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BOTANICAL SKETCHES FROM THE ASIATIC TROPICS

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III. JAVA

(Continued from September Torrey)

Of the several thousand tourists who annually visit Java probably ninety-five per cent make a pilgrimage to Buitenzorg to see the famous botanical gardens. They give it a hasty inspection of one or two hours, probably never deviating from the main travelled paths, and depart, carrying with them the idea that the garden is a curiosity or a tropical park, but having no idea whatever of its botanical importance. And they can be forgiven for this, for some preliminary knowledge of botany is really requisite to the proper appreciation of this immense collection of plants.

By the average tourist, the time in Buitenzorg could be far better spent by a visit, not to the Botanical Garden, but to the Culturtuin, or Economic Garden, located about as far north of the railway station as the Botanical Garden is south of it. Here there is a remarkable collection of the economic plants of the tropics, including all the important species, and scores of cultivated forms and varieties, growing under virtually the same conditions as exist on the plantations.

A botanist from the temperate zone will recognize many of the species at sight, and a glance at the scientific name on the label will give him all necessary information about most of the others. The non-botanical tourist would appreciate the plants more if the labels bore also the vernacular names in English or German.

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There are also many species the uses of which are local or limited, or which do not commonly enter into commerce. A brief statement of their uses added to the label would in such cases be of value to every visitor. But these remarks must not be construed as criticisms: the garden is not intended for public exhibition, and visitors, while welcome, are exceedingly few in number.

The garden occupies apparently about 120 acres of quite level land, arranged in three sections of about equal size, which are so placed that they form three quarters of a square. The two sections nearest the city are attractively laid out in rectangular beds, closely planted with a great variety of species, and intersected with well-kept gravel walks. The third section, lying farther to the north, is devoted chiefly to experimental plots for rice, tapioca, sugar, and other plants of local importance, and are neither very accessible nor very attractive to the visitor.



FIG. 23. Old trees of *Ficus elastica*. The scars on the trunk are made by tapping for rubber.

The botanist, however, will be interested in the numerous varieties of rice and tapioca, if in nothing else. Both of these species are very common in the fields near Buitenzorg, but apparently only one variety of each is cultivated. Here in the garden there is a great variation in the height and color of the

rice, and in the height, size of leaf, and spread of branches in the tapioca. It is quite likely that some of these varieties are more productive than those in general cultivation, but the Sundanese natives are very slow to take up any new improvement.

The approach to the center of the garden, the Landbouwweg, is a beautiful drive, with a noble line of lofty royal palms on the left and plots of coffee on the right. At the end of the drive are situated some of the buildings, including the laboratory for plant pathology, an office building, and the usual shops, storehouses and propagating grounds. At the east of these, at the edge of the garden, are the attractive new laboratory buildings.

In front of the old laboratories a small area is laid out in lawns and decorative plants, but this area is typically tropic in design, and is in no way an imitation of temperate zone landscape architecture. Any visitor here will be interested in inspecting the huge plant of the leguminous climber *Entada scandens*. Mention has already been made in these sketches of the plant of the same species growing in the Botanical Garden, but this one exceeds it in size. It has a basal diameter of about twenty inches, and, although not so old as the famous *Entada* in the Botanical Garden, has some advantages over it to the visitor. Many of its original supports have died or been broken, so that its twisted and tangled stems now lie on the ground in full view. Under living trees they again ascend and are lost to sight in the upper branches, although huge loops depending from heights of from 30 to 80 feet indicate something of the luxuriance of its growth. An entire morning was spent in tracing out in detail the course of the numerous branches, over a thousand feet of which are easily visible. In the tangle of foliage overhead *Entada* leaves and stems are frequently distinguishable, although their origin can not be traced. At 30 yards from the base twisted stems five inches in diameter loop down from the trees. In two places branches stretch from tree to tree across a small stream. At least twenty trees are covered by this huge climber, and the most distant of these is over 50 yards from the base. The larger branches of the vine are themselves covered with the epiphytic ferns *Drymoglossum heterophyllum* and *Asplenium nidus*.

Passing from the building toward the southeastern section of the garden, the visitor will first be attracted by a large tree of Para rubber, *Hevea brasiliensis*, now about two feet in diameter. This tree was planted in 1875, one year before the formal establishment of the garden, and is considered to be the oldest *Hevea* tree in the Dutch East Indies. It has been frequently tapped for rubber. There is also a plot devoted to Para rubber, with young trees averaging six to ten inches in diameter, which are being tapped regularly. Under them, as is the case in all modern plantations, there is not a trace of vegetation.

In the same section is a plot of nutmeg trees, not yet full grown, but old enough to bear freely the yellow pyriform fruit. Some distance beyond is a plot of clove trees, with glossy fragrant foliage and dense symmetrical conical crowns. Their principal branches exhibit well the feature described by Haberlandt in his *Botanische Tropenreise*. They deviate abruptly from the main trunk at a rather large angle for one or two feet, and then

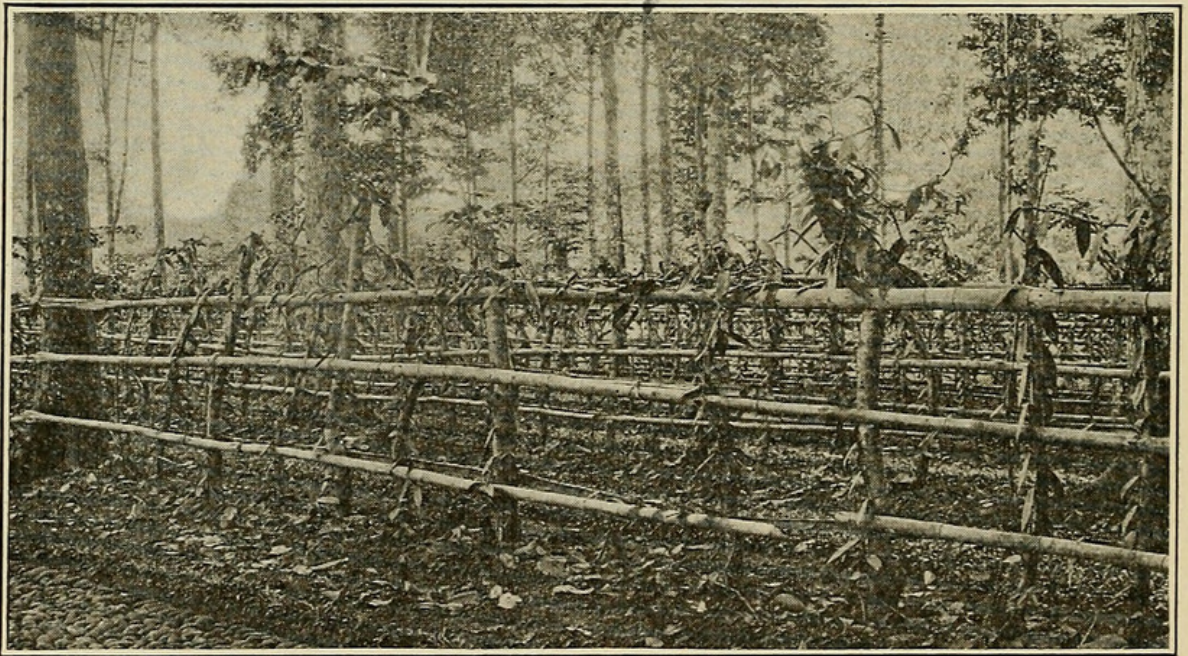


FIG. 24. A trellis of *Vanilla*.

bend upward, forming a very prominent elbow. The same peculiarity is observable in many species of tropical trees, but in none more clearly than in the clove.

Many plots in this section are planted to coffee. The visitor who knows of *Coffea arabica* only will be surprised at the display

of other species. The cultivation of *C. arabica* on a large scale has long since ceased in Java because of the ravages of the parasite *Hemileia vastatrix*. It was followed by *Coffea liberica*, and it by *Coffea robusta*, which now produces the bulk of Java coffee. But in the garden are also plants of at least a dozen other species or hybrids. These have been introduced from the Congo region and the Sudan in the hope that among them will be found, or from them may be developed, a variety that will combine the flavor of *Coffea arabica* with an immunity to *Hemileia*.

Most of the plots of coffee are planted with some species of legume between them for a catch-crop, and when older they are shaded by small trees of the same family. Shade is necessary to the coffee plants, and the leguminous trees furnish the protection and enrich the soil at the same time. The selection of the proper shade-tree is a matter of considerable importance and numerous species are on trial in the garden. The plant must grow rapidly, to keep well above the coffee, must not make too dense a shade, must have a spreading crown, and must be resistant to disease and wind. Until recent years the dadap, *Erythrina indica*, was in general use as a shade-tree, but it was lately attacked by a fungus disease and has had to be replaced in many plantations. At present *Leucaena glauca* is chiefly favored. This American species, imported into Java from the Philippines, is now grown even in Africa under the name of "Javaschattebaum."

There is also a plot of India rubber, *Ficus elastica*, composed of very old trees, covered with epiphytic ferns, and with a wonderful display of prop roots. Its branches are always ascending, never horizontal, and the prop roots always arise near the main trunk, so that the plant assumes nothing of the true banyan habit. As an illustration of prop roots, however, the plants excel anything to be seen in the botanical garden. The trunks and branches are always scarred with hundreds of oblique cuts, made in tapping for rubber. None of these is fresh and the plot as a whole is apparently neglected. In fact, most India rubber plantations in Java are neglected, although they can be seen frequently from the train windows. The species was always subject to disease,

and its cultivation at present is not profitable in competition with *Hevea*.

One of the most attractive features of the garden is the extensive grove of the oil palm, *Elaeis guinneensis*. These tall massive palms have rough trunks caused by the persistent leaf-bases, which afford a good foothold for ferns and orchids, so that they are now almost hidden by greenery. The straight avenues of palms, the luxuriance and variety of the epiphytes, the great leaves interlaced far above, and the semi-twilight beneath combine to produce an effect little, if any, inferior to the famous Canary Avenue of the Botanical Garden.

In the southwestern section of the garden a larger variety of economic species may be seen. There are fragrant young plants of *Cinnamomum zeylanicum*, yielding cinnamon, and *C. cassia*, yielding cassia bark. The two species of tea, *Thea chinensis* and *T. assamica*, grow side by side, but both appear to be in poor condition in this hot lowland climate. These tea plants are not picked regularly, and consequently grow taller than they do on plantations. For the same reason they also bloom freely, and the three-lobed capsules may frequently be found upon them. *Vanilla planifolia* is cultivated on two long trellises. There is a good-sized grove of four or five species of gutta-percha. Of these probably the largest is *Palaquium Treubii*, named for the former director of the garden. There are plants of *Strychnos* and *Cinchona*, sources of the well-known drugs.

Still two other species of rubber trees are grown in this section. Of these, *Castilloa elastica*, the ceara rubber, has been planted the longest. The trees are now about 60 feet high and have been tapped for rubber. Near them are seedlings of two other species of the same genus, planted for experimental purposes. *Manihot Glaziovii*, the fourth of the important commercial species, is growing in the same plot, but is represented only by small plants. A small planting of *Ficus Vogeltii* is a relic of attempts to use this species for rubber, when the plantations of *F. elastica* were failing, and before the universal introduction of *Hevea*. The old trees are short and squat, reminding one of old apple trees, but their gray, obliquely ascending branches are perfectly characteristic of the genus *Ficus*.

In this section also may be seen various species of *Andropogon*, yielding ethereal oils, and a number of fiber plants, such as species of *Agave*, *Hibiscus*, and *Sansevieria*. Most interesting to an American in this connection are the plants of abaca, *Musa textilis*. This species is a native of the Philippines, and as the source of Manila hemp is the foundation of a large and ever increasing industry. As yet it has not been found practicable or profitable to cultivate the species elsewhere, so that, for the time being at least, the Americans enjoy a natural monopoly of this important fiber.

The few species so briefly mentioned here indicate merely some of the more important or interesting features of the garden. There are scores of other species, used as forage or food plants, for oil, for drugs, in dyeing, and in many other ways.

As the visitor leaves the garden, he may well pause a few minutes on the Landbouwweg and watch the display of local economic plants. An unceasing stream of natives, each with a shoulder-pole and two loaded baskets, passes by on the way to



FIG. 25. Rice terraces on the Praenger Plateau, Java.

market. A dozen different plant products may be seen in as many minutes and each of them is of a little more interest to the tourist if he has already seen the live plant growing in the garden.

Of the various agricultural operations of the natives, the only one which deserves mention here is the rice industry. As in all the Asiatic tropics, rice is the staple food of the natives, and a correspondingly large proportion of the land is devoted to it. Between Batavia and Buitenzorg, one would estimate that two thirds of the land is in rice, and in certain other places the proportion is doubtless higher.

In the lowlands between Buitenzorg and the coast, the rice fields are usually extensive, and are separated by fields of tapioca and the groves and gardens around the villages. An observer gets the impression that the best land is always devoted to rice, while the other crops merely occupy what is left. That is doubtless true to a considerable extent, but the possibilities of irrigation must be considered.

The average rice *sawah* is located on a gently sloping hillside and is divided by earth terraces into numerous small level plots, whose size depends on the steepness of the slope. The natives avoid unnecessary labor as far as possible, and the terraces follow the contours quite closely. This leads to a peculiar optical effect, by which the relief of the ground is accentuated when viewed from the bottom, and is apparently flattened when seen from the top of the slope.

On the steeper hillsides, the natives go to great pains to use all the available land, building earth walls sometimes eight feet high, with nearly vertical outer faces, to support a narrow strip of rice above it. If the hillside is rocky, the walls are so located as to take advantage of the larger stones, while the smaller movable rocks are built into the terrace walls. The crest of the walls rises only a few inches above the water level behind it, and is about eighteen inches wide on top. So close to the water, they are always muddy, and are generally covered with various small weeds, especially sensitive plants. Laborers are always busy in the *sawahs*, working with huge hoes, and most of their labor seems to be the maintenance of the terraces.

The water supply is always taken from a river. The rapidly flowing streams descending from the mountains are diverted into irrigation canals, and the water is conducted at a slight fall in a

sluggish stream until it is many feet above the natural channel. Then a part of it is turned into the uppermost terraces of the *sawah*. These are filled to the proper level, and overflow into the next one below. If the terrace is small and the stream of water in proportion, it may spill out over the wall, but usually a split bamboo serves as the conduit. In this way the water in each terrace does not become stagnant, but is used in turn for other terraces, until it finally reaches the lowest and empties back into the river channel. Nor does its usefulness cease here, for the same stream may be diverted many times at successively

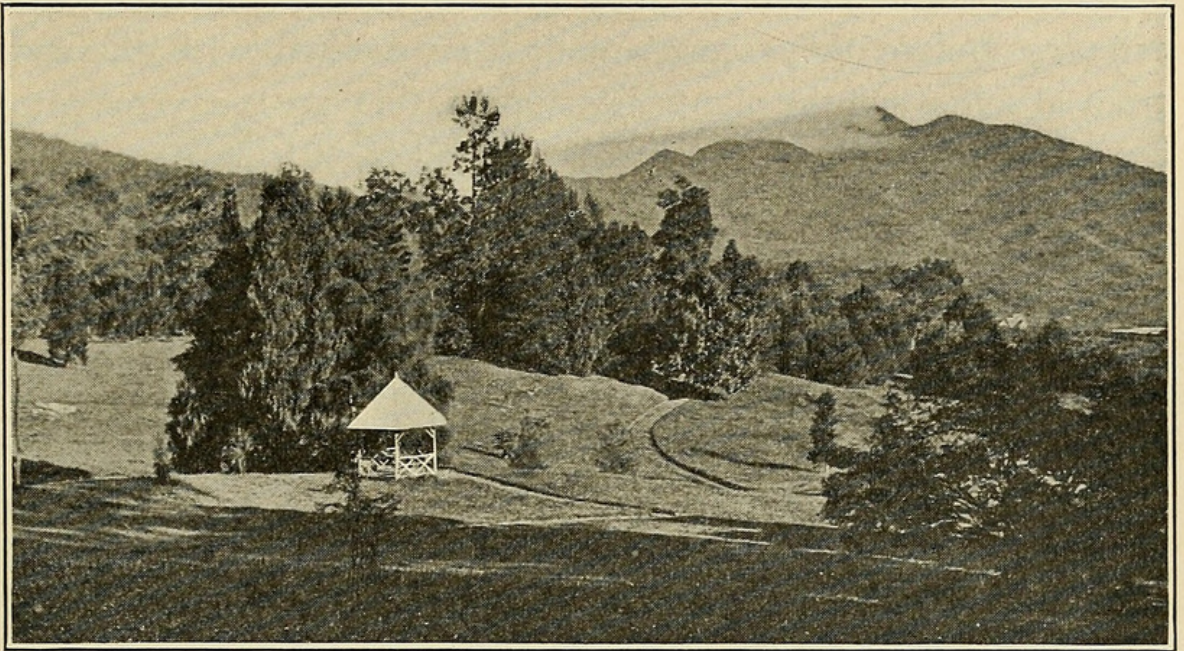


FIG. 26. The mountain garden at Tjibodas, Java.

lower levels. One can understand why the water of the lowland rivers is so muddy, when it has passed through some hundreds of rice-fields on its way down from the hills.

The magnitude of some of the irrigation systems is surprising. In Buitenzorg a concrete dam diverts the entire current of the Tji Sadane into an irrigation canal, so that the river bed below is merely a mass of boulders with a few small pools of water. The canal, a hundred feet wide, has been excavated in the hills to a depth of at least fifty feet. In the rural districts one is seldom out of sight or sound of some little canal, running either to or from the *sawahs*.

The Preanger plateau, lying to the southeast of Buitenzorg,

is famous for its rice cultivation. Our first view of this region was from a mountain pass at an altitude of 4,900 feet. Here the whole expanse of plateau was spread out before us, glittering with the reflection of sunlight from thousands of *sawahs*. For miles ahead the country was terraced, even on the steepest hillsides, into large fields of an acre or little fields as small as a room, but mostly the latter, because the country is very hilly. The terraces here are made, to a considerable extent, of rocks, and around the huge boulders bananas are frequently planted.

There are no shades of green in temperate zones to rival those of the tropics, and there the most brilliant greens of all are in the *sawahs*. Before they are planted, they are red with the red tropical soil, when the plants first appear, they are converted into a series of mirrors, as the sky is reflected back from the water, with just a faint tinge of yellowish-green from the young plants. Then it becomes a bright yellow-green, a bright emerald green, and later an intense deep green. Then the green turns to white as the rice heads out, then to yellow as it ripens, and finally to a pale yellow-brown as the old straw is left after harvest. One can look over a couple of miles of terraced valley and see the whole extent mottled with every one of these shades at once. No two valleys are ever terraced in the same way, and no two *sawahs* look exactly alike, so that they never lose their attractiveness to the traveller.

As the rice grows, so do the plants on the terraces, until at the time of brightest green one can hardly distinguish where the terraces are. Here too, as in all mountainous countries, it is impossible to decide on what is true level, so that many of the level *sawahs* seem to slope uphill. Little irrigation canals go rushing down the hills over the *sawahs*, other little canals flow smoothly and quietly around the hills between them, hollowed logs of coconut carry one stream across another, little streams drop over a low spot in the terrace wall from one *sawah* to the next, and all the water is used over again, in a series of rice fields, clear to the ocean. Paths run along the terraces from one village to another, brown bitterns fly over the *sawahs*, white herons wade in the shallow water, windmills whirl and squeak, scare-crows

flap in the breeze, small boys crack whips or pound bamboos together and shout at the birds, women with big flat baskets seine the unplanted *sawahs* for fish, and catch them, too. Always the rice fields are interesting to look at and always something interesting is happening on them.

The Mountain Garden at Tjibodas is reached most conveniently from the excellent hotel in the little village of Sindanglaja. Here at an altitude of 3,500 feet the climate is always cool, and there are many conveniences not to be found in the sleeping quarters in the garden. A well-made path ascends steeply through the rice fields to the garden, about an hour distant and some 1,500 feet higher. Beyond the *sawahs* the path crosses the

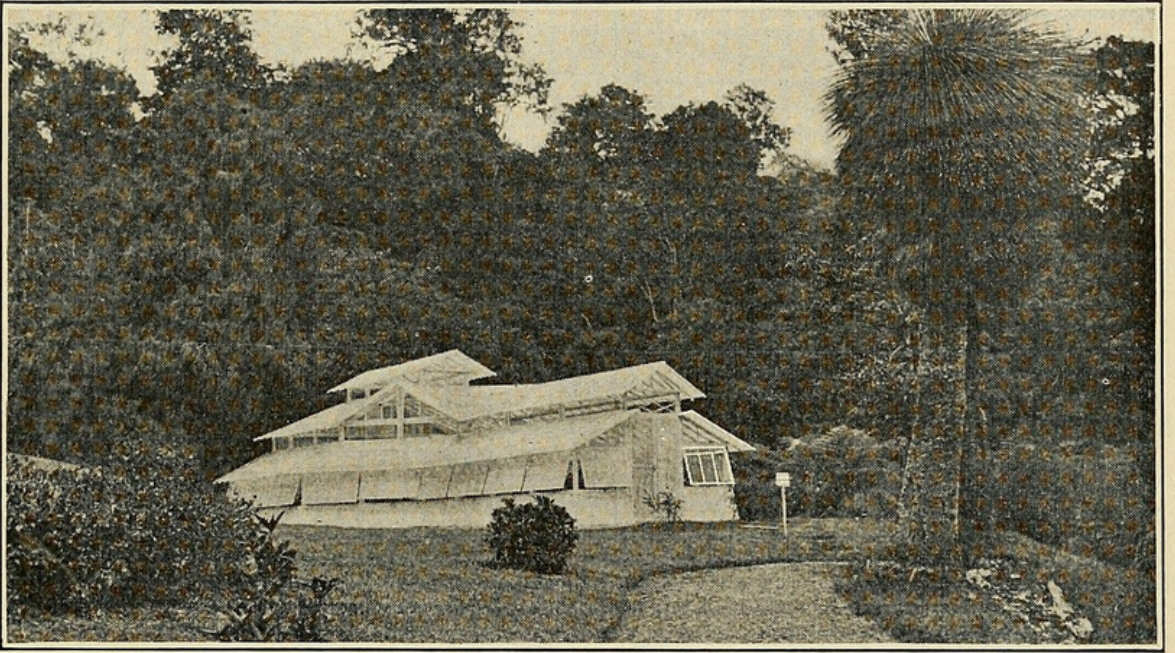


FIG. 27. The glass-house and a large grass-tree at Tjibodas, Java.

smooth lawns of the garden, with some remarkable views of the mountains to the east, and reaches the laboratory building under a row of huge *Araucaria* trees.

The one building is a simple but attractive one-story house of wood, containing a laboratory room and four sleeping rooms, three of which are available to visiting botanists. The laboratory room is small and very plainly furnished, with some tables, a couple of cases for apparatus, and a small collection of books. It does not seem to be well fitted for any sort of experimental

work. There is also a small glass-house, necessitated by the relatively cool climate at this altitude.

In front of the laboratory are the plantings, and they are decidedly suggestive of a temperate zone climate, with rectangular flower-beds, lawns, and coniferous trees. The best feature of the plantings is the display of conifers, which seems to find almost optimum conditions in this mild cool rainy climate. The genera *Agathis*, *Cryptomeria*, *Cupressus* and *Dacrydium* are represented by large trees of several species, and there are numerous species of *Araucaria*. The genus *Pinus* is completely lacking: in fact, the only genus of eastern America represented is *Juniperus*, with a couple of species.

Behind the laboratory is the government reserve of original forest, extending almost all the way to the top of the Gedeh. There are good paths through it in every direction, the different sections of the garden are numbered, so that plants are easily located, and many of the trees are labeled. The most interesting trees to us were *Vernonia arborescens*, up to three feet in diameter, and *Altingia excelsa*, up to eight feet. In general, giant trees are not common. Epiphytes and lianas occur profusely, but most of them are comparatively small. The ground cover is dense, with numerous species of ferns, *Medinilla*, and Marantaceae. Buttress roots are not well developed, and strangling figs are few in number and small in size. The numerous paths through the forest make all parts of it more accessible than is the case on Mt. Makiling, but as far as the vegetation is concerned, the Tjibodas forest is far inferior to the one on Makiling. This is probably due to the greater altitude and the consequently cooler climate, since the highest peak of Mt. Makiling is over a thousand feet below the lower edge of the Tjibodas forest.

We left Java for Ceylon in the middle of February, and that island will be considered in the next of these sketches.

(To be continued)



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