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THE MONTHLY BULLETIN.

**WATER HYACINTH.**

**A Menace to Navigation in the South.**

By ETHELBERT JOHNSON,<sup>1</sup> Sacramento, California.

Florists in southern California offer for sale a beautiful aquatic plant called water hyacinth, *Eichhornia crassipes* Solms. This plant, so highly prized in aquaria, and its near relatives, the pickerel weeds, have come into ill repute among navigators in tropical and subtropical waters, and more especially in the Gulf States, where the enormous sums expended in clearing streams of this pest have earned it the name

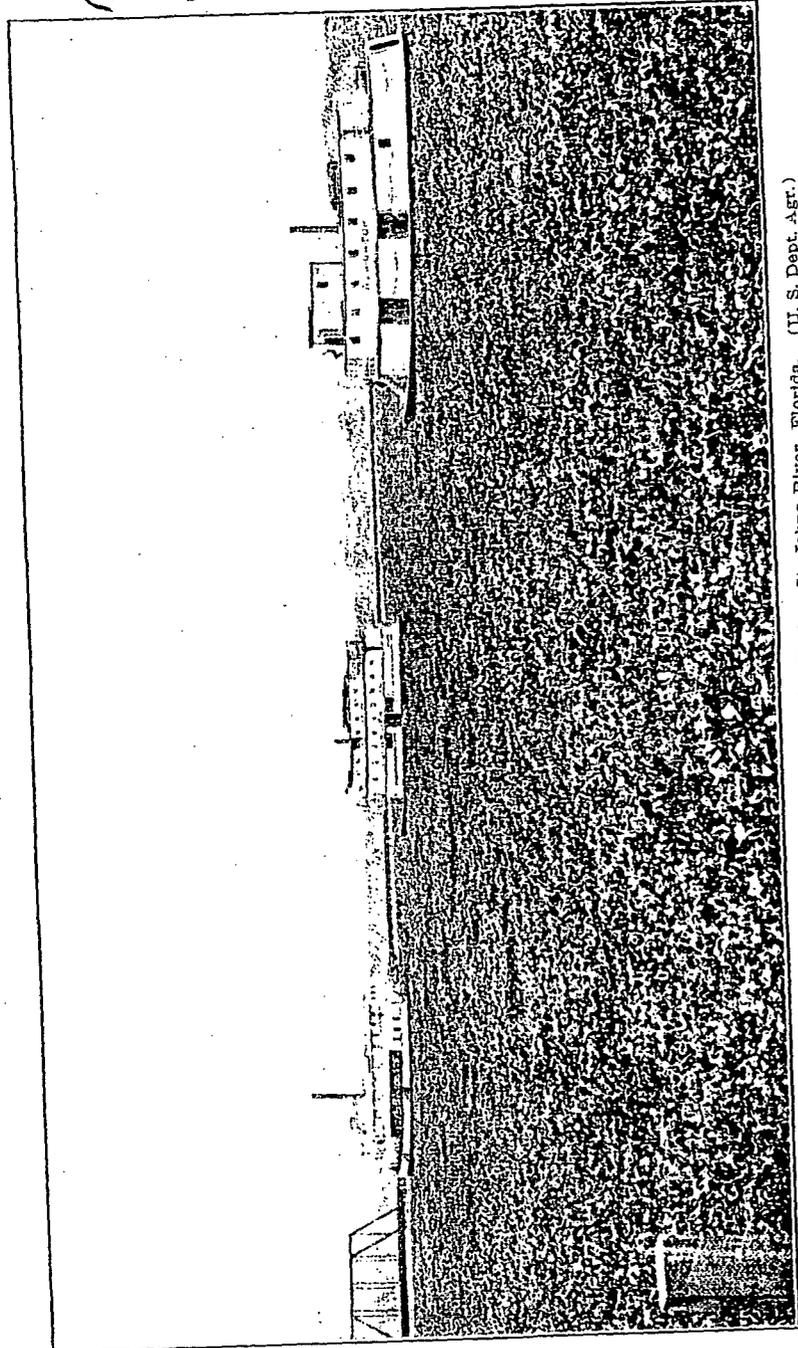


FIG. 20. Water hyacinth obstructing navigation at the Palatka Bridge, St. Johns River, Florida. (U. S. Dept. Agr.)



FIG. 21. Water hyacinth (*Eichhornia crassipes* Solms.). (U. S. Dept. Agr.)

of "million dollar weed." The history of its establishment is not known, but it was certainly introduced as an ornamental aquatic, and is said to have been planted in a pond near Palatka, Florida, where it soon became so abundant as to necessitate control measures, and it was taken up and thrown into the St. Johns River.

In addition to interfering with navigation the abundance of water hyacinth in the St. Johns River and its tributaries at one time caused an annual loss of about one-fourth the value of the logs rafted down

<sup>1</sup>Technical Assistant, Division of Plant Industry, State Department of Agriculture.

the river from the valuable forests of cypress, pine and red cedar bordering on that stream. The fishing industry also suffers, because of the difficulty encountered by fishermen in setting their nets. In time of flood, the bridges have sometimes been too low to allow the collected mass of plants to pass under, and the pressure has overturned them. Moreover, the rank and decaying vegetation has been declared a menace to health and sanitation, as it not only affords a shelter and breeding place for disease-carrying insects, but interferes with the disposal of sewage.

A description of the plant and its habits, with a view to considering the possibility of its becoming established in the navigable streams of California, and a consideration of the methods whereby its control has been attempted, is the object of this paper.

#### DESCRIPTION.

The plant is a floating perennial, the leaves forming in rosettes usually one to two feet in height from the surface of the water. The leaves are of two kinds: those below the surface of the water are long and narrow, while those above the water line are usually broad, obovate to

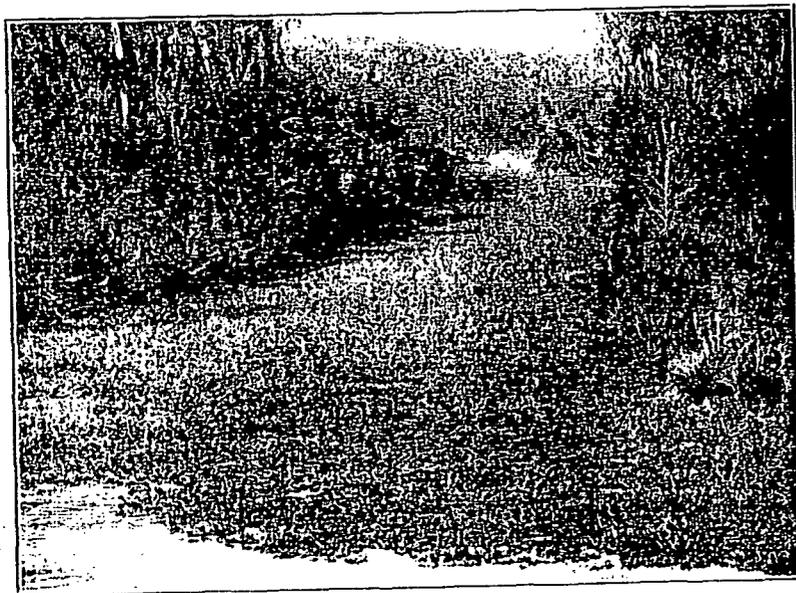


FIG. 23. An inland creek, completely covered with water hyacinth. (U. S. Dept. Agr.)

nearly circular. The leaf stems are enlarged into oval bulbs filled with aircells, especially in young plants and when the plants are growing in small groups. When the leaves are crowded the bladder-like petioles are not so large.

The stem which bears the flower is about a foot long, with a single leaf and several wavy-margined sheaths at and above the middle. This stem bears about eight flowers in a loose terminal spike. The flowers are funnel-shaped, pale violet in color, with six lobes, the upper of which

is larger than the others and has on it a large patch of blue with an oblong or pear-shaped spot of bright yellow in the center. The stamens are all curved toward the tip, three of them long and three short. The seed pod is three celled, becoming an egg-shaped or elongated capsule with the withered perianth remaining attached.

The plant produces numerous seeds. At maturity, the stem bends so as to immerse the pod. Propagation is also by means of runners which send out roots from the nodes.

The roots are of two kinds: horizontal roots, which are often thick and fleshy and pieces of which will grow readily; and vertical roots, with a slender, wirelike stem, often as long as two feet, covered with small fibrous roots which give them a feathery appearance. The roots are exceedingly numerous, forming a dense brushy mass. Where the water is shallow, the roots penetrate the soil and become anchored, but in deeper water they float freely.

The tops are easily killed by frost, for the plant is a native of tropical South America, but the root system is kept alive by its immersion in water. The growth is most vigorous in spring. During the season of

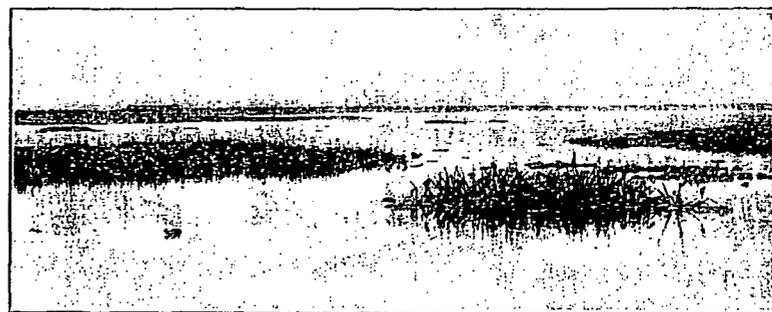


FIG. 23. Floating masses of water hyacinth. (U. S. Dept. Agr.)

low water the leaves become yellowish and growth appears to be retarded. After the plant has been established in any locality for a number of years, the growth is less vigorous than when young, but after a flood it resumes its vigorous growth in response to the new supply of nutrient material. It is quite sensitive to salt water, but thrives in subsaline or brackish water.

#### CONTROL.

The water hyacinth is so abundant in Florida, Louisiana, and Texas as to obstruct navigation in the waters emptying into the Gulf of Mexico. Its eradication was entrusted in 1899 to the United States Engineer's Office of the War Department, to which was given "authority to remove the plant by any chemical, mechanical, or other means whatever." From that time the Engineer Office has worked continuously on eradication, and has spent hundreds of thousands of dollars in attempting to remove it from navigable streams.

No method has ever been found which will completely remove the plant at a reasonable cost, although every known chemical has been experimented with; but the solution which has been found most effective is an arsenical spray.

The water hyacinth is eaten with relish by stock, and in Florida its use as a feed had become so well established that it was considered necessary, in making an appropriation by the Rivers and Harbors Act of 1905 for the removal of the plant from the St. Johns River and other navigable streams of Florida, to insert a proviso that "no chemical process be used injurious to cattle." It was at first attempted to break up the masses of the plant and push the pieces into the current, but this was found unsatisfactory and exceedingly expensive. Since 1909 an elevator fixed to a barge has been used which gathers the plant in much the same way as kelp is gathered. Fixed booms are maintained across non-navigable streams to prevent the plant floating into navigable streams, and movable and semi-automatic booms to prevent its floating from one navigable stream into another. Laborers and watchmen are employed to detect or prevent the spread of the plant.

In the other Gulf States, the use of chemicals is not prohibited, and although some difficulties are encountered by owners of stock along the streams allowing their animals to eat the sprayed plant, with fatal results, in general local cooperation is obtained in combating the pest.

In Louisiana, two barges, propelled by gasoline launches, and equipped with tanks for mixing and pumps for spraying the chemical solution, are kept continually in service from about April 1 to December 1 of each year. It is necessary also to maintain booms across the stream as in Florida.

To make the solution used in spraying the water hyacinths, 600 pounds of white arsenic and 600 pounds of sal soda are placed in a tank with about 600 gallons of water. The mixture is brought to a boil and kept boiling for two hours. It is then drained off and diluted with cold water to 9,600 to 12,000 gallons, depending on the strength of solution desired.

For spraying the solution over the hyacinths a duplex Worthington pump 4½ inches by 2½ inches by 4 inches is used, with one-inch six-ply steam hose and a Fuller nozzle which is designed to give a very fine spray. The pressure on the hose is usually 50 pounds. On warm sunny days, one gallon of the diluted solution is ordinarily sufficient to destroy ten square yards of hyacinths. If the day is cloudy or cool, a larger quantity is necessary. Where the hyacinths are very tall, the spray does not reach the shorter plants, and a second application becomes necessary to reach those not killed at first. In the year ending June 30, 1919, the two barges sprayed 1,613,383 square yards of the hyacinth in Louisiana waters, using 201,908 gallons of solution, at a total cost of \$13,464.21, or \$0.0083 per square yard.

In spite of the enormous quantities of this pest destroyed annually since the work was first undertaken in 1899, it is still necessary to repeat the control measures year after year. So insidious is this floating menace to navigation that wherever the strictest precautions are not observed, a stream or harbor may be over night rendered impassable.

It is hardly likely that this tropical plant could become established naturally in the waters of the Sacramento and San Joaquin rivers in California, but it is extremely probable that if once transplanted here, it would spread rapidly and soon prove as great a menace to navigation as it is in the waters emptying into the Gulf of Mexico.

## MOSQUITO ABATEMENT IN SAN FRANCISCO BAY DISTRICT.

By R. W. DOANE, Palo Alto, California.

We hear much and we read much about the insects that injure our orchards and our field crops. We hear something and we read something about the insect pests of our domestic animals. But in our eagerness to get the highest yield from our orchards or our fields, or to get the best returns from our stock and receive the highest prices for these things, we too often forget that our families and our neighbors and the communities in which we live, have a right to be protected from the insect pests that bother them.

Certain progressive districts in the state have realized the importance of protecting themselves from the mosquitoes that carry malaria, and, incidentally, they have been relieved from torment by other mosquitoes. Ask anyone who lives in one of these districts whether it pays and see how enthusiastic he becomes.

For several years two or three districts have been successfully fighting mosquitoes in regions where malaria is not endemic, and the Anopheles mosquitoes, therefore, were little to be feared. Other species, however, particularly those that breed in the salt marshes, were very serious pests of man and beast. These were often so bad that people working in their gardens, especially around shrubbery, had to protect themselves with screens and gloves if they wished to work in comfort. And there was no chance at all of enjoying a warm afternoon or evening on a cool open porch.

The successful way in which the residents of San Mateo County met and remedied these conditions, convinced the people in the northern part of Santa Clara County that they, too, might get relief from these pests in the same way and so the Matadero mosquito abatement district was organized and in the fall of 1918 work was begun, and this little story is to tell of the remarkably satisfactory results that were achieved.

One side of the district is bounded by a rather extensive salt marsh, over which the water of San Francisco Bay flows during the monthly high tides. The tide pools on these marshes were the source of most of the mosquitoes that pestered the residents of the whole district, for it was found that 80 per cent to 90 per cent of the mosquitoes that occurred around the houses, in the towns, in the woods, and in the foothills, were species that were breeding on the salt marshes. This was true not only for places within three to five miles of the marshes, but the salt marsh species were often the predominating forms ten miles or more from the marshes. They were doubtless carried inland by the prevailing light breezes.

Two species, *Aedes squamiger* and *Aedes onondagensis* (*O. lativittatus*) occurred commonly on these marshes, the latter seeming to be the most abundant.

Several fresh water species occur throughout the region. *Culiseta incidens* and *Culex tarsalis*, usually being the most abundant. Locally these are sometimes very troublesome, *C. incidens* is a vicious biter, but *C. tarsalis* is more persistent and often more annoying.

The district was organized under a state law which empowers the county commissioners, upon the petition of the majority of the residents of a district, to levy a special tax to provide for controlling mosquitoes and other pests. For the first year's work a tax of ten

<sup>1</sup>Heland Stanford Junior University, Palo Alto, California.