arnold Zweig, whose *Der Streit um den Sergeanten Grischa* (*The Case of Sergeant Grischa*, 1927) was a seminal work of the pre-Nazi era. The Bit-

terfeld Conference of 1959 formulated the role of the writer in the evolving Communist society and generated the movement known as the Movement of Writing Workers (Bewegung Schreibender Arbeiter) to encourage latent talent in the portrayal of "Socialist Realism" while at the same time allowing closer supervision and guidance by the authorities.

The theatre. All the theatres in the republic are owned by the state, a circumstance that, among other things, ensures an adequate subsidy. There are some 110 permanent theatres, almost 1,000 cultural centres, and almost 200 open-air seasonal theatres, including the Bergtheater Thale and the Felsenbühne in Rathen. The Deutsches Theater in Berlin opened as early as September 1945, being the first German theatre to perform following the Nazi collapse. Other historic theatres, including the Deutsche Staatsoper, the Komische Oper, and the Volksbühne—all in the capital—and the Schauspielhaus and the Oper in Leipzig, as well as the old Nationaltheater in Weimar, were rebuilt. Theatres have forged a strong functioning link between performers, audiences, and social organizations concerned with cultural affairs, and they perform a vital role in disseminating the ideological message.

The Berliner Ensemble

Berlin dominates theatrical life, and is the location of the Berliner Ensemble, long associated with Bertolt Brecht and probably the best known group internationally. Its often austere realism and disciplined professionalism have had a strong influence on contemporary theatre in many countries. Children's and youth theatres in Berlin, Halle, Leipzig, and Dresden are another new feature; their performances include not only productions of traditional favourites, such as fairy tales, but also productions that attempt to meet the problems of modern youth. Theatre, judging by the number of people attending performances, is highly popular.

Music. Concerts, too, are extremely well attended; the republic has more than 80 major orchestras of one kind or another, with the Leipziger Gewandhausorchester and the Staatskapelle in both Berlin and Dresden holding leading positions. The Thomaner Choir in Leipzig and the Kreuzchor of Dresden have a long and renowned tradition in the field of church music. There are also many amateur groups.

Sports and athletics. Sports occupy an extraordinarily large place in GDR life, under the aegis of the constitution, which invokes sport as essential to "development of a Socialist personality." Physical education and swimming are compulsory subjects in the schools, and around 5 percent of the labour force works at least part-time as coaches or sports officials. Members of state-supported sports clubs live on the club premises, and younger athletes even go to school on the club grounds, their classes being arranged around their training schedules. The German College of Physical Culture (Deutsche Hochschule für Körperkultur, founded 1950) in Leipzig has a renowned medical school that trains sports doctors. Women are trained as the men are, and women athletes, in consequence, have developed remarkably. Training emphasis is very much on Olympic sports, and its success was demonstrated at the summer Olympic Games in 1976, when the GDR took second place in gold medals won—40, surpassed only by the Soviet Union with 47; its women swimmers won 10 of 11 individual titles and broke eight world records.

The mass media. The state-owned film-making enterprise, DEFA (from Deutsche Film-Aktiengesellschaft), is located in Potsdam–Babelsberg and produces a wide range of cartoons, documentaries, and feature films, many of which are exported. Motion pictures continue to be a popular form of entertainment, especially in the rural communities. The highly developed radio network Deutscher Demokratischer Rundfunk is also government-owned and plays an important part in national life, while Radio Berlin International broadcasts on German subjects to many countries, including those of the developing world.

The Deutscher Fernsehfunk television network transmits through 10 channels, in two main program formats, from studios located in Berlin. It is a member of Intervision—the system linking east European countries—and, through this connection, of the west European Eurovision network.

Newspapers in the republic function as propagators of a Socialist viewpoint. There are some 40 dailies as well as many weekly, regional, and specialist publications. *Neues Deutschland*, the official newspaper of the Sozialistische Einheitspartei Deutschlands, is probably the best known internationally. (H.-J.K./R.E.H.M.)

THE OUTLOOK

The focal point of the future development envisaged for the German Democratic Republic is the economy. Up to the early 1960s, in the wake of the havoc wrought by World War II and in the light of the problems following the establishment of two German states, the main aim of economic policy was to ensure rapid growth in certain branches of industry, even at the expense of other industrial areas and sectors of the economy. More recently, steps have been taken to allocate investment funds more equitably, both within industry itself and among the various sectors of the economy. In the industrial field, the aim is to improve the technical level of production and move toward a new production pattern by concentrating on more sophisticated products, especially in engineering and electronics. It is felt that it is in these fields that the country has the greatest competitive advantage, since most other east European countries are not in the position to supply the required technological input. The German Democratic Republic is an enthusiastic member of Comecon, mainly because that body's specialization schemes have, on the whole, been helpful to the government's objective of rapid development in the more advanced industrial products.

Competitive advantages

The outlook for the economy is promising. The remainder of the 1970s is expected to see more economic reforms, which should lead to a further improvement in the system of economic management. This should help to make some progress in solving the country's principal problems, which Western observers interpret as the wasteful use of investment resources and the irrational price structures. This, in turn, is likely to have a beneficial effect on productivity, growth, and the advance of exports and should ensure a satisfactory trade balance, despite the need for large-scale food imports.

The Berlin Accord of 1971 seemed to reflect a changing climate of European affairs and some easing of regional tensions. The question of German unification, however, seems certain to occupy the republic and its citizens for some time to come. (E.I.U./Ed.)

BIBLIOGRAPHY. Comprehensive monographs concerning the physical and human geography of the German Democratic Republic are few in number in any language, but there is a wealth of periodical literature, especially in the magazines *Petermanns geographische Mitteilungen, Geographische Berichte*, and *Zeitschrift für den Erdkundeunterricht* (all published in the German Democratic Republic). The *Verfassung der Deutschen Demokratischen Republik*, 2nd ed., 2 vol. (1969), reflects the social conditions of the German Democratic Republic in official form. Political, demographic, economic, scientific, and cultural developments are reflected in great detail in the *Statistisches Jahrbuch der DDR* (annual). For economic geography, *Ökonomische Geographie der Deutschen Demokratischen Republik* (1969), a collective work, ed. by HORST KOHL, and *Die Bezirke der Deutschen Demokratischen Republik*, also ed. by HORST KOHL (1974), are standard reference sources. See also H.J. KRAMM, *Beiträge zur ökonomischen Geographie der Deutschen Demokratischen Republik*, 2 vol. (1962). English-language studies include ARTHUR M. HANHARDT, *The German Democratic Republic* (1968); and PETER C. LUDZ, *The German Democratic Republic from the Sixties to the Seventies: A Sociopolitical Analysis* (1970); a standard reference work is PETER C. LUDZ *et al.* (eds.), *DDR Handbuch* (1975).

(H.-J.K./R.E.H.M.)

Germanic Languages

The Germanic languages, a branch of the Indo-European language family, include a number of extinct languages as well as the earlier and present forms of German,