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Volume 17

P TO PLANT QUARANTINE



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P This letter throughout its known history has represented the unvoiced labial stop. It corresponds to Semitic *ʔ* (*pe*), perhaps deriving from an earlier sign for "mouth," Greek *π*, *ϕ*, *ϗ* (*phi*). The rounded form occurs in the early Greek inscriptions from the island of Thera. In the Italic alphabets the form varied strangely. Etruscan had *ϕ* and *ϖ*. The standard form in the Latin alphabet was evidently borrowed from the Etruscan *ϖ*, but the colonial Latin alphabet of the 3rd century B.C. also shows a form *ϗ* resembling the Chalcidic. The Umbrian alphabet had *ϗ*, a form resembling the ancient Semitic. Faliscan had the rounded form *ϗ*; *ϕ*. Oscan lengthened the second small vertical stroke and developed the form *π*.

The minuscule letter resembles the majuscule, the chief difference being that the loop is brought down to the level of the line of writing and the vertical stroke extended below the line. Thus a cursive form of the 6th century was *ṑ*, the uncial form was *ṑ*, the Carolingian *ṑ*.

The English initial *p* is slightly aspirated, that is, it is accompanied by a slight puff of breath, in contrast to the unaspirated *p* of French for example. In English, as in French and German, the letter is used in combination with *h* in words of Greek origin to denote the unvoiced labiodental spirant expressed in other words by the letter *f*; e.g., "philosophy," "phonetics" and "graphic." Initial *p* is silent in the combinations *ps* and *pt* in such Greek-derived words as "psychology" and "pterodactyl."

For the history of sound changes affecting the letter *p*, see GERMANIC LANGUAGES. See also ALPHABET.

(B. F. C. A.; J. W. P.)

PAARL, a town 36 mi. by rail E.N.E. of Cape Town, U. of S. Af., situated about 400 ft. above sea level on the banks of the Berg river, along which it straggles for about 7 mi. To the west are the Paarl mountains; to the east the Drakenstein range. In and around Paarl are gardens, orange groves and vineyards. It is a busy agricultural and industrial centre. Fruit and tobacco cul-

NAME OF FORM	APPROXIMATE DATE	FORM OF LETTER
PHOENICIAN	B.C. 1,200	<i>ʔ</i>
CRETAN	1,100-900	<i>ʔ</i>
THERAEAN	700-600	<i>ʔ</i>
ARCHAIC LATIN	700-500	<i>ϖ</i>
ATTIC	600	<i>ϗ</i>
CORINTHIAN	600	<i>ϗ</i>
CHALCIDIAN	600	<i>ϖ</i>
IONIC	403	<i>ϗ</i>
ROMAN COLONIAL	PRE-CLASSICAL AND CLASSICAL TIMES	<i>ṑ ṑ ṑ</i>
URBAN ROMAN		<i>ṑ ṑ</i>
FALISCAN		<i>ϗ</i>
OSCAN		<i>π π</i>
UMBRIAN		<i>ṑ</i>
CLASSICAL LATIN AND ONWARDS		<i>P</i>

DEVELOPMENT OF LETTER "P" FROM EARLIEST TIMES TO THE PRESENT

tivation is increasing. Wine, brandy, wagons and harness are made. There are several high schools, a training college and an industrial institute. In 1951 the population was 30,036 and con-

sisted of 15,295 mixed, 2,507 natives, 38 Asians and 12,196 Europeans. Paarl was founded in 1687.

PABJANICE, a town of Poland, in the province of Lodz, 10 mi. S.S.W. from Lodz. Pop. (1950) 48,800. It lies amid extensive forests around the headwaters of the Nér, which were the hunting grounds of the Polish kings. It has woolen, cloth and paper mills, and manufactures agricultural implements. German troops took the town in 1939. It was returned to Poland in 1945.

PABNA or **PUBNA**, a municipal town and district in the Rajshahi division of East Pakistan. Pabna (pop., 1951, 32,240) is situated on the Ichhmati river, a dying tributary of the Padma whose erosion of the town was nevertheless a serious problem by the 1950s. It is noted for its Hindu temple of Bengla, built about the middle of the 18th century.

PABNA DISTRICT (area 1,826 sq.mi.) had a population in 1951 of 1,587,247. It lies in the angle between the Brahmaputra, or Jamuna, river in the east and the Ganges, or Padma, in the south-west. It is intersected by countless water channels so that during the rainy season most of the villages are accessible by boat, and many by boat only. The district is a wide alluvial plain, the southwestern portion being higher in level. Fields of rice and jute, the two staple crops, are almost encircled by clumps of trees and bamboos which conceal the village sites.

PACA, a large, heavily built, short-tailed rodent recognized by its spotted fur. This rodent (*Cuniculus paca*), together with one or two other tropical American species, represents a genus akin to the agoutis and included in the family Dasypodidae. Pacas may be distinguished by their heavier and more compact build, the longitudinal rows of light spots on the fur, the five-toed hind feet and the peculiar structure of the skull. Their habits are similar to those of agoutis. Males differ from females in the rough outer surface of their cheekbones.

The paca-rana (*Dinomys branickii*), from the highlands of Peru, differs by its well-developed tail and the arrangement of the spots. See **RODENTIA**.

PACARAIMA, SERRA (Sp. SIERRA PACARAIMA; Eng. PAKARAIMA Mts.), is the tabular upland that surmounts the Guiana highlands along the border between Brazil and Venezuela, and between Brazil and British Guiana. It reaches its highest elevation in Mt. Roraima (9,432 ft.), located where the boundaries of the three countries come together. The Serra Pacaraima extends for about 500 mi. in an east-west direction. None of these surface features, including Mt. Roraima, is properly called a mountain, for the summits are flat or gently rolling; but the steeply cliffed sides make these tabular forms look like mountains as one approaches them on the ground. They are developed on the very thick, flat-lying sandstones of Cretaceous Age that lie over the top of the ancient crystalline rocks of the Guiana highlands. The rivers that rise on the plateau tops pour over the cliffed edges in spectacular waterfalls, such as Kaieteur falls in British Guiana. It was these massive tablelike features, their tops often obscured by clouds, that inspired A. Conan Doyle to write *The Lost World*, an imaginative account of an exploring expedition that found the almost inaccessible heights populated by dinosaurs and other extinct animals. Although the Serra Pacaraima has not been carefully explored, its essential character is known and the border between Venezuela and Brazil has been surveyed. The region is almost uninhabited except by a few tribes of Indians. Although the crystalline rocks of the Guiana highlands contain gold and diamonds, iron ore and other industrial minerals, the cover of sandstones contains no minerals of value. (P. E. J.)

PACATUS DREPANUS, LATINUS (LATINUS) (fl. c. A.D. 390), Gallo-Roman orator and poet, was the author of an extant panegyric addressed to Theodosius I at Rome in A.D. 389 after the defeat of the usurper Maximus. He was a friend of Symmachus, the champion of paganism, and of the Christian poet Ausonius. It is uncertain whether Pacatus was pagan or Christian; in his speech he denounced Maximus' persecution of the Priscillianist heretics.

In A.D. 390 Pacatus received the proconsulship of Africa and later held other high office.

For text see W. Baehrens (ed.), *XII Panegyrici Latini* (1911). See also E. Galletier, *Panegyriques latins*, vol. iii (1955). (W. S. Ms.)

PACHECO, FRANCISCO (1564–1654), Spanish painter and author, whose pictures and writings are equally representative of the Spanish baroque, was born at Sanlúcar de Barmeda, where he was baptized on Nov. 3, 1564. He went early to Seville, where he lived with his cousin, F. Pacheco, a canon whose house was a meeting place of the learned and artistic world of the town. Pacheco studied art under Luis Fernandez. It is not known whether he went abroad, but he greatly admired Italian art and formed a collection of Italian Renaissance drawings. Later he opened an academy, which was largely attended. Of his pupils the most distinguished were Alonzo Cano and Velázquez, who became his son-in-law. His early work is hard and cut out. After a visit in 1611 to Madrid and Toledo, where he met El Greco, he became interested in chiaroscuro. Specimens of his work are in the gallery, the university and the cathedral at Seville. The church of St. Sebastian at Alcala de Guadaira, near Seville, contains one of his most important works. He was a successful portraitist and is said to have executed 150 portraits. Pacheco visited Madrid again in 1623 with Velázquez and stayed until 1625. In his later life he devoted himself to writing. His treatise on the art of painting (*Arte de la pintura* [1649]) is of considerable value for the study of Spanish art.

PACHER, MICHAEL (fl. 1465–1498), German painter and wood carver, executed his chief work, the great altarpiece in the parish church of St. Wolfgang, in Upper Austria, between 1478 and 1481. It is one of the greatest monuments of the late German Gothic period. The centrepiece is an elaborate wood carving representing Christ and Mary with St. Wolfgang and St. Benedict. The wings, two on each side, are painted with scenes from the life of Christ and St. Wolfgang. While the carving is of the Late Gothic style prevalent in Germany at the time, the paintings are influenced by the Italian Renaissance, which penetrated into the Tirol from Verona; they especially show the influence of Mantegna. The figures are plastic, the composition clear and monumental. Other works by Pacher are: the altarpiece (wood carving) in the church of Gries, near Bozen (mod. Bolzano, Italy) (1471); the high altar for the church of St. Francis, in Salzburg, begun in 1484 and left uncompleted; and the altarpiece of the cathedral at Brixen (mod. Bressanone, Italy), representing the fathers of the church, panels of which are in the Munich and Augsburg galleries.

PACHMANN, VLADIMIR VON (1848–1933), Russian pianist known for his performances of Chopin was born at Odessa on July 27, 1848. In 1866 he went to Vienna where he studied under Joseph Dachs. He first appeared as a pianist at Odessa in 1869 and later played in Germany, Austria and France. Though his early concerts were successful he was severely self-critical and withdrew for long periods of study. He first appeared in London in 1882, married his Australian pupil Marguerite Oakley in 1884, and made his first visit to the United States in 1891. Until about 1925 he toured Europe and America as a performer almost exclusively of the works of Chopin which he played in an intimate, miniature style. The informal commentaries he provided on the music in the course of performance were a peculiarity of his concerts. He died in Rome on Jan. 7, 1933.

PACHOMIUS, SAINT (292?–346?), Egyptian monk, founder of Christian cenobitical life, was born, probably in 292, at Esna in Upper Egypt, of heathen parents. He served as a conscript in one of Constantine's campaigns, and on his return became a Christian (314); he at once went to live an eremitical life near Dendera by the Nile, putting himself under the guidance of an aged hermit. After three or four years he was called (by an angel, says the legend) to establish a monastery of cenobites, or monks living in common. (See **MONASTICISM**, § 4.) Pachomius spent his life in organizing and directing the great order he had created, which at his death included nine monasteries with some 3,000 monks and a nunnery. The order was called Tabennesiot, from Tabennisi, near Dendera, the site of the first monastery. Athanasius was his firm friend and visited his monastery c. 330 and later.

The date of his death was probably in 346.

The best modern work on Pachomius is by P. Ladeuze, *Le Céno-*

bitisme pakhomien (1898). There have been differences of opinion in regard to the dates; those given above are Ladeuze's, now commonly accepted. The priority of the Greek *Life of Pachomius* over the Coptic may be said to be established; the historical character and value of this life are now fully recognized. A good analysis of all the literature is supplied in Herzog's *Realencyklopädie* (ed. 3). See also W. E. Crum, *Theological Texts from Coptic papyri* (1913).

PACHUCA, a city of Mexico and capital of the state of Hidalgo, 55 mi. direct and 68 mi. by rail north-northeast of the city of Mexico. Pop. (1950) 58,650. Pachuca's railway connections are provided by the Mexican and the Mexican National.

It stands in a valley of an inland range of the Sierra Madre Oriental, at an elevation over 8,000 ft. above the sea, and in the midst of several very rich mineral districts—Atotonilco el Chico, Capula, Potosí, Real del Monte, Santa Rosa and Tepenén. It is said that some of these silver mines were known to the Indians before the discovery of America. It was there that Bartolomé de Medina discovered the "patio" process of reducing silver ores with quicksilver in 1557, and his old *hacienda de beneficio* is still to be seen. Pachuca was founded in 1534, some time after the mines were discovered. The city has some fine modern edifices, among which are the palace of justice, a scientific and literary institute (now a university), a school of mines and metallurgy, founded in 1877, a meteorological observatory and a public library. Mining is the chief occupation. Electric power is derived from the Regla falls, in the vicinity. The city's industrial establishments include smelting works and a large number of reduction works, including some of the most important metallurgical works in the republic.

PACHYDERMATA, a term often applied to thick-skinned animals, such as the rhinoceros, elephant and hippopotamus. The animals included by it have no close affinities.

PACHYSANDRA, a small genus of the Buxaceae family, comprising four species of herbs or subshrubs of value as ground cover in shade because of their more or less evergreen leaves. *P. procumbens*, native to eastern North America from the mountains of Kentucky to western Florida and Louisiana, is of little value as an ornamental because of the dingy colour and deciduous character of its leaves. *P. terminalis*, from Japan, is a true evergreen with thick glossy foliage, which makes it a very desirable low-growing cover plant, succeeding admirably in full sun or partial shade. The variety *variegata* is a choice cover plant for ornamental effects. (J. M. BL.)

PACIFIC, COMMAND OF THE. The history of modern naval strategy in the Pacific ocean may be said to have begun in 1894, when a victorious Japan eliminated the Chinese navy as a serious factor in the balance of sea power. Three European sovereignties then proceeded to establish bases in the far east, Russia at Port Arthur, Germany at Tsingtao, the naval fortress of Kiaochow on Shantung, and Great Britain at Wei-hai-wei. During this period, the most serious rivalry lay between Russia and Japan, each intent upon the control of Korea, and in 1904–05 the issue was resolved by a war in which Japan eliminated the Russian navy in the far east as completely as it had eliminated the Chinese navy ten years before. Japan was left in undisputed mastery of Asiatic waters from Kamchatka in the north to the Philippine archipelago in the south.

To safeguard its interests in the far east, Great Britain in 1902 concluded an alliance with Japan. The British force on the China station was then reduced to a mere cruiser squadron. While Germany continued to fortify Tsingtao as a refuge for its small Asiatic fleet, it was clear that its forces, whether on land or sea, did not materially affect Japan's supremacy in armaments. The United States kept a few secondary ships of war at Manila in the Philippines, but took no steps to develop the naval resources of this fine harbour. Lying 1,500 mi. to the east of the Philippines in the Marianas group was the island of Guam, like the Philippines a U.S. inheritance from the Spanish-American War of 1898, but despite its position, which invested it with unique strategic value, it was used only as a fuel station.

This situation continued, substantially unchanged, from the year 1905, when the treaty of Portsmouth was signed between Russia and Japan, to the outbreak of World War I in 1914. The

far eastern seas, which had long been the arena of conflicting claims to supremacy, had passed definitely under Japanese dominance. The conquest of Tsingtao early in World War I eliminated the only German stronghold in the Pacific. Domestic convulsions in Russia, by apparently reducing the naval forces of that state to impotence, rendered still more remote the prospect of Vladivostok again becoming the headquarters of a formidable fleet.

Under the treaty of Versailles, the former German islands north of the equator passed as mandates into the custody of Japan, while those south of the equator were assigned to members of the British Commonwealth. Japan now exercised mandatory powers over several island groups situated far out in the Pacific. Strategically, its most important acquisitions were the Peleliu Islands (500 mi. east of the Philippines); the Carolines; the Mariana Islands, except Guam; and the Marshall group, lying about 1,700 mi. to the southwest of Hawaii. It was believed that light naval vessels, aircraft and submarines, judiciously distributed among these islands, would represent a serious menace to a hostile force advancing toward Japan from the east. Fortification of these islands and their use for warlike purposes was, however, forbidden under the League of Nations mandate.

Under the Washington Treaty of 1922 the British empire, the U.S., and Japan agreed to limit naval building under the terms of the five-five-three ratio, and to maintain the *status quo* regarding fortifications and naval bases in a number of highly important strategic positions. The U.S. pledged itself not to improve the shore defenses or naval works in the Philippines, Guam or the Aleutian Islands; Japan accepted the like obligation in regard to the Bonin Islands, Formosa and other insular possessions; while the British empire was debarred from adding to the naval resources of Hong Kong.

The Hawaiian Islands were exempted, and Oahu became the pivoting centre of a fleet charged with the task of defending not only the western seaboard of the U.S. but also the outlying territories of Alaska, the Philippines and Samoa.

Singapore, likewise, was exempted from the agreement, and became the southern base of the British China squadron. During the 1930s it was developed into a Pacific naval base second only to Pearl Harbor in Oahu. The bulk of the British fleet was, however, kept in Atlantic waters, and it was never assumed that this fleet would be able during a general European war to exercise in the far east an influence at all commensurate with that of either the U.S. or Japan.

Between World Wars I and II the major determinants of the strategic situation in the Pacific were the Japanese and U.S. fleets. The Panama canal enabled the U.S. to operate its fleet in two oceans, the Atlantic and Pacific, and it was to the Pacific that it devoted its main naval developments. But since at that time any fleet was presumed to be limited to a narrow radius of action, determined by the relatively meagre fuel capacity of its larger ships, it could not be said that any one power, or group of powers, had achieved control of the vast Pacific. It remained for World War II to show whether Japan could challenge the undisputed control of the U.S. in the eastern Pacific, and the more dubious control of the British empire in the southwest Pacific waters, or whether the U.S. could invade the waters surrounding Japan.

As long as Great Britain and the U.S. chose not to interfere actively in the Japanese conquest of Manchuria and China, which began in 1931, Japanese sea power remained unchallenged. The opening of World War II saw the major portion of the British navy committed to keeping open the sea lanes of the Atlantic and Mediterranean. Ever-increasing losses to submarines and aeroplanes and finally the grave threat of a German invasion of the British homeland left no margin for anything but a skeletal naval force in the far east.

By 1941 substantial U.S. naval forces were being transferred to the Atlantic to support the endangered British position there. It was at this time that Japan chose to extend its conquests to southeast Asia. Since the U.S. battle fleet was the only concentrated and readily available force which could oppose such conquest, it was this battle fleet at which Japan struck first.

The attack on Pearl Harbor on Dec. 7, 1941, temporarily destroyed the offensive striking power of the U.S. in the Pacific. Three days later the British capital ships "Repulse" and "Prince of Wales," which had arrived at Singapore only the preceding week, were sunk at sea.

There then followed the most gigantic demonstration of sea-borne invasion that the world had ever seen. By the time Japan had conquered Singapore and the smaller bases in the Philippines, the East Indies and Melanesia, its control of the western Pacific was complete, and it was even threatening communications with Australia and India.

The pattern of Japanese conquest was a centrifugal one, a moving outward from a centre toward a periphery. This gave Japan the advantage of interior lines, with Japanese forces always disposed between the major concentrations of the forces opposing it and thereby able, so long as it held the initiative, to threaten two or more widely removed points simultaneously while concentrating mainly against one. But this advantage contained in itself the seeds of its own dissolution. However far the surge of Nipponese conquest might reach, always beyond its periphery were uncommanded seas over which Japan's enemies were bound ultimately to bring the full pressure of their vastly superior strength. Japan was isolated from its allies and surrounded by a hostile world.

The strategic problems of the Pacific war were in many respects without precedent in naval history. Never before had a war been fought by two great naval powers whose main sources of strength were on opposite sides of a wide ocean, in this case the widest ocean of all. Domination of the Atlantic, at least as far as surface ships were concerned, could be exercised from British bases against a European enemy by control of the exits to the North sea, the Mediterranean, and the waters off the coast of France. But in the Pacific no one area would if dominated automatically give command of the whole. And for the first year of the war neither side had the resources to assert supremacy in all the areas which might at any moment become critical.

Before World War II, it had become axiomatic that the first step in acquiring command in a disputed maritime area was to maintain there a force capable of dealing with the largest single force which the enemy could bring to bear. This usually meant concentration of one's major ships into a unified battle fleet. This idea, which was basic to the whole principle of command of the sea, was rejected as outmoded by both sides in the first year of the Pacific war. Both sides divided their fleets into separate formations or "task forces," each of which was considered an independent tactical unit. The task force system provided a means of covering widely separated areas simultaneously and of rotating units of strength in those areas which were especially important at the time but where it was impossible to maintain a fleet continuously. And at a time when enemy land-based air attack was a threat of profoundly disturbing proportions, the task force system offered a means of accomplishing one's ends without exposing to such attack any more ships than were absolutely necessary for the execution of the mission.

The task force principle was not wholly new, for in all great naval wars squadrons had been detached from fleets for independent missions. What was new was a dissolution of the fleet so complete as to enable a senior naval officer testifying before a U.S. congressional committee as late as the summer of 1943 to declare: "The fleet as such has ceased to exist!"

The Guadalcanal campaign illustrated both the operation of the task force principle and its limitations. The convoy which made the initial U.S. landing on Aug. 7, 1942, was covered by a sizeable force, including three aircraft carriers, one modern battleship and several heavy cruisers. But the carrier group and the battleship were shortly withdrawn because of fear of Japanese land-based air attack. On the night of Aug. 7-8, a Japanese surface force inflicted heavy damages on the remaining cruisers and destroyers in the battle of Savo Island, a blow that was second only to Pearl Harbor in its severity.

In the naval engagements which followed both sides suffered losses, but the U.S. surface forces were able, because of aid from

the land-based aircraft operating from Henderson field, to exercise a continuity of influence out of all proportion to the time they actually spent in the disputed waters. Nevertheless, real naval command was never established by either side. Both sides continued to send more men and supplies into Guadalcanal, and the U.S. eventually won the campaign at sea, thereby making possible victory ashore, only by superior fighting and staying power in a simple contest of attrition. Considering their own limited replacement facilities, the Japanese could not continue expending major ships for the defense of one remote island. But the cost to the U.S. was not light, and had it begun the campaign with all the forces dispatched to the area before it ended, it should have won the victory more speedily and with less cost.

The only conclusion to the chain of matching big by bigger, which was a consequence of the task force strategy, was a show-down match of maximum strength. But after the Guadalcanal campaign the Japanese showed increasing unwillingness to offer their surface ships for action. By the end of 1943, they withdrew the bulk of their fleet to home waters, where it was obviously being held in reserve for some decisive issue. Their disinclination to fight was due simply to the fact that they had become grossly inferior. The vast ship construction and armament production programs in the U.S. were making available ships, planes and weapons in unprecedented volume. And the Japanese had to be content to impede U.S. advances in the Solomons and the Aleutians as best they could with aircraft, submarines and occasional light surface forces—besides their land garrisons, which being isolated were considered expendable.

The descent of U.S. naval forces upon the Gilbert Islands in Nov. 1943 marked a revolution in U.S. naval strategy. For the first time in the Pacific war, the U.S. began an operation with a task force which was really an entire battle fleet, one capable of engaging and defeating the whole Japanese fleet. Moreover, the fleet remained off the shores of Tarawa and Makin, day and night, until the conquest of these islands was accomplished—which, in contrast to the six-months' fight for Guadalcanal, required only a few days. Such was to be the pattern of all future U.S. invasions—from the Marshalls to Okinawa. The establishment of the "fleet train," a tremendous auxiliary force of tankers and other supply ships, permitted the battle fleet to remain at sea for prolonged periods, and enormously extended its radius of operations. And with each new operation the fleet grew steadily larger. The principle of achieving and retaining decided command round any land area chosen for invasion replaced the attrition tactics which had won so costly and tardy a victory at Guadalcanal.

The revolution in United States strategy resulted from three factors: first, the great accretion in its ship and plane strength; second, a return in naval thinking to the classic principles of Alfred T. Mahan; and third, a tactical revolution in U.S. aerial offense and defense. The last factor consisted in the use of aircraft carriers for the first time in large concentrations, and the building up on the decks and superstructures of the ships a stupendous anti-aircraft shield comprising guns and directors of marvelous accuracy and novel projectiles of almost miraculous performance.

By using carriers in large groups, the U.S. navy incorporated within itself the only truly mobile air force of any size in the world. This force enjoyed all the peculiar advantages of mobility, such as ability to concentrate and to achieve surprise. Japanese ability, on the other hand, to combine or co-ordinate separate groups of land based aircraft depended on forewarning and on the distance between the stationary airfields.

The most striking single result of the great growth in the aerial offensive and defensive strength of the U.S. navy was the restoration to this navy of all its old freedom of movement. By the end of 1943 it enjoyed a decisive surface superiority over the Japanese fleet, and it roved in Japanese waters with all the insouciance which superior fleets had been wont to display in days long past. It exhibited a freedom of action among Japanese-held archipelagoes which many had predicted would never again characterize the movements of ships.

Following U.S. occupation of the Gilbert Islands, the Marshalls,

the Carolines, the Marianas and the Palau were assaulted, and many key islands captured, with almost total absence of loss or even damage to U.S. surface units. The taking of Guam and Saipan in the Marianas in June 1944 provoked the Japanese to the first major fleet action after Guadalcanal, and their fleet carrier strength was there severely crippled.

When the U.S. fleet moved into the Ryukyu-Formosa-Philippine area, it was for the first time in the war assaulting what was in effect a large land mass which, because of its position, was the key to the whole Japanese strategic system. Because of the qualitative superiority of U.S. carrier planes over Japanese land-based planes, and because of the capacity of U.S. planes to make themselves numerically superior at the point of attack, most of the Japanese land-based planes in this area were neutralized before U.S. landings in the Philippines.

Capture of the Philippines by the U.S. could mean only that that country would have a great staging base for future operations against Japan itself, and also the means of severing Japanese communications with all the lands between the Bay of Bengal and the Solomon sea. A more critical strategic situation for Japan could not arise unless the Japanese home islands themselves were being invaded. The Japanese fleet, therefore, moved in for the decisive fight, the battle for Leyte gulf. There its fighting strength was approximately halved, and the half which escaped did so in a very bad state of repair. U.S. losses were slight. The career of Japan as a major sea power was definitely ended, and the whole of the Pacific, with the exception of part of the home waters of Japan itself, could be regarded as a United Nations sea. The struggle for command had been decided.

The last great challenge of the Japanese to the U.S. fleet was the *Kamikaze* assault at Okinawa. In capturing this island the U.S. lost to the Japanese suicide squadrons 30 U.S. warships, and saw damage to an additional 223. The casualties in men comprised about one-seventh of the navy's total for the entire war. But heavy as was this damage, it did not begin to compensate for the estimated 2,500 Japanese planes lost during the assault. No major U.S. ship was sunk, and there was no question of which side could better absorb the blows inflicted upon it. Japanese recognition of the failure of the *Kamikaze* no doubt helped to assure their surrender within a very few months.

The close of World War II left the U.S. indisputably the master of the entire Pacific. Its navy, by this time far the greatest in the world, could see in that wide ocean no rival to oppose it. New air and ship bases had been won in the formerly Japanese-held islands, and the U.S. was plainly determined to keep them for its security, whether under United Nations organization trusteeship or otherwise.

However, this unparalleled dominance in the Pacific was no sooner won by the United States than it seemed to belong to an era that had vanished. The atomic bomb, which had helped bring World War II to a close, cast into considerable doubt the real meaning for the future of old-style naval command. The emergence of the Soviet power as the centre of an empire hostile to the United States and the latter's weakened allies in western Europe coincided with the beginning of a race in nuclear weapons which was soon to produce vast capabilities for destruction on either side. It began to appear increasingly that in an unrestricted war between the two major power blocs in the future, the affairs of the Pacific would be governed, and very quickly determined, by events taking place elsewhere.

In that context even the loss of China to the Communist camp, which was effectively completed in the summer of 1949, and the somewhat artificial alliance between the United States and its erstwhile enemy, Japan, had—in marked contrast to what such political shifts would have meant a decade or more earlier—relatively little strategic meaning. On the other hand, the Korean war of 1950–53 proved that so long as the major powers on both sides remained anxious to keep their military contests limited in scope and in location, the unchallenged naval power of the United States gave it complete access to any littoral area in the Pacific in which it might choose to intervene.

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B. Brodie, *A Guide to Naval Strategy* (1944) are useful in themselves and also contain bibliographies of other books in the field. The literature on the military operations in the Pacific is voluminous and is steadily growing, but one should consult the relevant volumes of Samuel Eliot Morison's official *History of United States Naval Operations in World War II* (1947–); and the U.S. Air Force, Office of Air Force History's *The Army Air Forces in World War II* (1948–).

(B. BE.)

PACIFIC, WAR OF THE (1879–1884), a conflict that grew out of a dispute between Chile and Bolivia over control of a part of the Atacama desert lying between the 23rd and 26th parallels on the Pacific coast of South America, a territory that contained valuable mineral resources, particularly sodium nitrate. Peru became embroiled in the war when, after an offer to mediate was rejected by Chile, a secret Bolivian-Peruvian treaty of alliance was revealed. In the opening phases of the war the Peruvian navy was destroyed by Chile, which then invaded Peru and captured several of its provinces and the capital city of Lima.

An effort by the United States at mediation failed in 1880, and although the last engagement took place in 1882 it was not until 1883 that Chile and Peru negotiated a treaty by which Peru made numerous concessions. The following year a truce was concluded between Chile and Bolivia by which the latter country lost its entire coastline.

PACIFIC ISLANDS. The Pacific islands are scattered largely in the southwest and west of an ocean twice as big as the Atlantic and more than 20 times as large as the United States. The word "Oceania" is popularly used to define loosely the ocean area and the islands of the southwest Pacific. Some of the innumerable islands are large land masses, separated in an earlier geologic age from the nearby continents. Borneo, Sumatra and Java were once part of Asia. New Guinea was cut off more recently from Australia. Elsewhere are isolated islands or island groups erupted from the ocean bottom by volcanoes; some of them are in chains 1,000 mi. or more in length; many islands owe their existence in part to the tiny animals that build coral reefs. From New Guinea north to the mainland of Asia, the floor of the Pacific reveals contours more varied and rugged than any on the land. It is pocked with mountains the tops of many of which are islands; other peaks are still below the surface; the bottom is incised by deep trenches. The two deepest abysses are the Philippine trench (Mindanao deep), 34,583 ft., and the Marianas trench, 35,800 ft. (by descent) or 35,958 ft. (by sounding). Other deeps include the Japan trench, the Bonin trench and the Ryukyu trench.

PHYSICAL STRUCTURE AND CHARACTERISTICS

Structurally, the Pacific may be divided into a large eastern and a smaller western part. The eastern part, the area that lies east of a line running north from New Zealand through the Tonga Islands, is an ancient undisturbed basin. All the islands in this basin, from Samoa to Hawaii and eastward across the ocean to the Galápagos and Juan Fernandez, are composed of volcanic materials that have been forced up through fissures or cracks in the earth's crust. The tops of some of them have emerged from the ocean relatively recently.

The islands of the western basin have a much more complicated structure and history, representing the exposed crests of upfolds of the earth's crust lying in a series of long arcs. One of these folds sweeps southeastward from New Guinea to the Solomon, Fiji and Tonga Islands, New Caledonia, and, perhaps, New Zealand. Another set of at least two parallel folds begins in Burma and can be traced through Sumatra and Java to the Moluccas, and possibly to the Philippines and the Palau. The successive upfolds are separated from one another by the deep trenches or downfolds. Their origin, with the exception of New Zealand, seems to be relatively recent, geologically speaking. They represent part of mountain-building earth movements dating back not more than a few tens of millions of years.

Scientists have made many suggestions about the origin of the Pacific arcs and trenches, but so far no one theory has been fully acceptable. However, there is no longer any doubt that the earth's crust just beneath the main Pacific basin is different from the uppermost crust of the rest of the globe. The boundary

roughly marking off this difference is the so-called "andesite line" or "Marshall line," the latter named after Patrick Marshall of New Zealand. Granite, an "acid" type of rock, is not known in the Pacific floor, yet everywhere else that man or his instruments get a deep look at the crustal rocks of the earth, there is evidence of granite in the topmost several miles of crust, whether dealing with continents or other ocean basins. In terms of rock composition, the material on the continental side of the line, that is in the continents and islands surrounding the Pacific basin, is more andesitic than the rocks in the region enclosed by the "andesite line." Basalt, a basic type of rock, is common in the Pacific basin.

Because ocean deeps in the Pacific follow fairly closely the andesite line where it is known, many earth scientists have come to think of these trenches as setting off the continental blocks from the oceanic block. Seismologists have evidence that the so-called "Mohorovicic" discontinuity (a zone beneath which longitudinal seismic waves are able to travel more swiftly) is 20 to 30 mi. down beneath continental blocks, but only a few miles beneath the Pacific floor. This is not an unexpected phenomenon where the granite layers appear to be missing. Between the ocean bottom and the Mohorovicic discontinuity in the Pacific lie sediments and basaltic rocks.

When we approach the island arcs from the Pacific side, in most cases we encounter first an ocean deep or trench. According to seismic soundings by the expedition of the Scripps Institution of Oceanography, La Jolla, Calif., in 1953, the deeps contain a large accumulation of a sedimentary type of rock which seems to extend 10–20 km. (6–12 mi.) deeper than in the surrounding area, on both sides. Consequently gravity is much lower over the trenches than on both sides:—a "negative gravity anomaly."

In the western part of the Pacific ocean, a belt of volcanic activity begins in New Zealand, at the south, and continues through the New Hebrides, the Solomons, the Bismarck archipelago and the islands north of New Guinea. A second line of active volcanoes starts at Sumatra in the west and runs through Java, and the Lesser Sunda Islands, turns northward in the northern Moluccas and extends through the Philippines, finally reaching the Japanese islands, the Aleutian arc in the North Pacific, and Alaska.

The belts of volcanic activity, following the upfolds, are sharply defined. They coincide also to a large extent with one of the heavier earthquake zones in the world. The earthquake zone, however, is more extensive than that of the volcanoes, and includes New Guinea and other areas of recent active mountain building.

Most of these earthquake belts, which account for about 80% of all earthquakes in the world, are not more than 100 km. (60 mi.) wide. The negative gravity anomaly decreases from the deeps toward the continent, and near the continent gravity is too high relative to the average. In the zones of high gravity are situated most of the recently active volcanoes and also belts of earthquake shocks at a depth of about 100 km. Inland from recent and presently active volcanoes there is a considerable number of older, extinct volcanoes, where the earthquake focuses descend to a depth of about 200 km. (120 mi.). The seismic activity indicates that relatively strong tectonic processes are continuing in these belts. In some Pacific arcs, as one goes inland, seismic activity descends to greater depths. Only one shock (in Spain) below 300 km. (200 mi.) has been observed anywhere on earth except inland of these belts. The maximum depth at which a shock has been observed is about 720 km. (450 mi.).

At the meeting of the American Geophysical union in 1953, the whole problem of the structure of the Pacific was discussed, but there was no agreement on details. Conclusions drawn from several theories regarding the arcs and deeps were not confirmed by observations. However, all such observations were in an early stage in the 1950s and were far too few to warrant any definite conclusions.

Under a geological classification, Pacific islands comprise two types—continental and oceanic. Continental islands are those that rise from the continental shelves and actually form parts of the continents, separated from them only by shallow water. Most of them are mountainous. Oceanic islands are those that rise from the bed of the ocean and are separated from the continents

by great depths of water; some are only a few score miles from continental lands, others several thousand miles away. Some oceanic islands are high and rugged; many are coral atolls. Coral atolls conform to a well defined type, namely a roughly circular or horseshoe-shaped fringe of low islets about a central lagoon. Some lagoons are accessible by passages from the sea; others are completely enclosed by reefs. Lagoons are from about 3 fathoms to 30 fathoms deep, studded with coral patches, some of which rise nearly to the surface; their floors are normally growing coral or coral sand. In contrast to the quiet wavelets of lagoon beaches, a heavy surf breaks on the ocean side of the atoll. Fragments of dead coral, forced above sea level by the action of tide, wind and wave, form land surfaces, many of which are only a few feet high.

(B. GG.; J. W. CR.)

Corals.—Among the more characteristic features of the Pacific islands are the coral reefs which form the bases of the low islands and which more or less completely girdle each of the high islands. Although a constant menace to navigation, they are the *raison d'être* of the low islands and the defenses of the high islands against wave attack. The reefs are solid masses of organic limestone—flattopped, and steep to seaward, extending from low tide level to considerable depths. There are many controversial problems connected with their development, especially that of the ring-shaped atolls. They represent accumulations of the calcareous skeletons secreted by the life processes of shallow-water marine organisms, principally reef-building corals, calcareous algae, and subordinate animals such as Foraminifera, mollusks, echinoderms, etc. Not all the organic limestone developed by reef organisms, however, goes into the construction of reefs. Loose material is carried by waves across the more or less even surface of reef flats and either heaped up on the flat here and there to form low islands and banks, especially during storms, or carried on beyond the flat and dumped into the lagoon behind the reef.

Most of the Pacific island reefs are covered on their seaward, windward margins by luxuriant growths of red calcareous algae, which can grow and maintain themselves in the very teeth of the breakers where corals are less able to survive. But down the seaward slope and behind the algal ridge, reef corals abound and contribute largely to the growth of the reefs. The thickets and heads of corals and the sandy bottom or rocky pavement between them give shelter to a vast variety of brilliantly coloured animals particularly adapted to the reef environment: fish; mollusks, including giant clams, oysters, gastropods, octopods; echinoderms, as starfish, sea urchins and crinoids; crabs, crayfish and other arthropods; bryozoans, sponges and other forms. The reefs of each island constitute a self-contained and slowly-expanding marine community whose ultimate nourishment comes from the plankton of the surrounding sea.

Corals are essentially sea anemones with the power of forming limy skeletons of great size and strength. They form one division of the Coelenterata, which also includes hydroids, jellyfish, sea fans, and soft corals, and are known to most persons in the form of bleached masses of a wide variety of shapes. Living corals are richly coloured in shades of brown, yellow, green, violet and gray, but the skeletons of most of them are white. The vast majority of corals on coral reefs are colonial in habit; that is, each mass of coral consists of a number, often running into hundreds of thousands, of individual coral polyps secreting a common skeleton and multiplying by incomplete division. Colonies are established as the result of the settling to the bottom of free-swimming, skeletonless, larvae, produced by sexual means. Soon after settling, the skeleton begins to develop and continues to be secreted as long as the founder polyp and its asexual offspring live. Some colonies are hundreds of years old. The rate of growth of colonies naturally varies from one species to another, but it averages about an inch per year. However, the accumulation of limestone from corals and other reef-building organisms on a reef site is probably less than one-half inch per year, and reefs grow very slowly, but steadily.

The conditions under which reef corals live are unique to the shallower parts of the tropical seas where the average annual water temperature is not less than 70° F. In the Pacific islands, the sur-

face water temperature is about 80° F. and reef corals flourish wherever other conditions are suitable. They shun muddy water and water diluted by influxes of fresh water, as around the mouths of rivers. They can live down to a maximum depth of about 150 ft., but actually most are found in the well-lighted waters less than 25 ft. deep. The reef coral polyps themselves are insensitive to light, but their endodermal tissues contain myriads of microscopic one-celled algae (zooxanthellae). The corals and these symbiotic algae, the latter living only in the presence of strong light, have become mutually interdependent, and the corals rely on the algae to absorb their waste products. Without this self-contained disposal system, the number of polyps that could live on a reef tract would be very much smaller, and great colonies, the mainstay of the reefs, would be impossible. (J. W. W.)

Climate.—The great majority of the Pacific islands lie within the tropics, but, because of their various altitudes, all kinds of climate from tropical heat at sea level to polar cold in high altitudes are found.

There are the steaming jungles of Guadalcanal, the snowy windswept reaches of high New Guinea, and the balmy climate of Hawaii and other mid-ocean islands. At and near the equator, at sea level, the temperature remains about the same throughout the year, but everywhere else there are definite seasons of heat and less heat. On both sides of the equator, for a distance of about 20° varying with the position of the sun, is an equatorward flow of air, known as the trade winds. Those north of the equator always blow from the northeast and those south of the equator from the southeast. In the western part of the Pacific the heat and cold of the huge land mass of Asia causes the trade winds to be replaced by alternating seasonal winds known as monsoons. A belt of very light winds, or, in some islands, an upward current of air (convictional current), lies between the northeast and southeast trade-wind belts. Known as the doldrums, its position also shifts with that of the sun during the course of the year.

Rainfall is the most variable factor in the climate; there is great variation from year to year, from month to month, and from day to day. On high islands the windward sides receive a heavy rainfall from 60 to 100 in., whereas the leeward sides are comparatively dry. Atolls receive much less rain than high islands, for rain-bearing winds blow over them without losing much, if any, of their moisture; in a year of drought the precipitation is sometimes as low as 5 or 6 in.

An important exception to the genial climate must be noted: the even weather is occasionally interrupted by tropical cyclones which are also known as hurricanes or typhoons according to their place of origin. These terrific wind- and rainstorms, generally occurring at the season of greatest heat, leave ruin in their wake. Tropical cyclones in the Pacific ocean are restricted to three fairly well defined areas. One is in the eastern Pacific, north of the equator, off the Central American and Mexican coasts. A second area is in the western North Pacific, in and near the China sea. In the western South Pacific, where most of the islands lie, the tropical cyclone belt is extensive, stretching from Australia eastward nearly half the width of the ocean, between latitudes 10° and 30° south.

The Pacific, like the other oceans, has its own system of currents. There is a movement of surface water toward the equator on the American side, and a movement largely away from the equator on the Asiatic side. One result of this is that tropical waters are squeezed into a narrow belt near the Americas, but are spread out widely in the western Pacific.

A number of complicated forces, acting together, cause a variety of tidal patterns among Pacific islands. But on all of them, the range between high and low water is usually very small compared with tidal ranges along continental shores.

The stars have been important factors in the lives of people of Pacific islands from time immemorial. Sailing south, after leaving the equator, the Southern Triangle and the Magellanic clouds lift higher and higher every night, as the North Star vanishes wholly from sight, and the Dipper sinks closer to the northern horizon. The Southern Cross comes into view—that constellation which throughout all history for the people who live “down under,” has

been the guiding symbol. In the darkness of the open ocean, the ancestors of modern Pacific islanders made thousands of voyages in open canoes without compass or sextant, steering by the stars over widespread distances from one island to another.

Flora and Fauna.—To explain the presence and the distribution of plants and animals in the islands of the Pacific ocean, the islands may be thought of both in relation to their geological history and also in relation to their geographical positions. Continental islands were connected with their respective continents during the last ice age, which ended about 30,000 years ago. In those times such an immense volume of water from the oceans was frozen in the polar icecaps that the ocean level is estimated to have been some 300 ft. lower than it is today. The direct effects of this reduction of sea level were to reunite many of the continental islands to their parent continents and to make some of the oceanic islands appreciably larger.

Perhaps the most remarkable characteristic of the flora and fauna of the islands is the great difference of so many of the plants and animals, including birds, from those living on the continents. Islands have acted as places of refuge for many species threatened with extinction and later wiped out by nature on the mainland. As one proceeds eastward from the western borders of the Pacific, plant and animal life become more and more restricted both in genera and species. (J. W. Cr.)

Land Flora.—The plant cover of the Pacific islands varies from rain forest to grassland and desert, depending on geographic and topographic situations, and also on the history of human occupation. The parts of the area that are within the trade-wind zones have a characteristic pattern of rain forest on the windward sides of the islands and sclerophyllous forest, grassland, scrub, or even desert in the rainshadow on the lee slopes; on some islands there are areas of luxuriant vegetation on dry slopes resulting from convection rainfall. The upper belts and crests of islands of moderately high altitude in this zone are usually covered with a cloud forest or mossy forest of small trees and dense undergrowth, conspicuously clothed with epiphytic mosses, hepatics, ferns and orchids. Rarely, on these summits, there are bogs and moorlike areas of dwarfed vegetation, underlain by peat. The higher mountains, as in Hawaii, protrude above the belt of effective orographic precipitation and have their upper slopes covered by xerophytic scrub and very sparse dwarfed alpine vegetation. Typical halophytic strand vegetation lines the coasts, with mangrove swamps common in the western islands, becoming rarer eastward, and altogether absent east of Samoa except where they have resulted from man's activity, for example, in the Hawaiian Islands. The low coral islands and atolls are clothed with strand vegetation except in the interiors of the larger and wetter ones where there are broad-leaved, mesophytic forest types. Very dry islands in the doldrums and other areas of calms have sparse herbaceous vegetation or open grasslands. In the western Pacific, where the influence of the monsoons is felt, the clear pattern of a wet windward side and a dry leeward side on each island becomes obscure, and the islands are generally covered by moderately luxuriant forests, most of which are not wet enough to be classified as true rain forests. Extensive savannas are found on some of these western islands, characterized by coarse grasses and scattered shrubs and trees. The origin of these is not clear, but may be in large part due to a long history of clearing and repeated burning by the native inhabitants.

Man's activities, beginning with the aborigines, but greatly accelerated since the coming of Europeans, have profoundly changed the vegetation of almost all the islands. Great areas have been cleared and converted to plantations, principally coconuts, breadfruit, sugar cane and pineapples. Clearing and burning resulted in the creation and extension of savannas and in the replacement of large areas of primary forest, rain forest and moist to dry forest, by secondary forest of various sorts including *Prosopis*, guava thicket, and, probably, the *Aleurites* in the Hawaiian Islands, *Hibiscus* forest in many islands, and mixed secondary forest of many widespread weedy trees in the western Pacific islands. *Lantana*, *Acacia*, *Leucaena*, and other weedy shrubs, as well as cacti, introduced into many islands, have become so abundant, especially

after disturbance by hoofed animals and fire, as to change, completely, the landscape.

The flora of the islands in general is essentially an attenuated Indo-Malayan one, possibly with New Guinea as the main centre of distribution. Outstanding centres of local development occur in New Caledonia, the Hawaiian Islands, and in New Zealand. The majority of the genera represented are those with a large number of species in the Malaysian region. Their number rapidly decreases eastward except where there have been centres of secondary development of local species on some of the higher island groups. Strong representations of Australian and New Zealand genera are also found, with a few American and boreal ones, and a number that are endemic in the islands, some of whose geographic affinities are not at all clear. The number of native species is generally not large, and it decreases from west to east and from higher islands to lower ones. (F. R. F.)

Marine Flora.—The marine flora of the Pacific islands is almost entirely an algal flora. Very small amounts of *Thalassia* and *Halophila*, the only flowering marine plants seen in the islands, play an insignificant role in their economy. In the Gilbert Islands *Thalassia* is a food of the turtles. Fungi in marine environments of the tropical Pacific are almost unknown. There are no truly marine ferns. No marine bryophytes are known. All the algal phylla are reported from the Pacific with the exception of the Chloromonadophyta.

The algae of the Pacific islands may be grouped into two categories according to their roles—physical and physiological. Red algae (Rhodophyta), mostly of the genus *Porolithon*, are apparently largely responsible for the development of, or for controlling the development of, atolls and reefs through their contributions—largely limestones, and through binding detrital solid materials from other sources. The lagoons of atolls gradually become filled, mostly with branch segments of *Halimeda* (Chlorophyta), but also with fragments of other calcareous algae and animals such as those found on the reef. Fragmentary reef materials accumulate on the flat reef surface as sand behind boulders and as sand bars. These topographic features are ephemeral unless bound together, for example, by the filaments and gelatinous masses of blue-green algae. By binding sand they cause the growth of islands on reef surfaces. They apparently contribute both to the formation and also to the removal of conglomerate rocks of an island above low water mark through effecting changes in the solubility of carbonates and promotion of rasping by snails.

When an island remains above high tide long enough, there are two major limitations to the development of a terrestrial biota. These are a fresh-water supply and a source of available nitrogen. The first of these limiting factors is removed by an increase in the size of the island and the lowered permeability of the shore area where island conglomerates form. Under these circumstances, when it rains, the formation of a “Ghybent-Herzberg” fresh-water lens results.

The blue-green algae play several physiological roles, one of the major of which is that of providing a source of available nitrogen. The soil of many atolls consists of a layer of coral fragments about a foot deep, coated above largely with blue-green algae. The roots of plants appear in and among the white to buff sandy material forming deeper layers of the island mass. In view of the absence of ordinary humus, and the fact that there is a high degree of aeration, the blue-green algae may well provide the essentials of humus as exocrine or decayed material.

In addition to the above roles, algae provide the food on which both the oceanic and reef fishes depend. It has been estimated that it takes at least 10,000 lb. of algal plankton to produce 1 lb. of tuna. Some fish (Scaridae) eat even the stonelike calcareous algae directly from the reef where they grow; others habitually feed on noncalcareous algae. (M. S. Dy.)

Mollusks.—The mollusks of the Pacific islands are particularly interesting in that they are represented by a wider assortment of species and have many unusual patterns of distribution. Each of the three major ecological groups—land, fresh-water and marine—has its distinctive families with their special modes of dispersal, unique habits and peculiar modes of living.

The shell-strewn beaches of the tropical Pacific islands are indicative of the comparative richness of the marine fauna. The great Indo-Pacific region, stretching from the eastern shores of Africa, through the Indian ocean and on eastward to Polynesia, is the largest and most diversified marine faunal region in the world. The southwestern Pacific islands constitute a particularly rich sub-region of the Indo-Pacific. While many shells, such as the money cowrie, (*Cypraea moneta*), are found from the Red sea to Easter Island, and northward to the Hawaiian chain and Japan, a number of species are either endemic to or flourish especially in Oceania. It is estimated that there are about 4,000 species of marine mollusks in the Pacific islands. A number of subspecies and a few species are endemic to the Hawaiian (volcanic) chain of islands and others to nonvolcanic atolls of Polynesia and Micronesia.

Among the larger and more attractive gastropod or snail-like shells that are well represented in the subregion of Oceania are the cone shells (*Conus*), the cowries (*Cypraea*), the marlinspikes (*Terebra*) and the spider conchs (*Lambis*). There are more than 100 kinds of cone shells in the Pacific islands, some of which live in sand, others in muddy bays, a few on rocky, coral shelves and others in deep, offshore water. Five species of cones, very venomous, are known to have inflicted fatal stings on human beings. Most other snails are not only harmless but edible and highly nutritious.

The golden cowrie, a bright-orange shell four inches long of glossy, enamel finish is highly prized as an adornment by the natives of the Fijian and the Solomon Islands. This species occurs as far west as the Philippines. The green turban (*Turbo marmoratus*) is fished in the southwestern sections of Melanesia and Australia for the manufacture of pearl buttons. Of the sea clams the *Tridacna* and bear's-paw (*Hippopus*) are best known among the reef dwellers, although they do not reach as great a size as do specimens in northern Australia and the East Indies. The heart clams (*Trachycardium*), the sunset clams (*Tellina* and *Asaphis*) and the tiger lucinas (*Codakia*) are probably the commonest bivalves.

The land-snail fauna of the Pacific islands is very extensive and, for the most part, specialized into many isolated and endemic species. Most kinds are small, insignificant-looking; some of them live under fallen leaves, others in humus in the forests. *Partula*, *Achatinella*, and a few other highly coloured groups are arboreal in habit. The land-snails may be divided into two groups: those living on low islands and on the shores of high islands, and those inhabiting the forests of high, volcanic islands. Many of the first group have a wide distribution suggesting dispersal by human or other adventitious agencies. Hurricanes are often very destructive, especially to those near the sea; their occurrence may be among the more important reasons for the usual absence of endemic species on the lower islands. It is possible, however, that hurricanes assist in their dispersal.

The mid-Pacific islands are unique in lacking the groups that constitute the bulk of all known continental land-snail fauna since the Eocene—the Helicidae, slugs, carnivorous snails and operculate Cyclophorid snails. Those of the Melanesian islands from Fiji westward show strong affinities with the Papuan, Australian and southeast Asian fauna. The Polynesian varieties, closely related to those of Melanesia, do not show any affinities with the groups of the Americas.

Most notable among land snails introduced into the Pacific islands is the giant East African snail (*Achatina fulica*) which reached the Marianna, Caroline and Hawaiian Islands in the 1930s and 1940s. Some of their shells attain a length of five inches. This animal, which feeds upon vegetable detritus and succulent plants, is a horticultural nuisance, but is not an agricultural menace.

The fresh-water mollusks, few in species, are represented by widely distributed pond-snails (*Lymnaea*, *Planorbis* and *Physa*). One operculate snail (*Thiara granifera*) is found in the larger streams of Tahiti, the Hawaiian and the Marianna Islands. Fresh-water mollusks increase in kinds and numbers in the southwestern Pacific islands with the *Neritina*, *Thiara* and *Bulinus* becoming

the dominant groups. Their affinities are with the fauna of the Philippines and southeast Asia. (R. T. A.)

GENERAL GROUPS

The Pacific islands owe their populations to a series of extraordinary migrations from south and southeastern Asia. The full story of the origin of the various native peoples will probably never be known. They comprise three main ethnic groups, distinguished from each other by their physical characteristics, their speech and the regions of the Pacific in which they live. These regions are called respectively Polynesia (Gr. *poly*, many; *nesos*, island), Melanesia (Gr. *melanos*, black; *nesos*, island), and Micronesia (Gr. *micros*, small; *nesos*, island).

Polynesia.—The principal Polynesian islands and island groups include Samoa, the Phoenix, Tonga, the Society, the Tuamotu and the Marquesas Islands, Easter Island and Hawaii. New Zealand is properly a part of Polynesia because its indigenous inhabitants are Polynesians. The islands of Polynesia, large and small, are innumerable, yet their aggregate area, excluding New Zealand, is only about 10,000 sq.mi. At one time the natives of this area were estimated at more than 1,000,000. By 1900, however, four-fifths of the original population of Polynesia had disappeared. These people who had developed an ideal culture in their own environment, were decimated by European diseases to which they had no immunity, and were injured in various ways by the treatment they received from foreigners. (See POLYNESIA.)

Melanesia.—Until World War II the islands of Melanesia were of comparatively little importance in world affairs. Certainly the names of many of them were unknown to most of the world. But Guadalcanal, Bougainville, Rabaul and Munda then took an unforgettable place in history.

New Guinea, the largest island, accounts for the bulk of the land area of Melanesia. Other important islands are the Bismarcks, the Solomons, the New Hebrides, New Caledonia, the Loyalties, and the Fijis. The last-named form the eastern outpost of Melanesia and the connecting link to vast Polynesia.

This region of the Pacific, named after the dark skins of its native inhabitants, extends from Fiji, a little west of the international date line in latitudes 15°–20° S. to about 130° E. longitude and northward to the equator. The total indigenous population in the 1950s was estimated at about 1,270,000, though figures were still far from accurate.

Beyond the fact that the people of Melanesia are distinguished from those of Polynesia and Micronesia by darker skins and more tightly curling hair, it is hard to name a physical characteristic common to all of them. Formerly the term "Melanesian" was used of one of two supposed main elements, the relatively light-skinned ones predominating toward the east and in coastal areas of larger islands. The darker, presumably aboriginal inhabitants of inland mountains (plus some lowlands) were called Papuans. As facts accumulate this simple dichotomy no longer fits. Later analyses distinguished three types: an atypical Negro in the mountainous interiors of New Guinea and probably of the Solomons and New Hebrides; an Australoid type in marginal areas of the northern Bismarck archipelago and northern New Caledonia; and a short, long-headed people of Negroid cranial type on the south shore and the plains of New Guinea. Elsewhere, so far as now known, the people represent various mixtures of these elements, blended locally with Polynesian, Micronesian and Indonesian strains.

Staple vegetables are raised in Melanesia with the digging stick, the main or only tool. Taro, yams and sweet potatoes are supplemented by bananas, coconuts and a variety of wild vegetables. In some places, as in the river deltas of New Guinea, starch from the pith of the sago palm is a staple. The sea furnishes the main supply of animal food, even inland peoples trading their produce for it when they can. Pigeons, cassowaries and other wild birds are hunted, but domestic fowl are not common. Except for parts of New Guinea where wallaby are found, wild pigs are the only land game of considerable size. Pork from domestic pigs is the favorite meat for festivals.

Thatched roofs supported by timbers are perhaps the only com-

mon architectural characteristic. Outstanding in the profusion of building styles are the men's clubhouses of parts of New Guinea. Men in many localities are organized into elaborately graded societies, embellished with initiation ceremonies, unique equipment and secret lore.

Social organization is characterized by a variety of clans and other kinship groups, some of them marked by multiple totems. Local units, by contrast, are simple. Even where chieftainship is important, chiefs nowhere rule over large areas. The important local unit is the village of 100 to 500 population, whose members co-operate in such undertakings as fishing and trading expeditions.

Underlying the maze of kinship ties, the simple family is everywhere fundamental in fitting individuals for participation in local life; though in some areas the role of the mother's brother approaches that of the parents in importance.

Christian missions have been active in all but the most remote parts of Melanesia, and it seemed likely at mid-20th century that the whole population was on the way to becoming at least nominally Christian. European governments—Australian, British, French and Dutch—are governing the area through territories, colonies, protectorates and trusteeships. (See also MELANESIA.)

Micronesia.—Micronesia is so-called because of the small size of the islands. However, the importance of some of these islands in world affairs is far out of proportion to their size. Yap and Guam were once vital links in the U.S. Pacific cable system. Earlier, Guam was a regular stopping place for the westbound Spanish galleons from Acapulco to Manila. Truk in the Carolines prior to World War II was the Japanese naval centre and key to the South Pacific. These islands will probably always serve as important naval bases, airports and weather stations.

Micronesia lies west of Polynesia and north of Melanesia, in latitudes from 3° S. to 20° N., and longitudes from the international date line to 130° E. The region includes four main groups of islands: on the east the Gilberts, adjoining Polynesia; north and a little west of them the Marshalls; then the Carolines, extending westward for nearly 1,750 miles; and the Marianas, running northward from the western Carolines. The westernmost group, the Palaus, is generally included in the Carolines.

The total area of Micronesia is about 3,000,000 sq.mi., approximately that of the United States; but the islands are so small and so widely scattered that, though there are more than 2,000 of them, the total land area is less than 1,000 sq.mi. Most of the islands are atolls, small rings of coral; but most of the land area is in the few high islands, notably Guam, Babelthuap in the Palaus, and Ponape in the eastern Carolines. Islands of a third, "raised coral" type, few in number, are economically important because of their phosphate deposits; for example Nauru west of the Gilberts and Angaur in the Palaus.

The origin of the inhabitants of Micronesia is not well known. Only after World War II was considerable study made of them. There was an obvious trend at mid-20th century from the nearly pure Polynesian stock in the Gilbert Islands to Malayan and Melanesian in the westernmost islands. The total population was approximately 108,000 most of it still native. Politically, except for the Gilberts, Nauru and Guam in the Marianas, the area comprises the U.S. trust territory of the Pacific islands.

All the native languages belong to the Malayo-Polynesian stock, but within that broad category vary widely. The native cultures represent local variations on a common base.

The high islands, whose larger populations have encouraged local development, are peaks not only geographically, but culturally, each with its own specialties. In general, native technology, dependent on rather meager resources, is extremely simple.

An outstanding exception is the outrigger sailing canoe, which in the "flying proa" (more accurately prao) of the Marianas and western Carolines is an admirable craft for speed and, considering its size, seaworthiness. Everywhere, but especially on the atolls, the people depend on the coconut, putting every part of this plant to a variety of uses.

Common features in the intangibles of the culture include small size of villages and of political units, strength of kinship obligations, ancestor worship, importance of hereditary rank developed

locally into complex hierarchies and reinforcement of the authority of chiefs by a belief that they are descendants of gods. Other emphases in native religions are tabus and magic, possession of certain living individuals by supernatural beings, concern with weather because of its importance to food supply, and with sickness and death. The basic kinship groups are matrilineal except where foreign influence has changed them, as among the Chamorros.

Some of the local developments in the extreme west—Palau, Yap and apparently ancient Guam—emphasize a prestige economy based on exchange of various kinds of valuables made of stone, shell, even fragments of ancient pottery. These treasures resemble money in their high symbolic value; but are more like jewellery in that the value of individual pieces is enhanced by their history.

Foreign influence changed native cultures in many ways. Except in the Yap, west Truk and Palau districts, all the people profess Christianity, though fragments of native belief persist among them. Protestants predominate toward the east, Catholics toward the west. The degree of change seems greatest among the Chamorros of Guam, long exposed to Spanish influence. (See also MICRONESIA.) (E. G. B.)

Languages.—The languages of Polynesia, Melanesia and Micronesia constitute three branches of the Austronesian language family, of which the Indonesian constitutes the fourth. A few languages in Melanesia are not Austronesian. These are restricted to the northern and western Solomon Islands. The Melanesian languages represent a fairly old stage of development, the Polynesian the youngest stage, while the position of the Micronesian language is not yet determined. The Melanesian languages are subdivided into the following groups: (1) New Guinea; (2) the Solomon Islands; (3) Santa Cruz Islands; (4) Torres Islands, Banks Islands and northern New Hebrides; (5) southern New Hebrides; (6) Fiji Islands; (7) New Caledonia and Loyalty Islands. These all have a certain part of the vocabulary in common, derived from the Austronesian mother tongue, and shared also with the other three groups.

In structure, the pronoun is the most complicated part of a Melanesian language. There are generally three numbers: singular, dual and plural, and in some cases a fourth—the trial. There is a distinction in the first person between “we” including “you,” and “we” excluding “you.” The pronoun roots are part of the common heritage. There is no gender, and in nouns usually no separate plural form. Suffixes are used to indicate possession. In Indonesian languages these are added to all nouns, in the Polynesian to none. In Micronesian and Melanesian, nouns are divided into two classes, one taking suffixed pronouns and one not. The former consist of parts of the body and of any whole, and most kinship terms. The latter may be subdivided into various groups. Thus in Fiji, *luve-nggu*, “my child”; *yava-nggu*, “my leg”; but *no-nggu vale*, “my house,” *nggau kakana*, “my food,” and *me-nggu mbu*, “my coconut to drink.” In Micronesia there may be a dozen or more such subdivisions of possessive forms, according to the nature of the object possessed. In Polynesia the forms are, for example, in the Maori language *t-o-ku tamana*, “my father”; *t-a-ku tama*, “my child,” on the basis of “passive” and “active” possession. Verbs do not change for person, and only in Polynesia for number. Tense and mood are shown by particles placed before the verb: Fijian, *au na lako*, “I shall go”; *au sa lako*, “I go, I went”; *au a lako*, “I went.” The system is similar in Micronesia, but Polynesia has developed some different types of forms. Suffixes are used to indicate whether the verb is transitive or not, and in Polynesia these suffixes have developed a passive meaning. Thus in Florida in the central Solomons, *ke tangi*, “he weeps,” but *ke tangi-hi-u*, “he weeps for me,” and Maori *kua whaka-he-ngia*, “he has been judged.”

Among the natives of the Pacific islands counting is in some instances decimal, as the original Austronesian counting was, and where this holds good, the numerals are common vocabulary. It is so in Polynesia and Micronesia, but in Melanesia this is not always the case; for among some tribes counting is done by fives, as in the southern New Hebrides; or by fives with a special word for

“ten,” and in other parts it is done by twenties. In Micronesia there is elaborate classification of numerals, and on Truk Island some 60 different ways of counting are found, suffixes being added to the roots of numerals 1 to 9 to indicate the nature, size, shape, etc., of the objects being counted.

Polynesian, representing the latest stage in development of the languages of the natives of Pacific islands, has the largest degree of phonetic simplification. The general theory is that the Indonesians first moved out from the Asiatic homeland, then the Melanesians and Micronesians (in which order is not clear), and finally the Polynesians. The relationship between the Polynesian languages is much closer than that between the Melanesian group and that between the various Micronesian languages. A Maori from New Zealand, a Hawaiian and native of the Cook Islands do not have much difficulty in learning to understand each other, but two Melanesians from different islands, and, in some cases, from the same island, would have to learn each other's language as something foreign. Melanesians and Micronesians seem to have found earlier peoples in possession of their islands, for the common mother tongue has been modified differently by different aboriginal peoples in the different islands. (A. CL.)

HISTORY

In 1519 Charles V of Spain sent Ferdinand Magellan, a Portuguese in Spanish service, westward across the Atlantic in search of a route to the fabulous spice islands, now known as the Moluccas. Magellan reached the coast of South America and sailed along it southward until he found the strait on the southern end of South America which bears his name. Working his way through the strait, he came up the west coast of that continent. Then turning westward again into the Pacific, he was carried by ocean currents and the trade winds to Guam and the Philippines. For 200 years Spanish ships—the Manila galleons—plied regularly back and forth between America and the outpost of the Spanish empire in the far east. The Marianas, the Caroline and the Marshall Islands, which lay along this route, were all claimed by Spain toward the end of the 17th century.

Though a Spanish ocean highway was thus in use across the heart of the Pacific from the late 16th century onward, it was not until toward the end of the 18th century that the continental coast lines and all the principal islands of the ocean were finally discovered and charted. Among the great figures of the early navigators who passed across this stage were Sir Francis Drake, Alvaro de Mendaña, Pedro Fernandez de Quirós, Luis Vaez de Torres and Abel Janszoon Tasman. Toward the middle of the 18th century, a new era in the exploration of the Pacific dawned, in which the advancement of knowledge became a dominant motive. The Englishman James Cook was the greatest trained navigator to explore the Pacific. He made three voyages, in 1768–69, 1772–75, and 1776–79. The first of these voyages took him to Tahiti and the Society group, to New Zealand and to the eastern coast of Australia. The second included visits to New Zealand, the Tuamotu archipelago, the Society Islands, Tonga, Easter Island, the Marquesas and the New Hebrides. The third included Tonga, the Cook Islands and Hawaii. Hawaii may have been known to the Spaniards earlier.

With the completion of Cook's voyages, the period of discovery in the Pacific came to an end. Subsequent voyages, made by navigators, served merely to fill in details on the map. Jean-François La Pérouse, a Frenchman, was the first navigator who was equipped with and made regular use of chronometers of considerable accuracy and was, therefore, able to establish longitudes with precision.

Although many discoverers laid claim to islands in behalf of their own countries, the home governments were in many instances in no hurry to confirm these claims by annexation. Great Britain, France and the United States were at first reluctant to assume the responsibility and expense of administering and defending remote and undeveloped places. However, by 1900 France was dominant in the east-central Pacific and also held the large island of New Caledonia, with its rich mineral deposits. The British and the Germans dominated the central and western Pacific. From

Spain the Germans had bought the Caroline, Mariana (except Guam) and Marshall Islands, after the Spanish-American War. In the 1880s they had acquired northeastern New Guinea, the Bismarck archipelago, the northern Solomons, and Nauru, where, in 1897, rich deposits of phosphates were found. In 1900 they had divided the Samoan group with the United States, taking the western part. The British ruled the central and southwestern islands, except for French New Caledonia, American Samoa, and the New Hebrides, the last of which they governed jointly with the French. The United States controlled the northeast Pacific, holding Hawaii and the Aleutians. The United States had also acquired the Philippines and Guam from Spain in 1898.

The principal change between 1900 and the Japanese invasion of 1941-42 was the establishment of mandates by the League of Nations under Australian, New Zealand and Japanese governments. The Japanese seized the Mariana, Caroline and Marshall Islands in 1914, immediately after the beginning of World War I; they were given a mandate for them in 1920. The Australian mandate covered northeastern New Guinea, the Bismarck archipelago and the northern Solomons; that of New Zealand covered western Samoa. Nauru became a mandated territory of the British empire—Great Britain, Australia and New Zealand jointly deciding from time to time which of the three should administer it.

After the discovery of the major islands of the Pacific, it was not long before white men followed to trade or otherwise to exploit the islands' resources. These were bad days for the natives. Traders and planters came, and with them adventurers of all types—beachcombers, deserters from whaling vessels, and escaped convicts from penal settlements. With no well-established government control, these men brought the worst of "civilization" with them. There were of course, better elements among the Europeans. The last century was also the time of missionaries—French Catholics and British and American Protestants. When western governments finally stepped into Pacific islands, their primary motive was power and wealth in the form of colonies.

DESCRIPTION OF INDIVIDUAL ISLANDS AND GROUPS

Government.—Various forms of government in the Pacific islands have arisen in large part from the diversity of circumstances under which they were acquired by European nations and by the United States. The position of the traditional native authorities under existing regimes differs considerably in different archipelagoes. Many islands are still governed by so-called "indirect rule." Under it the chiefs govern the natives according to their traditional laws and customs—the "native code." The chiefs are responsible to the governments concerned for law and order and other aspects of good government of the people. District commissioners, who are of the same racial extraction as the administrative authorities, exercise general supervision of their areas.

Fiji.—The Fiji Islands centred on the 180th meridian of longitude, exactly opposite Greenwich, Eng., are a crown colony of Great Britain. They form the eastern outpost of the chain of islands of continental origin that extends eastward from New Guinea through the Solomon Islands and the New Hebrides.

The colony is administered by a governor responsible to the British colonial office. He is assisted by an executive council, and a legislative council which meet regularly, in the style of a parliament. The duties of the two councils, however, are only advisory. The immediate problem of government in Fiji is that of preserving a balance of power among the three dominant races who live there: Europeans, Fijians and East Indians. Out of a total population of 293,764 in 1950, Europeans numbered 6,501; persons of mixed European and native descent 6,902; Fijians 129,896; Indians 138,425. (See also FIJI.)

Tonga.—Tonga's 160 islands are distributed in two distinct chains that trend roughly north and south, following a great submarine ridge that connects New Zealand with Samoa, through the Kermadec Islands. Tonga is a kingdom, the only one in the Pacific to survive the period of expansion of the great powers. The kingdom became a protectorate of Great Britain by a "treaty of friendship and protection" signed in 1900. A British agent and consul there is responsible to the governor of Fiji. Immigration

of foreigners to Tonga is discouraged by a law that prohibits them from owning land. (See TONGA.)

The governor of Fiji, with headquarters at Suva, has also jurisdiction over Pitcairn, Ducie, Oeno and Henderson islands and Rotuma. Pitcairn Island, an area of 2 sq. mi., is situated at 25° 3' S. lat. and 130° 8' E. long. It was discovered by Philip Carteret in 1767, but remained uninhabited until 1790, when it was occupied by the mutineers of the H.M.S. "Bounty," with some women from Tahiti. Ducie, Oeno and Henderson, uninhabited, are included in the district of Pitcairn. Rotuma is the principal island of a small group which lies about 220 miles N.N.W. of Fiji.

The Western Pacific High Commission.—The post of high commissioner for the Western Pacific was established in 1877, and thenceforward it was held by the governors of Fiji. The commissionership was made a separate office in 1952 and the headquarters were transferred from Suva to Honiara in the Solomon Islands protectorate. The territories of the Western Pacific high commission comprise the Gilbert and Ellice archipelagoes, a British crown colony; the British Solomon Islands protectorate; and the condominium of the New Hebrides, administered jointly by Great Britain and France. The 25 islands of the Gilbert and Ellice groups form a chain of coral atolls roughly between lat. 4° N. and 11° S., long. 170° E. and 180° E. Ocean Island, where the headquarters of the colony are located, lies some 250 mi. west of the Gilbert Islands; it is of great commercial value as a source of phosphate. The immediate representative of the high commissioner for the Western Pacific is the resident commissioner on Ocean Island. (See GILBERT AND ELLICE ISLANDS.)

Fanning, Washington and Christmas Islands, some 1,800 mi. east of the Gilberts, and the Phoenix group, some 600 mi. east of the Gilberts (except Canton and Enderbury Islands) also form part of the Gilbert and Ellice Islands colony. Fanning, Washington and Christmas have large plantations of coconut palms from which their populations produce copra.

British Solomon Islands Protectorate.—The Solomon Islands lie to the east of New Guinea and to the north of the New Hebrides. The main group comprises a double chain of islands, stretching roughly from northwest to southeast. It includes seven major islands: Bougainville, Choiseul, Ysabel, New Georgia, Malaita, Guadalcanal and San Cristobal; between 20 and 30 smaller islands, and numerous islets. Volcanic activity, which has been the main agent in forming the group, has been intermittent from Cretaceous or early Tertiary times to modern times. The core of the main islands is composed of ancient lavas.

Several smaller groups of islands, also isolated, are considered as part of the Solomons archipelago. They include: to the south, the large island of Rennell and its smaller neighbour, Bellona; to the southeast, the Santa Cruz group of Ndeni, Vanikoro and Utupua; the Reef and Taumako groups, and the small isolated islands of Tikopia, Anuta and Fatutaka; and, to the east and north, a number of atolls of which the most important are Ontong Java and Sikiana.

For administrative purposes only the major part of the group forms the British Solomon Islands protectorate. Bougainville, Buka, and several atolls to the north fall within the limits of the Trusteeship Territory of New Guinea which is administered by the Commonwealth of Australia.

The economic resources of the Solomons, only slightly exploited, are imperfectly known. The total population of the protectorate is about 100,000 of which a little over 100 are Europeans. The capital is at Honiara on Guadalcanal.

Condominium of the New Hebrides.—The New Hebrides, midway between the Solomons and the Fijis and north of New Caledonia, include upraised coral reefs, active volcanoes, and perhaps remnants of granite mountains in the larger islands at the north. The group includes 12 principal islands, arranged like a "Y" between 13° and 21° S. lat. In this archipelago 1,000 French and English planters living on four or five of the larger islands earn a living for the most part by raising coconuts to make copra; some of them also raise cacao beans for chocolate and cocoa. Settlers and speculating companies appropriated large areas of land, the ownership of which were still in dispute

in the 1950s. Along the coasts and in the interiors of the islands some 45,000 natives live largely in the ways of their ancestors. All three groups are subject to a joint administration called in international parlance a "condominium" but which in operation is really a tripartite government. In general, the national administrations have jurisdiction over their respective nationals, and the condominium has jurisdiction over natives and where the interests of British and French clash. (See NEW HEBRIDES.)

New Guinea.—New Guinea, after Greenland, the largest island in the world, lies to the north of Australia, separated from it by only about 100 mi. at Torres strait, the water of which is very shallow. The people of New Guinea—a handful of Australians, a few Chinese and a host of aborigines—gain a livelihood in ways which reflect their origins. The Australians, managers of plantations and mines, maintain in considerable part the habits and customs of their homeland; the Chinese, middlemen and small merchants, still practise the culture of Asia. A small proportion of the aborigines are labourers on plantations and in mines, working under indenture. The great majority of them are tribesmen, hostile to neighbours, carrying on native ways of living.

The inhabitants of New Guinea live under various forms of government. Under the terms of the Papua and New Guinea act 1949–1960, the Territory of Papua in the southeast and the Trust Territory of New Guinea in the northeast form an administrative union under the title of Territory of Papua and New Guinea; each retains its own status, Papua as a territory of Australia and New Guinea as a United Nations trust territory administered by Australia. West New Guinea (formerly Netherlands New Guinea) which comprises about one-half of the island, is administered by Indonesia. (See NEW GUINEA.)

The island of Nauru and Norfolk Island are also under the administration of Australia. Nauru, in lat. $0^{\circ} 30' S$, long. $166^{\circ} 55' E$, was discovered by Capt. Fearn in the "Hunter" in 1798; it was formerly often called Pleasant Island. It is the most important source of Australia's great supply of phosphate. World War I brought international attention to Nauru. In 1914 Australians occupied the island and evacuated all Germans to stake a claim which, after the war, the League of Nations honoured in mandating Nauru to the British empire; Australia was assigned administrative responsibility. A World War II sequel in Nauruan history had to do with its new status as a trust territory when, on Nov. 1, 1947, the United Nations general assembly approved a trusteeship agreement for the island, with Australia continuing as administering authority.

Norfolk Island.—Norfolk Island, in lat. $29^{\circ} 04' S$, long. $167^{\circ} 56' E$, is roughly 5 mi. long and 3 mi. wide, with a total area of 13.3 sq.mi.; it is about 920 mi. east of Sydney. It is a dependency of the Commonwealth of Australia, known officially as the Territory of Norfolk Island.

Western Samoa.—Western Samoa consists primarily of the two large islands of Savai'i and Upolu which comprise 99% of the total area of 1,137 sq.mi. Physiographically the islands are volcanic or "high" islands with an axial range of peaks which extend in an east-west direction and which lie close to the southern coast. The rugged, mountainous core rises more than 3,500 ft. on Upolu and more than 6,000 ft. on Savai'i. Three tree crops, cacao, coconuts and bananas, constitute about 90% of the exports and form the chief source of revenue. The population of Western Samoa is dominantly Polynesian. Under United Nations trusteeship with New Zealand as the administering authority, the people made considerable progress, achieving self-governing status Dec. 31, 1961 (see SAMOA ISLANDS).

New Zealand Dependencies.—Islands in the Pacific administered by New Zealand include the island territories (the Cook Islands, Niue and the Tokelau archipelago), the Kermadec Islands and a number of others (see NEW ZEALAND). The Tokelau (or Union) Islands (4 sq.mi.) were made a part of the island territories in 1948. The chief settlement is on Fakaofu Island, where there is a wireless station.

Cook Islands.—The Cook Islands, located in the southwest Pacific, are some 1,500 mi. northeast of New Zealand, 1,200 mi. east of Fiji, and 600 mi. west of Tahiti. Totalling 93 sq.mi. of land,

the 15 islands of the group are widely scattered over 850,000 sq.mi. of ocean. Annexed to the colony of New Zealand in 1901, they were incorporated within the dominion on its proclamation in 1907. Physically the islands comprise two contrasting groups. The seven islands of the northern group—Penrhyn, Manihiki, Rakahanga, Pukapuka, Suvarrow, Nassau and Palmerston—are all coral atolls. The members of the southern group, primarily volcanic, include the major islands from the points of view of agricultural production, population and land area. They are Rarotonga, the administrative centre for the whole group and the most important agricultural island; Mangaia, Aitutaki, Atiu, Mitiaro, Mauke and Manuae. The remaining island of the southern group, Takutea, is a coral atoll and is not permanently inhabited. Agricultural changes in the Cook Islands after mid-19th century fundamentally disrupted the traditional, native subsistence economy. European intervention resulted in a great demand for commercial crops, and a wide variety was grown at various times by both native and European planters. The export production of the northern atolls continued to depend upon copra and pearl shell. Copra from all the islands, with oranges and tomatoes from the southern group provide a threefold agricultural base for the economy.

Niue (or Savage Island) is a New Zealand dependency administered by the department of external affairs of the New Zealand government as a separate administration, through a resident commissioner at Alofi.

The Kermadec Islands, a rocky group lying 600 mi. northward of Auckland, are also a dependency of New Zealand. Sunday Island, thickly wooded, is the only island regarded as habitable. However, several attempts at colonization have been defeated by the factor which originally prompted them, namely isolation. New Zealand also administers the Chatham Islands, Auckland Islands, Campbell Island, Antipodes Islands and Bounty Islands.

The French Republic in the Pacific.—The overseas territories of France in the Pacific are New Caledonia, French Polynesia, and Wallis and Futuna. The island of New Caledonia ends the southern swing of the Melanesian arc. It extends 220 mi. from southeast to northwest, about 700 mi. east of the Queensland coast of Australia; its average width is 30 mi. It lies at the southern border of the tropical zone, about 20° to $22^{\circ} S$. lat. The mountains include ancient rocks like those of New Zealand, rich in minerals, especially nickel. Politically, New Caledonia and its dependencies are an overseas territory, administered by a governor, who acts as high commissioner in charge of French interests elsewhere in the Western Pacific. The government of New Caledonia also administers the Isle of Pines, the Chesterfield Islands, the Loyalty Islands, the Huon Islands, Alofu and Walpole Islands. Though New Caledonia lies along the line of volcanic disturbances in the Western Pacific and is near the New Hebrides, where considerable volcanic activity has taken place, there is no active volcano on the island and no volcanic lava or ash has been found. Both metamorphic and sedimentary formations occur in great quantity. The metamorphic rocks fall into two major groups: gneiss and schists; and serpentine. The principal outcrop of gneiss constitutes the Ignambi chain about 40 mi. long in the northeast part of the island, with several main summits. Chief of these is Mount Panie, 5,413 ft., one of the higher points in New Caledonia. The second group of metamorphic rocks, composed largely of serpentine, attains its chief development in the south of the island. Among the principal summits are Mount Humboldt, 5,361 ft.

The mineral wealth of the island is great and varied, though some of the resources have been only partially developed owing to competition from other areas with lower production costs. The metamorphic rocks of the north yield a certain amount of copper, gold and argentiferous lead and zinc. The serpentine of the northwest and southeast yields nickel, chrome, cobalt and iron, and the sedimentary earths give some manganese, antimony and coal. The amount of nickel ore is large, and the island is the producer of third rank in the world. However, it does not supply a high proportion of the world's output, the major share being contributed by Canada. The climate of New Caledonia, though tropical, is not excessively hot or damp; it is sunny and, for the most

part, tempered by frequent light breezes. The prevailing winds are the trades, from the southeast and east. The vegetation is remarkable from several points of view. Endemic species form about 77% of all the native plants. A second remarkable feature of the vegetation is that, unlike that of most of the large Pacific islands, it consists very largely of drought-resistant plants.

Native agriculture still relies to a considerable extent upon the cultivation of the coconut palm, various kinds of yam and taro, and the banana. Advantage has been taken of introduced manioc to provide a drought-resistant crop. European agriculture has had only a restricted success in New Caledonia. Cultivation of many types of crops has been attempted, but few have been effectively established commercially. Commercial agriculture depends primarily upon coffee, copra and cotton, all produced for export; and cattle-raising, to a large extent for the domestic market. The pastoral industry, taking advantage of the large savanna areas with their native grasses, has occupied an important position since the early days of the colony. Among the industrial plants established in the colony are blast furnaces for smelting nickel ore, a meat-preserving works, timber mills, a barking mill for coffee, a grain storage and cleaning depot, distilleries for the manufacture of *niaouli* essence, and several printing establishments.

France took possession of New Caledonia in 1853, stimulated particularly by the development of Australia and by the desire to have an alternative convict settlement to Guiana. In 1864 the first batch of convicts arrived, and from then until 1894, when transportation began to be reduced, the majority of the European population was composed of them. Europeans were attracted to the island by various colonization schemes, most of which had indifferent success. A scarcity of labour led to the importation of orientals.

In 1956 the population totalled 68,480, of whom 25,160 were Europeans and Asians, 43,320 indigenous.

French Polynesia (*Établissements français de la Polynésie*, abbreviated E.F.P.)—comprises five archipelagoes: the Society Islands; the Tuamotus; the Gambier Islands; the Marquesas; the Tubuai or Austral Islands; and one island, Clipperton, 1,800 mi. west of the Panama Canal. These island groups, administered as an overseas territory of France, comprise the whole of the eastern portion of the Pacific islands. They are administered from one centre, the town of Papeete, situated on a beautiful bay on the northwest coast of Tahiti.

The Society Islands in the heart of Polynesia, first attracted the attention of Europeans in mid-18th century. It was in these islands that the first efforts were made by Protestant missionaries to convert the natives. In April, 1769, a year after Bougainville, Cook, charged by the Royal society of London with the mission of observing the passage of Venus before the sun and of pursuing geographic researches, arrived in his turn at Tahiti. The ships which visited French Oceania from this epoch on cannot be enumerated.

A great many adventurers began to roam the south seas; sailors who deserted their ships established themselves in the islands, where they often gave the natives a poor idea of western civilization.

From the point of view of geographic characteristics, the archipelagoes are very different from one another. Tahiti, the Leeward Islands of the Society group, the Marquesas, the Gambier Islands, and the Austral Islands are made up of high basaltic lavas surrounded by a fringe or barrier of coral reefs, the others—the Tuamotus and Clipperton are low, coral islands.

Society Islands.—This archipelago comprises two groups: the Windward Islands and the Leeward Islands. The principal island of the Windward group is Tahiti; then comes its neighbour Moorea, then Tetiaroa, Maiao and Mehetia. Tahiti has an interesting feature in its tides. They come every day at approximately the same time—midday and midnight for the high tides, six o'clock morning and evening for the low tides, with the exception of local variations due to ocean currents. The island, high and rugged, has about 100 rivers, but most of them are torrents which flow only after heavy rains. Tahiti, 33 mi. long and 388 sq.mi. in area, is one of the more widely known small islands in the world. It has

often figured in the tales of adventurers and writers of romantic fiction. There Paul Gauguin settled after leaving his home in Paris and it was there and in the Marquesas that he painted the pictures that later made him famous.

Of the Leeward Society Islands, which are west of the Windward group, Raiatea is the most important; its chief village is Uturoa.

The Tuamotu (or Paumotu) Archipelago, east of Tahiti, extends for many miles. Its 80 islands are low atolls with a total area of 345 sq.mi. In the warm, limpid waters of the lagoons where pearl oysters are found native divers sometimes reach 19 fathoms. The natural vegetation is poor because of insufficient moisture. Coconut palms, however, do very well. Makatea, a raised coral atoll, is noted for its great deposits of phosphate rock. Many thousands of tons have been exported and the work still goes on. The Gambier Islands, stretching out to the south of the Tuamotus, have an area of 47 sq.mi. The four principal islands are volcanic, inclosed in a common lagoon. The largest, Mangareva, has the little port of Hikiha, the chief village of the group.

The Marquesas Archipelago, constituting a group of 11 islands, is the most equatorial of French Polynesia. Knife-edged ridges separate most of the valleys on the larger Marquesas, a fact that isolated the original Polynesian inhabitants into a number of hostile communities. The valleys are the only habitable and cultivable areas. There are only a few European planters and traders scattered through the group owing to the isolation of the archipelago.

The Tubuai or Austral Islands are the most southerly of French Polynesia. They form a chain extending from the southwest to the northwest over a distance of about 800 mi. Of the four principal islands the most important is Tubuai which has an area of 19 sq.mi.

Clipperton Island, at 10° 30' N. lat. and 106° 20' W. long., the remaining French island, is an uninhabited atoll.

French Polynesia comprised, according to the census of 1962, a total population of 85,231.

U.S. Territories in the Pacific.—Of the territories in the Pacific for which the United States is governmentally responsible, Hawaii (a state since 1959), American Samoa, Guam and the U.S. Trust Territory of Pacific Islands are by far the more important. All of them have strategic value in the defense of the mainland; in addition Hawaii is an important source of sugar and pineapples. For a description of this island group, see HAWAII.

American Samoa.—American Samoa, a possession of the United States, comprises the islands of Tutuila, Tau, Olosega, Ofu and Aunuu and the coral atoll Rose Island, all east of long. 171° W.; they extend from 14° 10' S. to 14° 32' S. Administered by the U.S. navy for 51 years, the territory was placed under the administrative jurisdiction of the department of the interior on July 1, 1951, by executive order of the president of the United States. The islands are mountainous and only about one-third of the land is arable even in terms of the rudest types of land cultivation. On Tutuila, the main island, the interest of Samoans is centred mainly in wage-earning activities.

Considerable employment is available at the U.S. naval station at Pago Pago, on the best harbour in the whole Samoan archipelago.

The sovereignty of the United States was extended to Swains Island, which was made part of American Samoa by a joint resolution of congress, approved March 4, 1925. Swains Island is in 11° 04' S. lat. and 171° 06' W. long.

The constitution of American Samoa, effective from Oct. 17, 1960, provided for a bicameral legislature with certain defined legislative powers and established a judicial branch independent of the executive and legislative branches. (See SAMOA ISLANDS.)

Guam.—Guam, the largest and southernmost island of the Marianas, has an area of 209 sq.mi. The population in 1960 was 67,044, including about 35,000 military; about half of the population were service personnel; the other half were workers recruited in the U.S. (including Hawaii), the Philippines and other

Pacific islands. Agana is the capital.

Guam is an unincorporated territory of the United States and an organized sovereignty, governed under the Organic Act of Guam, passed by the U.S. congress and approved by the president on Aug. 1, 1950. Under this legislation, Guamanians became citizens of the U.S.

United States Trust Territory of the Pacific Islands.—The United States Trust Territory of the Pacific Islands comprises the Marshall, Caroline and Mariana islands with the exception of Guam. Located in the western Pacific, north of the equator, the islands are scattered over an area roughly as large as the United States. The total land mass of about 687 sq.mi., distributed among 96 island units, contains 65,039 inhabitants (1956 est.). There is no ethnic unity, and nine different languages are spoken.

The islands of the trust territory were governed by Japan from World War I until World War II under mandate from the League of Nations. Japan invested heavily in the area in an effort to promote agriculture and fishing, and sent thousands of colonists. Following World War II, all Japanese nationals were repatriated, and the islands were placed under the United Nations trusteeships system. The area was designated as a strategic trusteeship, and the United States was authorized to administer it under terms of the trusteeship agreement of 1947.

The navy of the United States was assigned administrative responsibility on an interim basis in 1947. July 1, 1951, marked the formal end of the naval administration of the trust territory and the assumption of responsibility by the department of the interior. The territory is divided into six administrative districts: Majuro (Marshall Islands), Ponape, Truk, Yap, Palau and Saipan. Headquarters of the territory is at Fort Ruger, Honolulu.

Marshall Islands.—The Marshall Islands comprise a large group of low coral atolls, with a total area of 61 sq.mi., scattered in two irregular, roughly parallel chains extending in a north-south direction from about 14° 43' to 4° 34'. They lie between 160° 48' and 172° 10' E. The easternmost row, called the Ratak Chain, comprises 14 atolls and two single islands. The westernmost row, called the Ralik Chain, comprises 15 atolls and three single islands.

The northern Marshalls lie in the westward flowing north-equatorial current; the equatorial countercurrent flows eastward through the southern islands. The northern Marshalls, well within the trade-wind belt, are appreciably drier than the southern Marshalls. The climate is tropical oceanic, without any orographic rainfall. December to March is the dry season, May to August the wet season. The precipitation on any one atoll varies tremendously from year to year, even in corresponding months.

The material of the islets is so porous that rainfall filters downward readily and quickly. There is no running surface water, except during typhoons or tsunamis, when great waves occasionally sweep across the islets. There is normally no standing surface water except where depressions or taro pits extend down below the water table. Most of the original vegetation of the atolls has been replaced by coconut plantations, especially on the larger islets. The northern Marshalls are much less densely populated than the southern, more fertile islands.

The Caroline Islands.—The Caroline Islands, west of the Marshalls, form a broad belt extending from 131° E. long. to 163° E. long. They lie between 1° and 10° N. lat. The 148th meridian east longitude separates the archipelago into two divisions, the eastern and the western Carolines. The total land surface of the eastern Carolines is about 245 sq.mi. The climate, like that of all the islands in Micronesia, is tropical oceanic. Precipitation is especially heavy in the high islands. Kusaie, in the southeast, has the heaviest rainfall. Two of the atolls in the eastern Carolines, namely Kapingamarangi and Nukuoro, are inhabited, not by Micronesians but by true Polynesians.

The total land surface of the western Carolines amounts to approximately 200 sq.mi. Most of this area is made up of two principal islands—Yap with 39 sq.mi. and Babelthuap in Palau with 158 sq.mi. The western Carolines lie in the belt of alternating northeast trade winds and southwest monsoons, which divide the year into two seasons. Although there is considerable variation from year to year, the northeast trades ordinarily begin in October

and prevail until May and often until June. The Asiatic (south-west) monsoon usually sets in fairly early in June on Yap, but not until July or even later in Palau. The monsoon lasts until October, or sometimes a little later, when the trade winds return.

The Mariana Islands.—The Marianas form a chain extending from 14° to 20° 33' N. lat., and lie between 144° 54' and 146° 05' E. long. They consist of 13 single islands and one group—Maug—of three small islands. They are all high and volcanic.

The total land surface of the Marianas amounts to approximately 184 sq.mi. About two-thirds of this area is made up by the three principal islands of the group: Saipan with 47 sq.mi., Tinian with 39 sq.mi. and Rota with 33 sq.mi.

Extending 385 mi. from Pajaros in the north to Rota in the south, these islands are the southernmost volcanic peaks of a gigantic mountain range rising almost six miles from the ocean bed of one of the deeper parts of the Pacific. The island peaks of this range form a series of steppingstones from Guam to Japan.

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PACIFICO, DON or **DAVID PACIFICO** (1784–1854), a Portuguese Jew, born a British subject in Gibraltar, who brought an action against the Hellenic government claiming £26,000 compensation for his house in Athens, burned down in 1847 in an anti-Semitic riot. Pacifico finally received compensation.

PACIFIC OCEAN, the largest division of the hydrosphere, lying between Asia and Australia and North and South America. It is nearly landlocked to the north, communicating with the Polar sea only by Bering strait, the open passage of which is 40 mi. wide and less than 180 ft. deep. The southern boundary was sometimes regarded as the parallel of 66½° S., but this limit is artificial, and it is now considered that the Pacific extends to the borders of the Antarctic Continent, exactly as the Atlantic and Indian oceans do. As east and west boundaries in the higher southern latitudes one may take the meridians passing through South cape in Tasmania and Cape Horn. The north to south distance from Bering strait to Antarctica, near Cape Colbeck, is 9,900 mi., and the Pacific attains its greatest breadth between Panamá and Mindanao (Philippine Islands), where it measures 10,700 mi. The distance between Yokohama, Jap., and San Francisco, Calif., is about half as great again as that from New York city to Southampton, Eng.; similarly, the distance between Sydney, Austr., and Cape Horn is greater than that from Buenos Aires, Arg., to Cape Town, U. of S. Af., by fully a half. The coasts of the Pacific are of varied contour. The American coasts are for the most part mountainous and unbroken, the chief indentation being the Gulf of California; but the general type is departed from in the extreme north and south, the southern coast of South America consisting of bays and fiords with scattered islands, while the coast of Alaska is similarly broken in the south and becomes low and swampy toward the north. The coast of Australia is high and unbroken; there are no inlets of considerable size, although the small openings include some of the finest harbours in the world, as Moreton bay and Port Jackson.

The Asiatic coasts are for the most part low and irregular and a number of seas are more or less completely enclosed and cut off from communication with the open ocean. Bering sea is bounded by the Alaskan peninsula and the chain of the Aleutian Islands; the Sea of Okhotsk is enclosed by the peninsula of Kamchatka and the Kuril islands; the Sea of Japan is shut off by Sakhalin Island, the Japanese islands and the peninsula of Korea; the Yellow sea is an opening between the coast of China and Korea; the China sea lies between the Asiatic continent and the island of Formosa, the Philippine group, Palawan and Borneo. Among the islands of the Malay archipelago are a number of enclosed areas—the Sulu, Celebes, Java, Banda and Arafura seas.

The Pacific was first scientifically explored by the great English deep-sea expedition of H.M.S. "Challenger" (1827–76), by the German expedition of S.M.S. "Gazelle" (1874–76) and then by the two United States ships "Tuscarora" (1874–79) and "Albatross" (1888–1905), by the Russian warship "Vitiaz" (1887), by