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number of sheep in the province is comparatively small, and is, indeed, not greatly in excess of that of the goats. The wooded hills are well stocked with deer, and a stray wolf occasionally finds its way from the forests of the Ardennes into those of the Hunsrück. The salmon fishery of the Rhine is very productive, and trout abound in the mountain streams.

The great mineral wealth of the Rhine province probably furnishes its most substantial claim to the title of the "richest jewel in the crown of Prussia." Besides parts of the carboniferous measures of the Saar and the Ruhr, it also contains important deposits of coal near Aix-la-Chapelle. Iron ore is found in abundance near Coblenz, the Bleiberg in the Eifel possesses an apparently inexhaustible supply of lead, and zinc is found near Cologne and Aix-la-Chapelle. The mineral products of the district also include lignite, copper, manganese, vitriol, lime, gypsum, volcanic stones (used for millstones) and slates. By far the most important item is coal. Of the numerous mineral springs the best known are those of Aix-la-Chapelle and Kreuznach.

The mineral resources of the Prussian Rhine province, coupled with its favourable situation and the facilities of transit afforded by its great waterway, have made it the most important manufacturing district in Germany. The industry is mainly concentrated round two chief centres, Aix-la-Chapelle and Düsseldorf (with the valley of the Wupper), while there are naturally few manufactures in the hilly districts of the south or the marshy flats of the north. The largest iron and steel works are at Essen, Oberhausen, Dinsburg, Düsseldorf and Cologne, while cutlery and other small metallic wares are extensively made at Solingen, Remscheid and Aix-la-Chapelle. The cloth of Aix-la-Chapelle and the silk of Crefeld form important articles of export. The chief industries of Elberfeld-Barmen and the valley of the Wupper are cotton-weaving, calico-printing and the manufacture of turkey red and other dyes. Linen is largely made at Gladbach, leather at Malmedy, glass in the Saar district and beetroot sugar near Cologne. Though the Rhineland is *par excellence* the country of the vine, beer is largely produced; distilleries are also numerous, and large quantities of sparkling Moselle are made at Coblenz, chiefly for exportation to England. Commerce is greatly aided by the navigable rivers, a very extensive network of railways, and the excellent roads constructed during the French régime. The imports consist mainly of raw material for working up in the factories of the district, while the principal exports are coal, fruit, wine, dyes, cloth, silk and other manufactured articles of various descriptions.

The population of the Rhine province in 1905 was 6,435,778, including 4,472,058 Roman Catholics, 1,877,582 Protestants and 55,408 Jews. The Roman Catholics muster strongest on the left bank, while on the right bank about half the population is Protestant. The great bulk of the population is of Teutonic stock, and about a quarter of a million are of Flemish blood. On the north-west frontier reside about 10,000 Walloons, who speak French or Walloon as their native tongue. The Rhine province is the most thickly populated part of Prussia, the general average being 617 persons per sq. m. The province contains a greater number of large towns than any other province in Prussia. Upwards of half the population are supported by industrial and commercial pursuits, and barely a quarter by agriculture. There is a university at Bonn, and elementary education is especially successful. For purposes of administration the province is divided into the five districts of Coblenz, Düsseldorf, Cologne, Aix-la-Chapelle and Trier. Coblenz is the official capital, though Cologne is the largest and most important town. Being a frontier province the Rhineland is strongly garrisoned, and the Rhine is guarded by the three strong fortresses of Cologne with Deutz, Coblenz with Ehrenbreitstein, and Wesel. The province sends 35 members to the German Reichstag and 62 to the Prussian house of representatives.

History.—The present Prussian Rhine province was formed in 1815 out of the duchies of Cleves, Berg, Gelderland and Jülich,

the ecclesiastical principalities of Trier and Cologne, the free cities of Aix-la-Chapelle and Cologne, and nearly a hundred small lordships and abbeys. At the earliest historical period we find the territories between the Ardennes and the Rhine occupied by the Treviri, the Eburones and other Celtic tribes, who, however, were all more or less modified and influenced by their Teutonic neighbours. On the right bank of the Rhine, between the Main and the Lahn, were the settlements of the Mattiaci, a branch of the Germanic Chatti, while farther to the north were the Usipetes and Tencteri. Julius Caesar conquered the tribes on the left bank, and Augustus established numerous fortified posts on the Rhine, but the Romans never succeeded in gaining a firm footing on the right bank. As the power of the Roman empire declined the Franks pushed forward along both banks of the Rhine, and by the end of the 5th century had regained all the lands that had formerly been under Teutonic influence. The German conquerors of the Rhenish districts were singularly little affected by the culture of the provincials they subdued, and all traces of Roman civilization were submerged in a new flood of paganism. By the 8th century the Frankish dominion was firmly established in central Germany and northern Gaul. On the division of the Carolingian realm the part of the province to the east of the river fell to the share of Germany, while that to the west remained with the evanescent kingdom of Lotharingia. By the time of Otto I. (d. 973) both banks of the Rhine had become German, and the Rhenish territory was divided between the duchies of Upper and Lower Lorraine, the one on the Mosel and the other on the Meuse. Subsequently, as the central power of the German sovereign became weakened, the Rhineland followed the general tendency and split up into numerous small independent principalities, each with its separate vicissitudes and special chronicles. The old Lotharingian divisions passed wholly out of use, and the name of Lorraine became restricted to the district that still bears it. In spite of its dismembered condition, and the sufferings it underwent at the hands of its French neighbours in various periods of warfare, the Rhenish territory prospered greatly and stood in the foremost rank of German culture and progress. Aix-la-Chapelle was fixed upon as the place of coronation of the German emperors, and the ecclesiastical principalities of the Rhine bulk largely in German history. Prussia first set foot on the Rhine in 1609 by the joint occupation of Cleves; and about a century later Upper Gelderland and Moers also became Prussian. At the peace of Basel in 1795 the whole of the left bank of the Rhine was resigned to France, and in 1806 the Rhenish princes all joined the Confederation of the Rhine. The congress of Vienna assigned the whole of the lower Rhenish districts to Prussia, which had the tact to leave them in undisturbed possession of the liberal institutions they had become accustomed to under the republican rule of the French.

RHINOCEROS, the designation for such perissodactyle (odd-toed) ungulate mammals as carry one or more horns on the head, and their extinct relatives (see PERISSODACTYLA). Rhinoceroses are of large size and massive build, but have little intelligence, and are generally timid in disposition, though ferocious when wounded or brought to bay. The African species use the nasal horns as weapons, with which they strike and toss their assailant, but the Asiatic rhinoceroses employ their sharp lower tusks much as does a boar. Rhinoceroses are dull of sight, but their hearing and scent are remarkably acute. They feed on herbage, shrubs and leaves of trees, and, like so many other large animals which inhabit hot countries, sleep the greater part of the day, and are most active in the cool of the evening or even during the night. Some are found in more or less open plains, while others inhabit swampy districts. Members of the group have existed in both east and west hemispheres since the beginning of the Miocene period; but in America they all became extinct before the end of the Pliocene period, and in the Old World their distribution has become greatly restricted. They are, for instance, no longer found in Europe and North Asia, but only in Africa and in portions of the Indian and Indo-Malayan regions. Living rhinoceroses may be arranged in three groups: (1) With a single nasal horn, and very thick skin, which is raised into strong, definitely arranged ridges or folds. In this group there are two well-marked species. The Indian rhinoceros (*Rhinoceros unicornis*), the largest of the Asiatic forms, is the most widely known, from its being exhibited in zoological gardens. A famous rhinoceros presented to the Zoological Society of London in July 1864 lived till December 1904. This species stands from 5 ft. to 5 ft. 9 in. at the shoulder and is blackish grey in colour; the horn rarely exceeds a foot in length, but one in the British Museum measures 19 in. This species is now only met with in a wild

state in the Assam plain, though it formerly had a wider range.

The first rhinoceros seen alive in Europe since the time when these animals, in common with nearly all the large remarkable beasts of both Africa and Asia, were exhibited in the Roman shows, was of this species. It was sent from India to Emmanuel, king of Portugal, in 1513; and from a sketch taken in Lisbon, Albert Dürer composed his celebrated but fanciful engraving, which was reproduced in so many old books on natural history. This species chiefly frequents swampy grass jungle and is fond of a mud-bath. According to General A. H. Kinloch, it is hunted by "tracking the animal on a single elephant until he is at last found in his lair, or perhaps standing quite unconscious



FIG. 1.—Indian Rhinoceros (*Rhinoceros unicornis*). This and the following illustrations are reduced from drawings by J. Wolf, from animals in the London Zoological Society's Gardens.

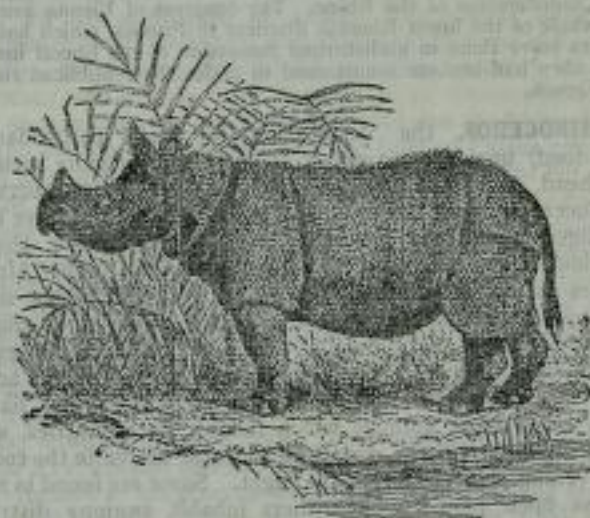


FIG. 2.—Javan Rhinoceros (*Rhinoceros sondaicus*)

of danger; or by beating him out of the jungle with a line of elephants, the guns being stationed at the points where he is most likely to break cover. In the latter case it is necessary to have reliable men with the beaters, who can exercise authority and keep them in order, for both mahouts and elephants have the greatest dread of the huge brute, who appears to be much more formidable than he really is." The Javan rhinoceros (*Rhinoceros sondaicus*) is distinguished by its smaller size, and a different arrangement of the skin-folds (as may be seen by comparing figs. 1 and 2). The horn in the female is little developed, if not altogether absent. This species has a more extensive geographical range than the last, being found in the Bengal Sundarbans near Calcutta, Burma, the Malay Peninsula, Java, Sumatra and Borneo. The colour is uniform dusky grey. A female obtained in the Sundarbans

stood 5 ft. 6 in. high. This species is more an inhabitant of tree-forest than of grass jungle, and its usual habitat appears to be in hilly countries.

In the second section there is a well-developed nasal, and a small frontal horn separated by an interval. The skin is thrown into folds, but these are not strongly marked, and lower tusks are present. This group or genus is represented at the present day only by the Sumatran rhinoceros, *Rhinoceros (Dicerorhinus) sumatrensis*, with its sub-species. It is the smallest of all the species, and its geographical range is nearly the same as that of the Javan species, though not extending into Java; it has been found in Assam, Chittagong, Burma, the Malay Peninsula, Sumatra and Borneo. The colour varies from earthy brown to blackish, and the greater part of the body is thinly covered with hair, and the ears and tail are fringed. The average height of adults is from 4 ft. to 4 ft. 6 in. This species inhabits forests, and ascends hills to considerable elevations; it is shy and timid, but easily tamed even when adult. A specimen from Chittagong acquired in 1872 by the Zoological Society of London was named *R. lasiotis*, as it differed from the typical form by its larger size, paler and browner colour, smoother skin, longer, finer and redder hair, and the long fringe of hair on the ears. It is now recognized as a local race.



FIG. 3.—Black or common African Rhinoceros (*Rhinoceros (Diceros) bicornis*).

To the third group or genus (*Diceros*) belong the two African rhinoceroses, which have two horns, the skin without definite folds, and no lower tusks. The black rhinoceros (*Rhinoceros (Diceros) bicornis*) is the smaller of the two, and has a pointed prehensile upper lip. It ranges through the wooded and watered districts of Africa, from Abyssinia in the north to the Cape Colony, but its numbers are yearly diminishing, owing to the opening up of the country. It feeds exclusively on leaves and branches of bushes and small trees, and chiefly frequents the sides of wood-clad rugged hills. Specimens in which the posterior horn has attained a length as great as or greater than the anterior have been separated under the name of *R. keillou*, but the characters of these appendages are too variable for specific distinctions. The black rhinoceros is more rarely seen in menageries in Europe than either of the Asiatic species, but one lived in the gardens of the London Zoological Society from 1868-1891.

Lastly we have the white—Burchell's, or square-mouthed—rhinoceros (*Rhinoceros (Diceros) simus*), the largest of the five, and differing from the other species in having a square truncated upper lip. In conformity with the structure of the mouth, this species lives entirely by browsing on grass, and is therefore more partial to open countries or districts where there are broad grassy valleys between the tracts of bush. In its old haunts in

the south it is practically extinct; but ten were reported from a reserve in Zululand in 1907. A detached colony exists, however, near Lado, on the Upper Nile. No specimen of this species has ever been brought alive to Europe. Mr F. C. Selous gives the following description of its habits:—

"The square-mouthed rhinoceros is a huge, ungainly looking beast, with a disproportionately large head, a large male standing 6 ft. 6 in. at the shoulder. Like elephants and buffaloes they lie asleep during the heat of the day, and feed during the night and in the cool hours of early morning and evening. Their sight is very bad; but they are quick of hearing, and their scent is very keen; they are, too, often accompanied by rhinoceros birds, which, by running about their heads, flapping their wings, and screeching at the same time, frequently give them notice of the approach of danger. When disturbed they go off at a swift trot, which soon leaves all pursuit from a man on foot far behind; but if chased by a horseman they break into a gallop, which they can keep up for some distance. However, although they run very swiftly, when their size and heavy build is considered, they are no match for an average good horse. They are, as a rule, very easy to shoot on horseback; as, if one gallops a little in front of and on one side of them, they will hold their course, and come sailing past, offering a magnificent broadside shot, while under similar circumstances a prehensile-lipped rhinoceros will usually swerve away in such a manner as only to present his hind-quarters for a shot. When either walking or running, the square-mouthed rhinoceros holds its head very low, its nose nearly touching the ground. When a small calf accompanies its mother, it always runs in front and she appears to guide it by holding the point of her horn upon the little animal's rump; and it is perfectly wonderful to note how in all sudden changes of pace, from a trot to a gallop, or vice versa, the same position is always exactly maintained. During the autumn and winter months (i.e. from March to August) the square-mouthed rhinoceros is usually very fat; and its meat is then most excellent, being something like beef, but yet having a peculiar flavour of its own. The part in greatest favour among hunters is the hump, which, if cut off whole and roasted just as it is in the skin, in a hole dug in the ground, would, I think, be difficult to match either for juiciness or flavour." (W. H. F.; R. L.)

RHINTHON (c. 323–285 B.C.), Greek dramatist, son of a potter. He was probably a native of Syracuse and afterwards settled at Tarentum. He invented the *hilarotragedia*, a burlesque of tragic subjects. Such travesties were also called *phylaces* ("fooleries") and their writers *phylacographi*. He was the author of thirty-eight plays, of which only a few titles (*Amphitryon*, *Heracles*, *Orestes*) and lines have been preserved, chiefly by the grammarians, as illustrating dialectic Tarentine forms. The metre is iambic, in which the greatest licence is allowed. The *Amphitruo* of Plautus, although probably imitated from a different writer (Archippus of the Middle Comedy), may be taken as a specimen of the manner in which such subjects were treated. There is no doubt that the *hilarotragedia* exercised considerable influence on Latin comedy, the *Rhinthonica* (i.e. fabula) being mentioned by various authorities amongst other kinds of drama known to the Romans. Scenes from these travesties are probably represented in certain vase paintings from Lower Italy, for which see H. Heydemann, "Die Phylakendarstellungen auf bemalten Vasen," in *Jahrbuch des archäologischen Instituts*, i. (1886).

Fragments in monograph by E. Völcker (Leipzig, 1897); see also E. Sommerbrodt, *De Phylacographia Graecorum* (Breslau, 1875); W. Christ, *Geschichte der griechischen Literatur* (1898).

RHIZOPODA, the name given by Dujardin (*pro parte*, 1838) to a group of Sarcodine Protozoa. They are distinguished by their pseudopods, simple or branched, passing by wide bases into the general surface, never fine radial nor fusing into complex networks; skeleton absent or a simple shell ("test," "theca"), never (?) a calcareous shell, nor represented by a siliceous network, nor spicules. Reproduction by binary fission; by division or abstriction of buds after the body has become multi-nucleate; or by the resolution of the body into numerous uninucleate zoospores (amebulae or flagellulae) which may conjugate as gametes; plasmodium formation unknown; encystment (in "resting cysts" or "hypocysts") common. Without a knowledge of the history it is impossible to distinguish a naked Lobose from the Amoebea (pseudopodiospore) of a Myxomycete or Proteomyxan. As to the name, Dujardin included the thecate Lobosa, the Filosa, and the Reticularia or Foraminifera

(*q.v.*). The latter had already received the name Foraminifera (for their shells) from d'Orbigny; and as it is impossible to separate naked from thecate Lobosa we have merged his Amoebea (Amibiens) in the larger group. The Filosa were removed by Lang from the Reticularia; in habit and test they are inseparable from the Lobosa; and though their cytoplasm approximates to that of Reticularia, their ectosarc is much less granular, though not free from granules as stated by Lang.

The majority of Rhizopoda are fresh-water forms, some occurring in the film of water on mosses, among Sphagnum, or about the bases of grass-haulms; many, however, are exclusively marine. The aquatic forms generally may lurk among Confervae or higher weeds, or lie in the bottom of decomposing or excrementitious matter in still or slow-flowing waters. Of these some may become temporarily pelagic, floating up by the formation of gas vacuoles (containing probably CO₂) in the cytoplasm. It is easy to verify this by placing *Arcella* (fig. 1, 7) in a drop of water on a glass cover and inverting this over a glass ring; the *Arcella* sink to the free convex surface of the drop and escape from this most unnatural position by secreting gas-vacuoles; when they float up to contact with the glass cover, so as to touch it by the convex back of the shell, they put forth long pseudopodia which attach themselves to the glass and by their contraction turn the animal over, so that it can crawl over (i.e. under) the glass. *Amoeba* (*Eutamoeba*) *histolytica*, Schaudinn, is the cause of tropical dysentery and hepatic abscess in man. *Pelomyxa* (fig. 1, 5–6) is remarkable for containing symbiotic bacteria. *Zooxanthellae* (symbiotic green cells—Algae or Flagellates) occur in several species; and *Paulinella* contains two sausage-shaped blue-green bodies, "chromatophores," which are probably symbiotic Cyanophyceae. The shell, even when not a simple membrane, has always a continuous inner membrane of a complex nitrogenous substance containing sulphur, allied to keratin and termed pseudochitin. The outer layer when present is composed of little hollow prisms (*Arcella*, fig. 1, 7), sand, or inorganic matter first swallowed by the animal (*Difflugia*, *Pseudodifflugia*), sometimes partially digested (*Lecquereuxia*), or else of plates secreted as "reserve plates" within the cytoplasm of the animal *Cyphoderia* (fig. 6, B), *Quadrula*, *Nebelia*, *Euglypha* (figs. 4, 6, A), &c. In *Quadrula irregularis* alone are the plates said to be calcareous; elsewhere they are always siliceous and simply refractive, so that the silica is probably hydrated (opal). The cement is possibly of silicified pseudochitin. This material is often permeated by a ferric oxide or hydrate, even when it is not coloured rusty brown. Shell formation of the membranous test is by simple surface-excretion; under budding we describe its accomplishment in the aggregated shells.

The "pylome," or aperture for the protrusion of the protoplasm, is usually single. There are two pylomes at opposite poles in several Filosa (*Ditrema*), hence united by some authors into a distinct family (fig. 7, 1, 5, 11), and in the gelatinous theca of *Trichosphaerium* (fig. 5) are numerous permanent pylomic pores. The nucleus is variable in form and character. In *Amoeba binucleata* two nuclei are always present; and some genera are permanently plurinucleate (*Pelomyxa*, *Arcella*, fig. 1, 7). It often gives forth fragments into the cytoplasm, the "chromidia" of R. Hertwig, which, as in Foraminifera (*q.v.*), may play an important part in reproductive processes. The contractile vacuole (there are two in *Arcella*, fig. 1, 7) in actively progressing Rhizopods always discharges at the hinder end. Absent or sluggish in marine forms, it is of constant occurrence in all fresh-water Rhizopods except *Pelomyxa*.

The pseudopods vary greatly in type. In *Amoeba princeps* (fig. 1, 4) they are mere promontory-like extensions of the body; in *A. radiosa* (fig. 1, 1–3) and *Trichosphaerium* (fig. 5) they are distinct slender processes, tapering, and either blunt or finely pointed at the apex; in *Pelomyxa* (fig. 1, 5, 6) as in *A. (Lithamoeba) discus* (fig. 2) they are "eruptive," hemispherical, formed apparently by the rupture of the ectoplasm, and the outpouring of the endoplasm which at once differentiates a clear outer layer as a new ectoplasm; in *Amoeba limax* during