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There was once a mapmaker, see...And he was asked to chart a 19-mile long by one or two mile wide stretch of sand along the Bradford-Clay County line, four miles east of Starke, known as Trail Ridge.

The young cartographer completed all of his preliminary calculations and began to start drafting the finished product. Being a very thorough fellow and impressed with the need for accuracy, he decided to recheck some measurements, just to be on the safe side.

It had been a month since he first pulled out his tripod and other tools of the trade – but to his profound amazement and dismay, two manmade lakes at either end of the sandy tract had crept 600 feet closer to each other than when first measured!

But, in spite of his fears, his instruments hadn't malfunctioned, and the young mapmaker was cold sober. The lakes actually had moved, and they'll keep on moving at about the same 600 feet per month until they finally meet and merge in another 25 years – about the time that Starke welcomes the year 2005.

Our conscientious young mapmaker wasn't from this area, and he can be partially excused for his befuddled conclusion that the earth must indeed be shrinking. The fact is that many residents of Bradford County know little more than our confused friend about the huge mining operation and its mysterious "movable" lakes – this, in spite of the fact that the E.I. DuPont de Nemours Company has been hard at it, east of Starke and Lawtey, for 30 years now.

Close to 400,000 tons of valuable heavy minerals are extracted yearly from what appears to be the same old Florida quartz sand we curse when it blows into our picnic lunch, or is tracked into our house. But there's one big difference – three to four per cent of the Trail Ridge sand contains an assortment of minerals that are sucked up, swirled, piped and separated before heading to points throughout the U.S. for conversion into a usable product.

The task of separating minerals from the sand is done by mammoth, complex machinery, plus the skills of 338 men and women, earning an annual payroll of close to \$5 million – making DuPont operations, known collectively as The Florida Plant, the county's largest industry and largest non-government employer. About 90 per cent of the employees reside in Bradford County, and most of the payroll is spent here, too.

The moving force behind the lakes and the Blanding Trail Ridge site and Lawtey Highland Plant are two giant dredges, looking somewhat like huge, waterborne, mechanical beetles that can tunnel as deep as 40 feet to find their ore.

The original Trail Ridge dredge, in use since the mine first started production in 1949, was recently replaced by a larger, improved – but still basically similar dredge, and this new behemoth is scheduled to chew its way through a 200-foot gap in State Road 16 later this year, probably in October. Traffic will be detoured to SR-230, and cut-through should take about three months, according to K.B. Platt, plant manager.



Dupont's original dredge makes picturesque scene as it eats its way through ilmenite ore body in "moving lake." This dredge was replaced early this year by new dredge with larger capacity.

The old dredge had been in use for 30 years before retirement, a real testimonial to the maintenance capabilities of the dredge's caretakers – plants mechanics who are assigned for repairs about one day every other week.

With 1,100 tons of adhesive sand passing through the mechanism every hour, seven days a week, 24 hours a day, it is understandable why repairs are a routine aspect of the sand-mineral dredging operation. Add this maintenance item to the other costs of land reclamation and water purification, and dredging for heavy minerals becomes quite expensive. But the mineral harvest from the sands makes it all worthwhile.

Ilmenite, zircon, staurolite may sound like elements found on a far off planet, but the truth is that the average consumer comes in contact with all three, in their processed form, every day.

Ilmenite, after being converted to titanium dioxide, becomes the whitest substance know to man, despite its blackness in the natural state. White TiO_2 pigment make from Starke ilmenite

provides color and hides the surface beneath the paint layer. TiO_2 pigment is also used to make paper and plastic goods white, and is added to manmade fibers as a delusterant. Zircon is mined only in Florida, and is used in sand foundry industries. The metal, Zirconium, coats the inside of nuclear reactors, preventing the escape of radiation. Staurolite, the lightest of the three, is used in concrete, and also in steel sandblasting.

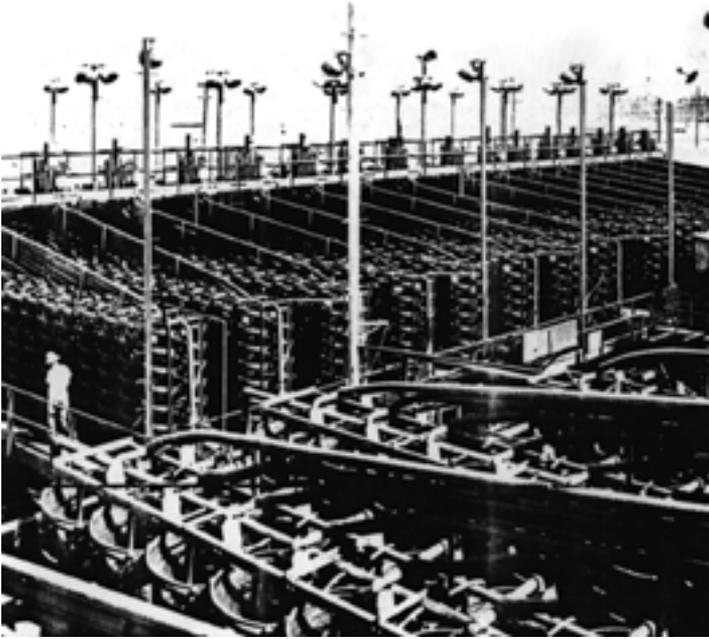
THE STORY HOW IT CAME TO BE

Three widely diverse and somewhat exotic factors account for the DuPont operation atop Trail Ridge.

These three strange elements concern a one-time Rajah of Travancore, a tiny country on the southwest tip of India; the earth's ice age, millions of years ago; and a crew of eight men in snake-proof boots, drilling holes in the ground in 1946. Without any one of these three seemingly unrelated factors, DuPont may never have dredged its first ton of ilmenite at the local plants.

Most of the ice age discussion will be left to Tom Garner, DuPont's resident geologist, whose article on the formation of the Trail Ridge appears in this section. Suffice it to say that Florida, submerged under the sea millions of years ago, began to emerge as the polar caps froze and the sea levels began to lower. One of the first parts of the peninsula to emerge from the sea was our own Trail Ridge, which is actually composed of sand dunes that were part of an ancient beach. The heavy minerals now being mined came from eroded rocks in other areas, washed down to the sea in streams, and deposited on Trail Ridge by the action of wind and wave.

As for the Rajah of Travancore – he enters the scene in the early days of World War II when he decided to raise the price on India's ilmenite, the being exported to the DuPont Company. The beaches of southwestern India have a rich deposit of heavy minerals – about 75 per cent concentration, as compared to only four per cent in Trail Ridge. Prior to World War II, U.S. Paint manufacturers were importing all the ilmenite they needed at a low price from India, where the mining is done by hand with cheap labor.



Imposing banks of spirals where ilmenite undergoes its first separation, by centrifugal force, from the quartz sand in which it is found.

But political unrest as a result of the war made the Indian ilmenite supply uncertain, and the U.S. Bureau of Mines and DuPont began a joint search for a reliable domestic supply of the mineral, which eventually led them to Florida.

As a matter of fact, before supplies from India were entirely cut off. DuPont had already started the search for domestic ilmenite, since the Indian source, though inexpensive, was not entirely satisfactory. For one thing, shipments were restricted to only six months a year because of the monsoon season during the other six months. Also, the Indian coastline had no good harbors, and the titanium concentrate had to be loaded into dugout canoes and floated out to freighters standing well offshore – an extremely slow and precarious process, obviously not keyed to modern methods of American production.

Florida geologists had been aware of the existence of ilmenite in lake beaches of this area for quite some time, since a report of the Florida Geological Survey had mentioned heavy mineral concentrates as early as 1928. Ilmenite may still be seen in the beaches of Kingsley lake as streaks of silky smooth, fine black sand in the otherwise coarse white sand. Although the presence of the minerals was known the deposits were not considered commercially feasible to mine.

Eighteen years later, in July 1946, the Bureau of Mines, working with a \$10,000 grant, began an in-depth exploration of Florida's inland beach sites as well as off-shore locations. On the suggestion of veteran state geologist, Dr. Herman Gunter, they concentrated their efforts in the Trail Ridge area. Drill samples were taken, and large concentrations of heavy minerals – though low grade ore – were disclosed in an area 3,000 to 8,000 feet wide and 19 miles long, almost the exact outline of the present mining area along Trail Ridge.

DuPont had started its own search in Florida before the Bureau project was begun, but had failed to find anything to interest it commercially on present day beaches or off-shore sites. The company's geologists had also drilled along Trail Ridge, but did not at that time consider it an economic ore body. However, when the Bureau of Mines crew came along, with money to spend for "wildcatting," the DuPont geologists told them to "go to it" and see what they could find. The closer check by Bureau crews was encouraging enough to lead DuPont to negotiate a contract with the State Armory Board in December, 1947 for the lease of 4,000 acres of Camp Blanding land.

Curtis J. Malone, now DuPont's laboratory supervisor, was with Dr. Gilson and six other men when DuPont began serious exploration of the ridge in September, 1947, three months before the contract was signed. Malone's lengthy tenure is not unusual, 131 employees at the Florida Plant have over 25 years of service, and 94 are still on the job.

An eight-man sleeping hut left over from Blanding's active days was the only building on the site, and it served as a home away from home for the eight men. The explorers, among them two geologists, a mining engineer, and a maintenance mechanic,



Some of the first testing for use of spiral process with ilmenite was done with simulated spiral made from old rubber tire before Trail Ridge mine construction began.

had the job of determining the amount, quality, and size of the Trail ridge ore body.

“We knew it was here, but it hadn’t been defined. We had to find a big deposit before DuPont would decide it was commercially feasible to mine,” says Malone.

After taking core samples at half-mile intervals and then moving closer to make sure the concentration was consistent, DuPont’s men disclosed a saucer-shaped ridge with a concentration of four per cent heavy minerals.

Compared with India’s 75 per cent concentration, the Trail Ridge deposit would not be seen economically feasible. But DuPont had an ace in the hole, and

that ace was an innovative technique for the efficient separation of minerals and sand – the spiral concentrator which had been developed by Humphreys Gold Corporation for use with gold gravels in Colorado. Although original tests by Humphreys were simply done by using an old tire as a simulated spiral, the basic premise that persuaded DuPont to go ahead with the Florida project is still in use today. Flowing through the spirals at relatively high speeds, the heavier minerals shift to the inside of the spiral rim, while the lighter sand is thrown by centrifugal force to the outside, resulting in an 80 per cent mineral concentrate leaving the wet mill after coming in as a four per cent mixture.

In February 1948, DuPont signed a contract with Humphreys for the construction and operation of the Trail Ridge Plant, and work was started the following month.

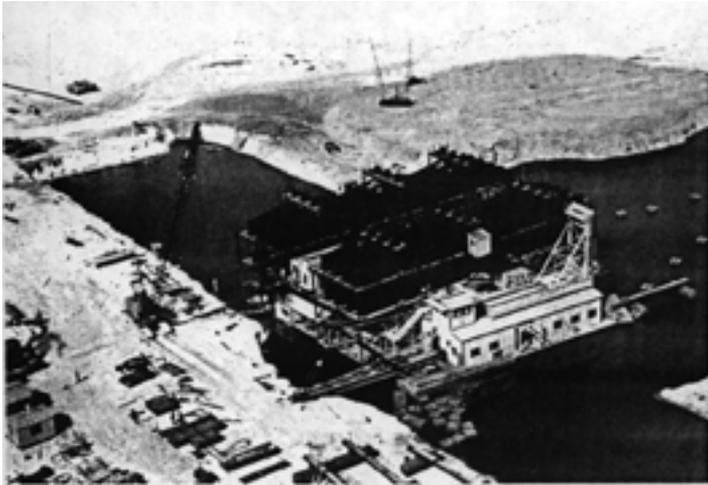
According to Bill Beam, staff engineer for DuPont since 1951, other companies, along with DuPont, had bid about the same price on the Armory Board land, but DuPont got the nod because it guaranteed starting the mining operation within the year – and it did just that. In the spring of 1949 Humphreys began operation of the Trail Ridge plant under contract with DuPont.

In a February 6, 1948 Telegraph news item, DuPont geologist Harry Cannon said the company's goal was 100,000 tons of ilmenite annually from the Blanding operation. By 1950, 211 workers were employed at the mine, with an annual payroll of \$875,000.

In 1953 DuPont expanded its operation by purchasing land near Lawtey for construction of a second plant. When operations started in 1955, the Highland Plant doubled the company's output to 200,000 tons of ilmenite per year and by 1960 the payroll had jumped to \$1,871,000 with 303 employees.

Sturdier coating materials, to reduce wear on machinery from the abrasive sand, and other minor changes have resulted in slight increases in production during the 31 years of mining here, and the addition of zircon and staurolite production have upped the total from the two mines to their present 400,000 tons a year. The spiral process, developed by Humphrey's Gold, plus electromagnetic and high tension mineral separation at the dry mill, have proved efficient and economical, and changes in basic concepts have never been necessary.

At each plant, floating dredges suck up mineral-bearing sand which, after being cleaned through a "root hog," is piped to the wet mill floating behind the dredge. There the sand is separated from the minerals through giant screens and high-speed trip through a series of spirals. The new concentrate, now 80 per cent mineral, is pumped through a pipe to the dry mill, located next to the main offices at both plants. The remaining sand, which comprises 96 per cent of the original ore, is piped behind the wet mill and sprayed into the lake, where it builds up to fill in as the dredge moves.



Aerial view of Highland Plant while under construction. Dredge (in foreground) and wet mill with its banks of spirals are pulled up side by side before actual mining gets under way.

Back at the dry mill, the concentrate goes through a series of separation processes after drying, with a separate zircon mill handling the heaviest mineral and the original dry mill separating ilmenite and staurolite. Some of the finished zircon and staurolite products are bagged at the rate of 20 bags per minute, but the vast majority of all three minerals is loaded onto rail cars for transport.

As a result of filling in with “tailings” behind the wet mill, non-fertile areas of land are formed, and DuPont spends over \$1,200 per acre to reclaim the barren acreage.

Although reclamation is now required by the Environmental Protection Agency, DuPont began its efforts long before the EPA regulations. Drew Reddish was employed in 1955 to give some professional assistance to the program, and planting experiments began in 1952. The State Armory Board, owners of the land, required the filling in of mining cavities, but DuPont took matters one step further and put much time and money into restoring vegetation on the mined-over land.

Over the years, many different varieties of trees and grass, as well as fertilizers, were tried with little success. The problem

was that the mined-out land had no organic material left to support vegetation, and it was not until 1969 that the company hit upon the answer.

A modified bulldozer, called a "scraper," was developed for literally removing six inches of top soil from the area to be mined, and then returning it later, along with roots, natural grass seeds, and organic matter, to re-cover the mined area. Six months after the topsoiling method was started, voluntary plant growth on the mined land was knee high, and pine seedlings planted there are now flourishing.

But land is not the only material that comes through the wet mill in less than perfect condition. Water must be clarified before flowing back to Alligator Creek. This, also, is no small task, considering the fact that several million gallons of water recirculated daily through each plant, and all of the overflows must be made "fishable and swimmable."

Again, DuPont has found the answer. Says manager Platt, "Actually the quality of the water leaving the plant is a lot better than the quality of the natural surface water in nearby streams. When we're through with it, the flow goes straight by the Starke golf course, and if anything was wrong, we'd hear about it."

Flowing simply by force of gravity to a series of ponds, the water is treated with acid and impure matter is settled out. The pond's overflow is crystal clear. To neutralize the acid, the water is given a final lime treatment close to the edge of the DuPont property line and flows toward Alligator Creek.

DuPont looks after the nearby community conscientiously, and its efforts will be evident for generations to come. The company has made a tremendous industrial impact, both economically and socially, on Starke and Bradford County, which had always been traditionally agricultural.

DuPont figures show the average length of service for its employees is 16.5 years, and the job security of the company's workers is reflected by the growth and stability of the area, officials say.

Industry is necessary if an area is to progress, and it is especially reassuring to see a potentially devastating industry, such

as mining, working so hard to reclaim the land that necessarily must be exploited.

“DuPont has long stood by the company’s policy to leave the land as we found it – or even better,” says plant manager, Platt.

With 25 more years of dredging to go – that’s a good thing to know.

THE EVENT

PETRIFIED LIGHTNING FROM CENTRAL FLORIDA

A PROJECT BY ALLAN MCCOLLUM

CONTEMPORARY ART MUSEUM
UNIVERSITY OF SOUTH FLORIDA
MUSEUM OF SCIENCE AND INDUSTRY
TAMPA, FLORIDA