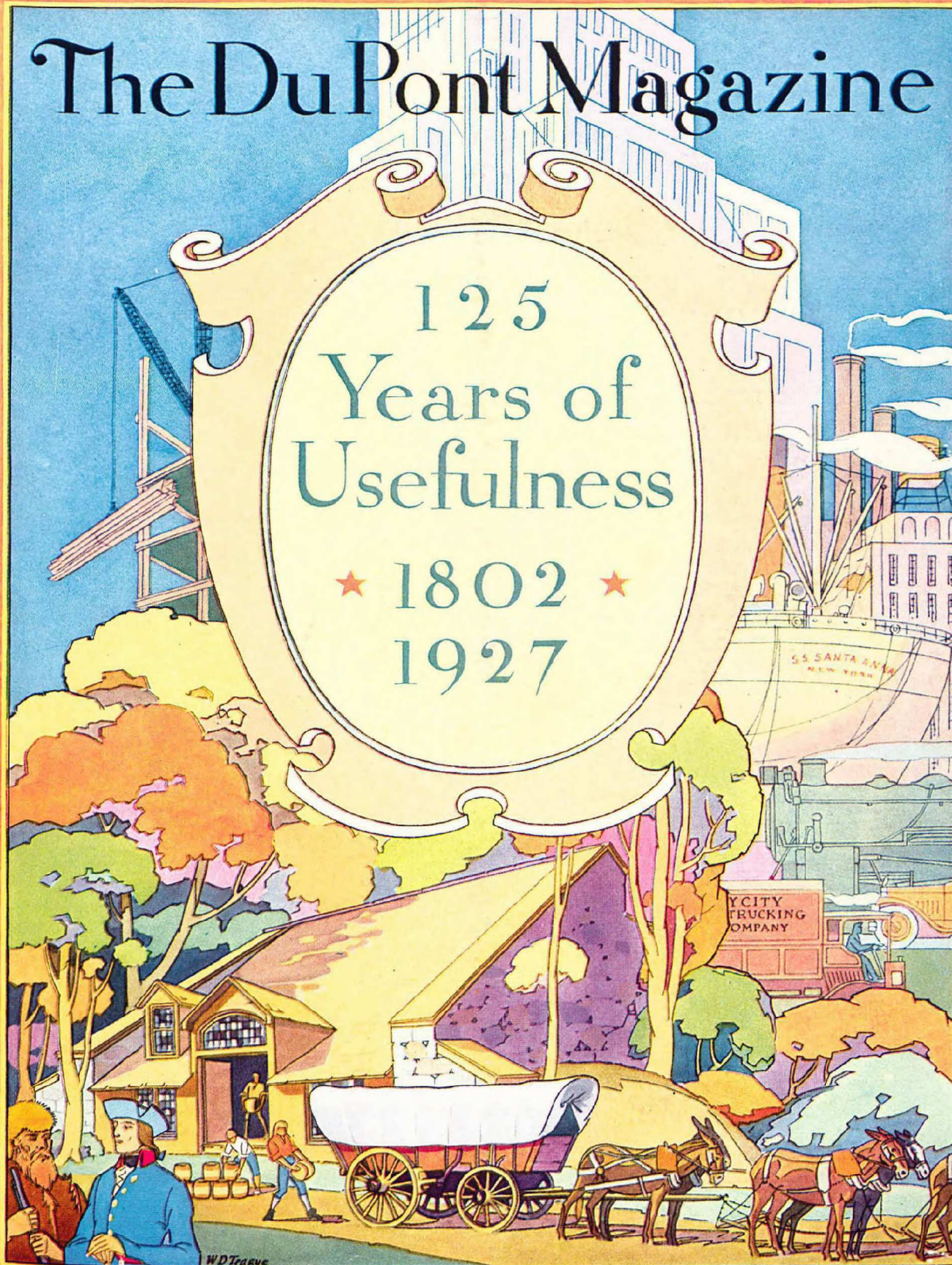


The DuPont Magazine

125
Years of
Usefulness

★ 1802 ★
1927



“**I**NDUSTRY is founded upon
the manufacture and sale
of things that make this
world a better place in which to live.

“Industry has nothing to sell save useful service

“Practical application of knowledge to the making of things which are useful in man’s every day life is Industry’s contribution to the advance of civilization.

“Civilization is our inheritance from the ages; ours, in trust for a while, to which we must add some useful knowledge that coming generations may increase their horizon.”

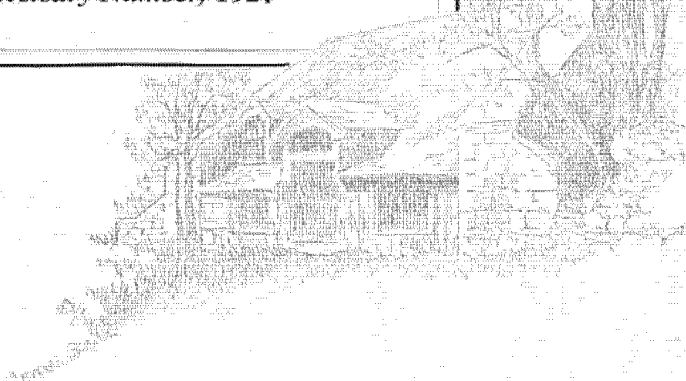
—PIERRE S. DU PONT



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Anniversary Number, 1927





The Founder of E. I. du Pont de Nemours & Company, from an Old Steel Engraving

SKETCHING THE BACKGROUND

*The du Pont Company, like the institution of which Emerson wrote,
"is the lengthened shadow of one man"*



ON New Year's Day, 1800, the *American Eagle* dropped anchor at Newport, Rhode Island, and among the passengers to disembark were three men—Pierre S. du Pont, better known as du Pont de Nemours, and his two sons, Victor and Eleuthère Irénée.

The aged father had been prominent in French national affairs and was a distinguished scholar, author and political economist. Victor, the elder son, had held various diplomatic and consular positions in the United States for more than ten years. Irénée, then twenty-eight years old, had at one time studied powder chemistry under Lavoisier when that celebrated chemist had charge of the French Government gunpowder works at Essonne. More recently he and his father had operated a printing house in Paris until political disturbances growing out of the French Revolution forced them to suspend business.

These three du Ponts had come to America—land of freedom and opportunity—to share it and to re-establish themselves and their fortunes. Originally they planned to develop a large tract of land in western Virginia, but that project never materialized. Another one did—and the du Pont Company today is its fruition.

This is the story of its inception: Irénée du Pont and Colonel Toussard spent a day together with guns and dogs.

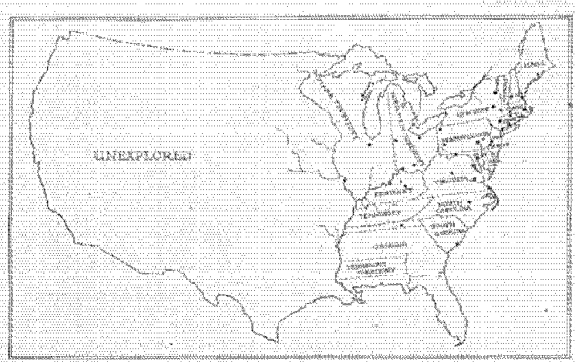
They had shot away all their powder and had bought a new supply at the nearest shop. It was of poor quality; also it was expensive, and Irénée, after learning how it was made, became convinced that a powder plant built and managed on the plan of the French Government Works

could produce a much superior product, and that a real business opportunity lay before him. He grasped it eagerly.

His friend, President Jefferson, gave him encouragement on learning of his plans. He secured financial support from friends, returned to France, purchased the machinery he needed, and in 1802 began building the first du Pont powder mills along the banks of the Brandywine Creek, near Wilmington, Delaware.

Since that time the United States has grown marvelously. Frontier lines have been pushed back from the Mississippi River to the Pacific Ocean. A network of railroads has reached out to bind the states together with bands of steel; its highways, mines and quarries, its farms and factories and all the other factors of national development have operated to place our country as a leader in world affairs. Since that time, too, the du Pont Company

has grown and expanded and developed its resources largely because its products have been useful products, honestly made and sold, and intelligently serviced. As a manufacturing organization the scope of its activities today is so large and its products are so many that to some extent at least it has outgrown public understanding. And so to mark its 125th birthday, we have sought to convey in the following pages a sketchy outline of the company's progress and products to the end that the readers of



The United States in 1800. When the du Pont family landed in America on New Year's Day, practically all west of the Mississippi River was Indian country, as yet unexplored.

THE DU PONT MAGAZINE may see the company as we see it—an old but still virile and forward-looking organization, successful because it has steadfastly adhered to the business principles and practices of E. I. du Pont in all its dealings with the public.

THE SWEEP OF THE YEARS

Just a few milestone markers along the course of American history... Great progress has been made during the past century and a quarter of the du Pont Company's business life



The first du Pont office building along the Brandywine Creek

ONE hundred and twenty-five years have passed since the du Pont Company had its modest beginning along the Brandywine. As time is measured, this is a short period; into it have been crowded marvelous achievements in science, invention and industry. Not only has du Pont grown up with the nation, but du Pont industries have provided, directly or indirectly, many essential products to make national growth possible.

1800-1810: The Union consisted of sixteen states. Thomas Jefferson was President... U. S. Military Academy established at West Point... E. I. du Pont started building his first powder mill... Louisiana Territory purchased... Lewis and Clark expedition started for the Northwest... First du Pont advertising appeared in a New York newspaper... The War with Tripoli ended... Robert Fulton's *Clermont* made first voyage up the Hudson... The first du Pont customer of note during this decade was the U. S. Government.

1810-1820: Steamboat navigation first undertaken on the Mississippi and Ohio rivers... Work started on the first national highway joining the Potomac and Ohio rivers... War with Great Britain... Du Pont powder transported by covered wagon to Commodore Perry on Lake Erie... Stephenson invented the locomotive... The *Savannah* made first steam voyage across the Atlantic... Du Pont gunpowder shipped to New York, Boston, Baltimore, Pittsburgh, and other cities by boat and covered wagon.

1820-1830: Wire bridge method of electric blasting developed by Dr. Robert Hare... Erie Canal completed... The B. & O. Railroad began operations—passenger service established... First public school opened in Baltimore.

1830-1840: Cyrus McCormick obtained patent on first mechanical reaper... Morse invented the telegraph... Building of Erie Railroad begun... Bickford's "miners' safety fuse" first manufactured in America.

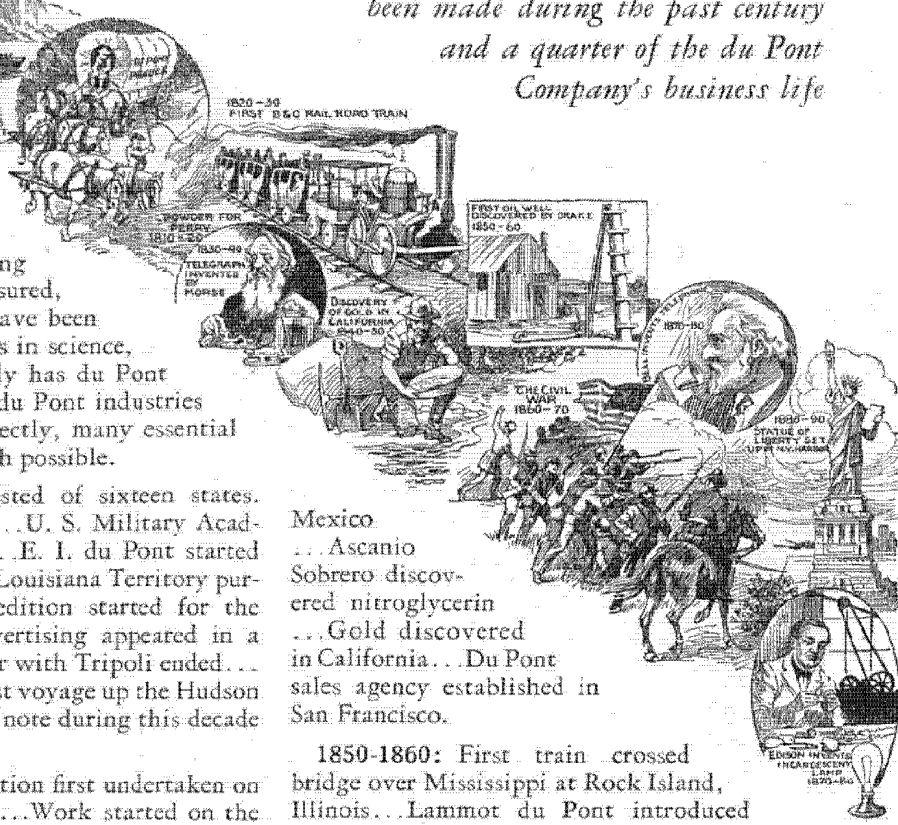
1840-1850: Croton Aqueduct opened to supply New York City with water... Goodyear developed process of vulcanizing rubber... United States Naval Academy established at Annapolis, Maryland... War with

Mexico... Ascanio Sobrero discovered nitroglycerin... Gold discovered in California... Du Pont sales agency established in San Francisco.

1850-1860: First train crossed bridge over Mississippi at Rock Island, Illinois... Lamot du Pont introduced soda powder, which quickly displaced the more expensive saltpetre powder... Wapwall-open, Pennsylvania, plant built to supply anthracite coal miners with powder... Drake discovered oil at Titusville, Pennsylvania... First Pullman sleeping car in service.

1860-1870: Pony Express established between St. Joseph, Missouri, and San Francisco... The Civil War—du Pont plants busy supplying powder for government troops... Homestead Law enacted to encourage settlement of undeveloped areas... First blast furnace opened at South Bethlehem, Pennsylvania... First nitroglycerin made in America—used in driving the Hoosac Tunnel... First successful trans-Atlantic cable laid... First dynamite made in America at San Francisco—three pounds... First transcontinental railroad completed at Promontory Point... Nitroglycerin used to increase the flow of oil wells.

1870-1880: Dynamite first used for tunnel construction by the Lehigh Valley Railroad Company... Christopher Sholes invented the typewriter, and Bell, the telephone



... Nobel invented blasting gelatin... Dynamite first used for improvement work in New York harbor... Blasting caps first made in America... Edison invented the incandescent lamp... First elevated trains running in New York City.

1880-1890: Du Pont began manufacturing high explosives at Repauno, N. J... Northern Pacific Railroad completed... Du Pont experimental work started on smokeless powders at Carney's Point, N. J... Synthetic silk fiber (rayon) first produced in France by Chardonnet... First electric street railway operated in Baltimore... Ballistite smokeless powder invented by Nobel.

1890-1900: Niagara Falls Tunnel constructed for hydroelectric power system... Edison announced invention of motion pictures... Francis G. and Pierre S. du Pont developed du Pont smokeless powder... First gasoline-propelled automobile... The Röntgen ray discovered... Rural free delivery postal service established... News of Klondike gold discovery precipitated rush to Alaska... Spanish-American War emergency forced the du Pont Company to extend facilities... E. I. du Pont de Nemours & Company was incorporated.

1900-1910: Chicago Drainage Canal opened... First subway construction begun in New York City... Boxer Rebellion in China... Marconi sent first wireless message... Wright Brothers first flew heavier-than-air machine... Du Pont Chemical Department established... First successful low-freezing dynamite developed by the du Pont Company... Bureau of Mines testing station established in Pittsburgh

... Hudson River tubes opened at New York... Peary discovered the North Pole... Railroads issued the first regulations governing shipment of explosives by rail.

1910-1920: Du Pont began manufacturing Fabrikoid... First fibersilk produced commercially in the United States... Amundsen discovered the South Pole... Livingston Channel opened in Detroit River... Parcel Post established... Black powder plant started at Du Pont, Washington... Cordeau fuse first made in the United States... Panama Canal completed... The World War began... The du Pont Company expanded its facilities for powder making... *S. S. Lusitania* sunk by submarine... Du Pont Company began manufacture of Pyralin products, rubber-coated textiles, paints, varnishes, pigments, dyestuffs and dyestuff intermediates... U. S. air mail service established... Airplane N-C-4 and Dirigible R-34 crossed the Atlantic.

1920-1927: New York-New Jersey vehicular tunnel started... First radio broadcasting service established by KDKA, Pittsburgh... First American-made dirigible *Shenandoah* launched... Shandaken Tunnel, longest in the world — 18 miles — completed... Alaska Railroad built... Duco, Du Pont Oval powder, pellet powder and Semesan developed and marketed... Commander Byrd reached North Pole in airplane... Moffat Tunnel driven through Continental Divide in Colorado... Work started on the Conowingo, Maryland, hydroelectric power dam... Trans-Atlantic wireless telephone service established... Lindbergh made first one-man non-stop flight from New York to Paris... The International Peace Bridge was dedicated at Buffalo, N. Y.



Right—The present du Pont office building at Wilmington, Del.



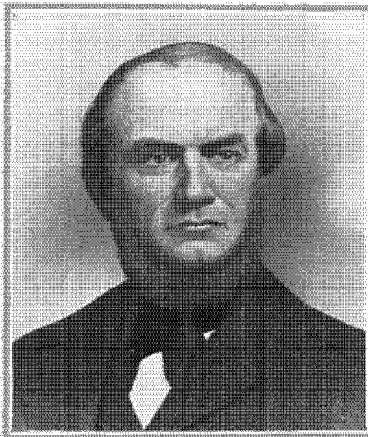


E. I. DU PONT DE NEMOURS
1802 - 1834

The Presidents
1802-1927



ALFRED DU PONT
1834 - 1859



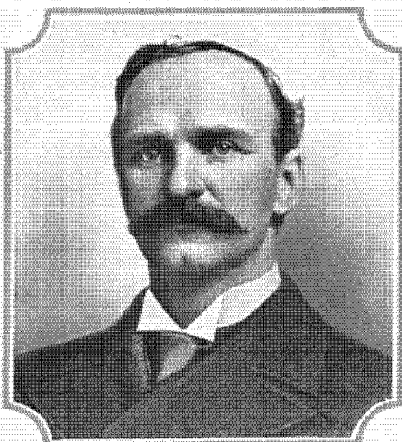
HENRY DU PONT
1850 - 1889



LAMMOT DU PONT
1926



EUGENE DU PONT
1889 - 1902



T. COLEMAN DU PONT
1902 - 1915



PIERRE S. DU PONT
1915 - 1919



IRÉNÉE DU PONT
1919 - 1926

ANNIVERSARY GREETINGS

Brief messages from four members of the du Pont family who have served the Company as president

ONE hundred twenty-five years of continuous successful business life for an American corporation is unusual, so unusual as to frequently raise the question: How has it been done? Common honesty and business fairness are among the obvious essentials for extended corporate life, and "owner management" is another requirement not so generally recognized, but these are common to many business organizations that do not long survive.

Du Pont has always trained its own management. Its reorganizations have been numerous, but always from the inside, being brought about and led by men of long experience with the business or in close family or business association with the former management. Thus, each succeeding management has been familiar with the preceding policies and has been in a position to guide the business safely and make only such changes as were clearly indicated as desirable by past experience.

It is interesting to note that the fifty individuals who might today be considered the leading men in the du Pont Company have an average of 21 years' service with the company and its predecessors. If there is anything in the theory of self-trained management, this augurs well for the future.

Edmund du Pont

THIS is the Anniversary Number! Anniversaries, of course, commemorate the past. The past is history. History is of little use—I was going to say no use—excepting in that it may indicate the future, thereby enabling us to act properly in the present. Pride in past achievements is foolish unless it leads to greater effort in the present to accomplish greater things in the future.

The du Pont Company has a history to be proud of. You men of the du Pont Company would not be human if you didn't take pride in the results, but let it not be a foolish pride. Rather, let it be a stimulus to produce in the future greater things than you or your fellows produced in the past.

As one of the older men I am entitled to give advice. It is that, in attacking any problem, you first seek such information pertinent to the question as may be had in a reasonable time; decide from it what you are going to do; then not be distracted from accomplishing your object unless you find that either your information or reasoning was erroneous.

"Go to it!"

Edmund du Pont

ONE hundred twenty-five years! Among the very oldest business associations of our country and dating back to the very foundation of American industry. Yet thirty per cent of this time is within the term of my direct connection with the company's affairs and forty-five per cent within my lifetime. Not such a long period after all. You ask me why this has come about; why are the \$80,000 of assets of the year 1810 now worth \$308,000,000? I answer—

Hard and conscientious work;
Honor and integrity;
Faith and loyalty;
Confidence, love and respect for
the fellow man.

That is the basis of good and successful business, as it is of good and successful living.

Edmund du Pont

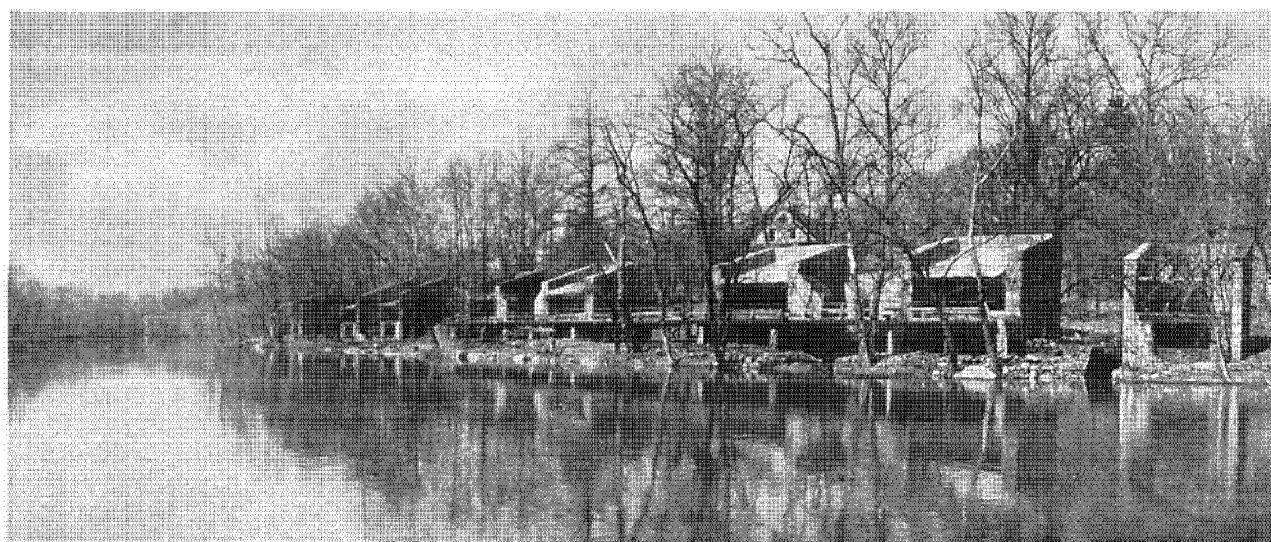
I CLAIM to be one of the oldest employees of the company, as I began as its agent in western Kentucky in 1884 or 1885, almost contemporary with Kerr and Macklem. I became actively associated in the direction of its affairs in 1902, just before its hundredth anniversary.

The men who took hold with me in March of that year reorganized a company that for a century had stood for integrity and fair dealing in American business. Its development had been chiefly due to the forming of companies in all localities where business had been stimulated by a corresponding development of the nation itself. The new problem, then, was to bring some 133 separate companies into one organization; to hold that organization as more important than any individual in it; and to continue to recognize honesty, ability, efficiency and loyalty as the prime requisites for advancement within its borders.

As an example of the growth that followed this consolidation and reorganization, when I joined the company there were seven employees in the main office. When I resigned, there were about twenty-five hundred. Today, the company, including its controlled organizations, is the largest in the world.

And so long as organization is paramount and all positions are won by honesty, ability and efficiency, rather than by seniority or favoritism, no stockholder need fear for the future of the company.

Edmund du Pont



This panoramic view, in two sections, shows the black powder mills along Brandywine Creek, near Wilmington, Delaware. The picture above includes the wheel mills built in 1828 and known as the Lower Hagley Yard.

RÉSUMÉ OF BLACK POWDER HISTORY

A summary of the development of the industry, stressing the economic importance of the product in the upbuilding of the nation

CONSIDERING that black powder has so revolutionized the art of war and given the forces of civilization such an immeasurable advantage over mere

numbers and savage valor, and has so incalculably assisted man in the realm of useful arts, as of mining, agriculture, and the execution of gigantic engineering enterprises, it would be interesting to know both the time and circumstance of its discovery. The gloom of the Dark Ages veils this information. The researches of all authorities suggest the Far East as its birthplace, and that the germ of its science originated in the accidental discovery of the deflagrating properties of "nitre," when brought in contact with the charred embers of the nomads' wood camp fires.

It seems probable that gunpowder as a propelling agent originated with the Moors or Saracens and from them spread eastward and northward into Europe, where it was known to have become quite generally used during the 14th century.

And it is quite certain that in its earliest development the means of its fabrication were crude and its quality was, of course, much inferior to the present-day product. We are told the earliest cannons or mortars were made of iron staves roughly hooped together, and even before this stage of artillery development, it is probable that guns were made of wood or leather, bound with coils of rope. Probably only "rockets" were discharged from them. Marcus Graecus, who lived during the closing years of the 8th century, clearly describes such a powder and its uses for military purposes. His formula, indeed, is not so

By E. H. FORD

Director, Black Powder Manufacturing Division,
E. I. du Pont de Nemours & Co., Inc.

far afield from that in use at the present time—"6 parts of saltpetre, 1 part of sulphur and 2 parts of willow charcoal. * * * reduce to a fine powder

in a marble mortar and mix together."

It is not within the scope of this article to discuss the technique of manufacturing black powder; yet we may briefly say that we have not departed from this fundamental recipe—"to finely powder the ingredients and mix them together." It has long been recognized that purity and selection of these essential ingredients were of primary importance, and chemistry's research has brought ample confirmation of that fact, but that is another story.

Next to the purity and proper selection of ingredients, no step in black powder manufacture requires such care and thoroughness as the intermixture of its components. Thus the marble mortar, on account of its inefficiency and attending hazards of operation, was superseded by the preliminary grinding of each material in machinery of progressively improved design, and the subsequent mixing of the three in "stamping" mills, the bowls of which were lined with leather as a safety precaution. Even these bowls did not insure the proper degree of incorporation so necessary for uniformity of the finished product. Hence, they were discarded in favor of the ponderous incorporators known as "wheel-mills."

With the improvement in the art of making guns of all calibers, came the necessity of controlling the explosive-ness of powder within different prescribed limits suitable for each. No physical property was found to affect the



Left to right, the pulverizing mill and wheel mills built in 1812, a section known as the Upper Hagley Yard. The last lot of powder was made in the Brandywine Mills on October 22, 1921. These buildings have since been dismantled

explosiveness of gunpowder so much as density, by which is meant the actual quantity of matter contained within a certain bulk of powder. This brought about the development of machinery to regulate this property; first, the crude hand-screw press, and later, the engine-propelled press. These were used until more elaborate and efficient hydraulic, or hydrostatic machinery was devised.

Then the unwieldy masses of pressed material had to be broken into grains of a size suitable for the caliber of the gun in which the powder was to be used. Granulating machines were the result of this necessity. Of course, powder up to this stage of its fabrication contains a certain amount of moisture to promote cohesion. This finally has to be eliminated, and it was accomplished first in furnace-houses or dry-houses. Later, when it was discovered that the keeping qualities of the product were increased by smoothing or polishing the surface of the powder grains and that this treatment in itself affected the explosiveness of the powder and insured greater regularity, both the drying and the polishing processes were effected simultaneously and the modern glazing mill was the result.

With the coming to this country of E. I. du Pont and the establishment of his first mill on the banks of the Brandywine, he brought with him and put to use the accumulated knowledge of the art and the most up-to-date machinery of his day. From 1802 until the present time, the du Pont Company has always been in the vanguard of those who have contributed to improvements in powder making.

One could not well stress the economic importance of black powder in the upbuilding of this nation without referring to the part it has played in the military history of our country. Until near the close of the 19th century, it was the only propellant we had. Black powder has

certainly been a great factor in both the achievement and the maintenance of our national status. However, with the advent and the perfection of smokeless powder and high explosives, its "swan-song" has almost been sung as far as its military use is concerned.

If, in the foregoing, I have dwelt too long upon the technical development of black powder as a propelling agent, it is because these very processes and properties are as essential to its production and efficiency as an explosive used in the peaceful arts. As a commentator on the du Pont Company's activities and progress has already written: "The company began its career in a time of peace, supplying powder for the pioneers, whose food depended upon their guns; for the blasting of rocks and the clearing of highways and for other enterprises essential to the growth of the young nation."

No reader, remembering that high explosives did not become a factor in the development of these "essential enterprises" until the 8th decade of the last century, will overestimate what a tremendous part black powder played in this development. So great was the demand for its most important ingredient, saltpetre, that not enough of it could be obtained from abroad. Notwithstanding that the chemical industry knew of the large nitrate fields of Chile, the substitution of sodium nitrate for saltpetre in the manufacture of black powder had not been considered because it absorbed moisture too readily, and it was essential to "keep one's powder dry."

It remained for Lamont du Pont, the father of our present president, to point out that for use in the peaceful arts powder would not have to be subjected to long storage and that by giving its grains a smooth surface and high polish, thus closing their pores, the sister-salt could be used satisfactorily for most blasting powder purposes. In 1857, Mr. du Pont patented his conviction and since

(Continued on page 41)

New-England Palladium & Commercial Advertiser.

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No. 11. Vol. XIVIII.]

FRIDAY, FEBRUARY 5, 1819.

[FOUR DOLLS. PER ANN.]

FOLLOWING is the text of the accompanying clipping, reproduced from the front page of a Boston newspaper published 108 years ago. It reflects the esteem in which the du Pont Company was held even in those early days.

DU PONTS' WORKS

"Fifteen years ago, not a tree was felled on Christiana Creek, nor a mill established there. Now, upwards of one thousand men, women, and children are comfortably lodged, fed and cherished by the single establishment of the Messrs. Duponts, on that stream.

"They have two powder mills which are in constant operation, the demand for their powder being greater than they can supply. About a year ago, a dreadful explosion destroyed nearly the whole of their old powder mill, but the mill is now rebuilt on the plan of their new mill, which is so fixed that in case of an explosion, the mischief will be confined to the part blown up. The walls are very thick, and of large and heavy stones. The roof is of wood, and very light, and inclines towards the stream; of course, in case of an explosion, the whole destruction outside of the building would be nothing—the roof would simply be blown over into the stream.

"When an explosion took place a few years ago, in which a number of lives were lost, the Messrs. Duponts gave to each widow and orphan \$1000 annual income. In the explosion about a year ago, thirty-one lives were lost, and these gentlemen generously pursued the same course. Such examples are worthy of imitation.

"The same gentlemen are concerned in the manufacture of cloth. During the war, the very best cloth was made at this factory, and they are now employed in making common cloth for the troops of the United States. They are likewise concerned in a manufacture of cotton, and are now extensively engaged in manufacturing goods of this material for the United States. Connected with their establishment

is an extensive Tannery, in which, by chemical process, the leather becomes fit for use, of the first quality, in three weeks. Their leather stands as high in the Philadelphia market, where it is best known, as does their powder in the United States. Indeed, the reputation of their powder is not confined to this country. It is well known in South America, and in other parts of the world.

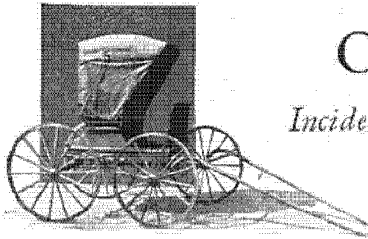
"All the establishments we have described are on the same stream; and although in the vicinity of each other, are yet at a sufficient distance to be safe even from any apprehension of danger to the other establishments from the gunpowder concern.

"During the war (1812), Messrs. Dupont & Co. raised three hundred men from among their own workmen, armed and equipped them, furnished them with ammunition, held them in readiness, and often encamped them under the command of one of the brothers, ready, at a moment's warning, to defend the soil against the enemy.

"There is one fact connected with this subject, worthy of mentioning. Proposals have been several times made to Messrs. Duponts to manufacture inferior powder for shipping, and to sell it, under the sanction of their name, at a little less price. They have constantly refused listening to any such suggestions. We understand they have lately been urged on the subject, on the ground that another manufactory did the same, and was by that means enabled to undersell them for shipping. But they have sternly refused, and, as we hear, are firmly determined to refuse ever to listen to any such intimations. Their powder stands peculiarly high in the estimation of the army and navy of the United States, as well as with all sportsmen who have tried it. The consumption of

it is very great in the Southern and Middle States. Every day makes it better known and increases the consumption of it in New England....."





The president's carriage
in the early eighties

OLD BLACK POWDER DAYS

Incidents of nearly a half century ago are brought to mind by the writer of this article, one of the oldest active employees of the company

By J. W. MACKLEM

ON the thirty-first day of May, 1881, I was seated on a wagon in front of the original du Pont office on the Brandywine, watching two men in conversation along the roadside.

One of these men was my father; the other, David B. Curlett, who was for many years a faithful and efficient member of the office staff of E. I. du Pont de Nemours and Company. During the conversation, they turned toward me, and I could judge from their smiles that the "boy" was the subject under discussion. And so it proved, for very soon thereafter I was informed that an office boy was needed—to start work the following morning. Whether by design or otherwise, I was selected to fill the position temporarily. However, before a month had passed, Henry du Pont, then president of the company, told father that if "the boy" suited him, the employment would be permanent.

Our quaint stone office along the Brandywine at that time was divided into four rooms. One was occupied by the bookkeeper; another by the shipping clerk, who was also cashier; the third by the statistical clerk, while the fourth room was occupied by the correspondent clerk and the writer, on whose desk the telegraph instrument was located.

The first annex to the structure, built in the very early period of the company, was occupied as a private office by Henry du Pont. During his forty years of work in this room, a hole resembling very much the shape of a cobbler's seat was worn in the floor under his desk. I presume it is still in evidence—at least it was when we discontinued using that office. The second annex, built in the late seventies, was used more particularly as an executive chamber. Colonel H. A. du Pont and Mr. William du Pont also occupied this room as their private offices.

Henry du Pont was a natural-born general of industry. I doubt if any one could have been better qualified to succeed his father, Eleuthère Irénée, and his brother, Alfred. During his forty years of management, the foundations of the company, financially and otherwise, were strongly built up. He always had the interest of the employees at heart. In the office safe, for example, a box was maintained

exclusively for the men where they could deposit deeds and valuable papers of any kind for safekeeping.

On his daily rounds of inspection, he used a horse and buggy, the latter being somewhat different from the ordinary buggy of that period. It was conspicuous on the road and, if seen in the distance, was usually a warning of a visit from "Mr. Henry." He kept in touch with many

activities, visiting daily some portion of the plants or company farmlands, including his own personal properties.

Mr. du Pont did much of his letter-writing in the evenings, which necessitated the return to the office of the correspondent clerk to copy them and get them into the early mail next morning. It fell to my lot to be on duty before six each morning in order to get the mailman off and to start the six-mule teams on their day's work.

In the early days we did not have stenographers and typewriters. All our letters were written in longhand. Mr. du Pont wrote his own letters, using for the purpose a quill pen; he never used steel pens. The typewriter was first introduced to the Brandywine office in March, 1888. Our correspondent clerk, Frank E. Haley, and I were curious to understand the workings of



J. W. MACKLEM

the machine; so we hired one for a month, keeping it at our respective homes for practice purposes. Before the month was up, Mr. Haley prepared some of the company letters on the new device and placed them on Mr. du Pont's desk for his signature. He instantly became interested and issued orders that we purchase one for office use. It is needless to say that thereafter Mr. du Pont ceased to write his letters in longhand, but scribbled them off in the rough for the boys to type.

At the works barns were stabled thirty-six head of mules and about the same number of horses, plus several "spares" or extras in case any of the "regulars" were indisposed. The horses were used on the farms, in the works and for extra hauling. Our large covered wagons of the Conestoga type, however, would not have appeared complete unless drawn by six mules each.

These wagons were built in our own shops and were especially adapted to the needs of the business. They were

(Continued on page 46)



In 1895 Repauno Plant, New Jersey, consisted of the few buildings shown here. Now there are 1118 buildings within the plant area—2337 acres in all, with about 1800 acres fenced in. Today, Repauno is the largest high explosives plant in the world.

HIGH SPOTS OF DU PONT HIGH EXPLOSIVES HISTORY

Reviewing the development of a key industry that has helped unlock vast stores of wealth to the nation's profit



OF all the factors that have contributed to modern progress there is none that has played a more important part than explosives, and of these the most important, the most widely used, and the most adaptable is the high explosive, dynamite. Though nitroglycerin, the essential ingredient of dynamite, was discovered by Sobrero in 1847, the commercial manufacture and use of high explosives may be said to date from the erection of Alfred Nobel's nitroglycerin factory near Hamburg, Germany, in 1865, and the manufacture there a few years later of Nobel's dynamite.

DU PONT LONG A LEADER

It was practically in the infancy of the industry that Lamont du Pont established in 1880 at Repauno, on the Delaware River, the dynamite factory that is now the largest in the world. From that day to this the du Pont Company has been the leader in the high explosives industry, contributing the most to the art of the manufacture of explosives and to their adaptation to the varied uses demanded by the rapid changes of modern civilization. Although Lamont du Pont predicted at the time the Repauno plant was being built that eventually it would be the largest dynamite plant in America, it is doubtful if even he foresaw the extent to which would grow the industry in which he had embarked. In 1882, two years before his untimely death, there were consumed in the

By J. THOMPSON BROWN
General Manager, Explosives Department,
E. I. du Pont de Nemours & Co., Inc.

United States some seven million pounds of dynamite. The domestic consumption of high explosives for blasting purposes in the year 1926 had risen to the unprecedented quantity of just under four hundred million pounds, and it is an interesting fact that in a single month of that year there were produced at the Repauno Works sufficient commercial high explosives to have supplied the entire demand of the country in 1882.

RESEARCH ACTIVITIES

From the beginning the importance of research was recognized, and as early as 1889 there was accomplished the successful recovery of the acids used in the manufacture of nitroglycerin. About ten years later the introduction of refrigeration into this operation made possible still further economies, and eliminated its greatest hazard. It was also during these early years that nitrate of ammonia was first used as an ingredient of dynamite. The importance of this development is attested by the fact that the dynamite of today contains a greater quantity of nitrate of ammonia than of nitroglycerin, and the equipment that was installed for its manufacture enabled American producers to supply the Government with the immense quantities of nitrate of ammonia required for military purposes during the World War.

In 1902 there was established at Repauno an explosives research laboratory, the Eastern Laboratory, and through its achievements the du Pont Company assumed the leadership in explosives research which it still retains. The

great improvements that the company has made in the properties of high explosives, and their adjustment to the new uses continually arising, have been due largely to the work performed at this laboratory.

ORGANIZATION WORK

It was also in 1902 that the du Pont Company began the centralization of its high explosives interests, involving the establishment of operating and sales departments in Wilmington. This brought about, in the course of the next ten years, an advancement in manufacture and sales that even the most optimistic had not contemplated. Manufacturing processes were standardized, great strides were made in eliminating the hazards of manufacture and of transportation by rail and on the highways; costs were greatly improved, due to taking over the manufacture of some of the more important raw materials and the more advantageous purchasing of the others, as well as to greatly improved efficiencies on the plants; sales districts were charted and selling prices logically based; a technical sales service was instituted which proved of incalculable advantage not only to the company but also to its customers; and an organization was built up and a personnel developed that enabled the du Pont Company to perform feats during the World War that no other supplier of ammunitions could equal.

LOW-FREEZING DYNAMITES

It is well known that the dynamites first produced would freeze at comparatively high temperatures, necessitating the thawing of the sticks in the winter months, which was an operation inherently dangerous and which resulted in many accidents. A way of lowering the freezing point was consequently one of the first research problems attacked. Therefore, perhaps the most important

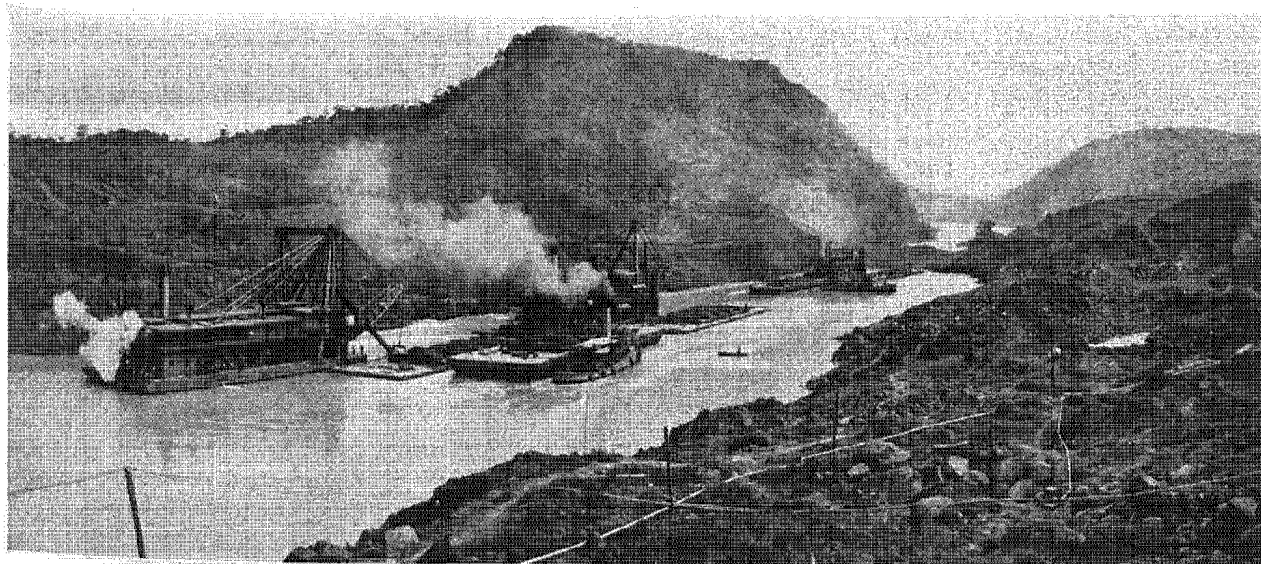
improvement in high explosives that has been brought about—and a fundamental one—was the development first in 1907 of nitroglycerin high explosives with low-freezing properties, and the improvement of these from time to time until in 1925 there were produced dynamites and gelatins, containing nitroglycerin, which could be depended upon not to freeze at any climatic temperature encountered in this country. The thawing kettle is a thing of the past. It is now possible in the month of January for the open-pit miner of Minnesota to fire his charge of dynamite with as much assurance of success as the stump-blaster in Alabama.

THE FIRST PERMISSIBLE EXPLOSIVES

Another problem was that of providing explosives that could be used safely in gaseous and dusty coal mines. Up to 1909 black blasting powder has been used almost exclusively for mining coal, and many disastrous mine explosions had been attributed to its use. In that year the du Pont Company put out the first safety, or so-called permissible, explosives, as the result of several years of intensive work at the Eastern Laboratory. The need of this class of explosives is clearly shown by the fact that in 1926 over sixty-five million pounds of permissibles were sold to the coal mines of the United States.

Another development, entirely original with du Pont, and which also was particularly advantageous to the coal mining industry, was the successful control in 1910 of the velocity of detonation of permissibles. This accomplishment enabled the mine owner to select an explosive which would give him a larger proportion of lump coal than had previously been possible.

An achievement that has proved far reaching was the placing on the market in 1917 of the first so-called low-density, ammonium nitrate permissible. A fifty-pound



The construction of the Panama Canal—one of the greatest engineering feats in history—was made possible through the use of high explosives. The work required about 60,000,000 pounds, the larger part of which was supplied by the du Pont Company. The view here shows Culebra Cut where dynamite was freely used to break down the barrier walls of the mountain.

case of this explosive contained one hundred and sixty $1\frac{1}{4}$ by 8-inch cartridges (the old standard 40 per cent dynamite ran one hundred cartridges to the case). From time to time since then still lower density explosives of this type have been evolved until in 1925 Monobel No. 10, with one hundred and eighty-five $1\frac{1}{4}$ by 8-inch cartridges to the case, was put on the market. As the density of these powders is lowered they more nearly approach the action of black blasting powder, which produces a greater percentage of lump coal than any other explosive, but which cannot, of course, be used safely in gaseous or dusty mines.

At the close of the World War it was recognized that surplus Government explosives might be thrown on the market, and the du Pont Company prepared itself and in 1921 marketed a blasting high explosive, Dumorite, that contained as its principal explosive ingredient artillery propellant powders of both the pyro and cordite types. This Dumorite was the forerunner of the Government's agricultural explosives, Sodamol and Pyrotol, both of which have been produced by du Pont for the Government, the latter under the largest contract ever written for commercial high explosives.

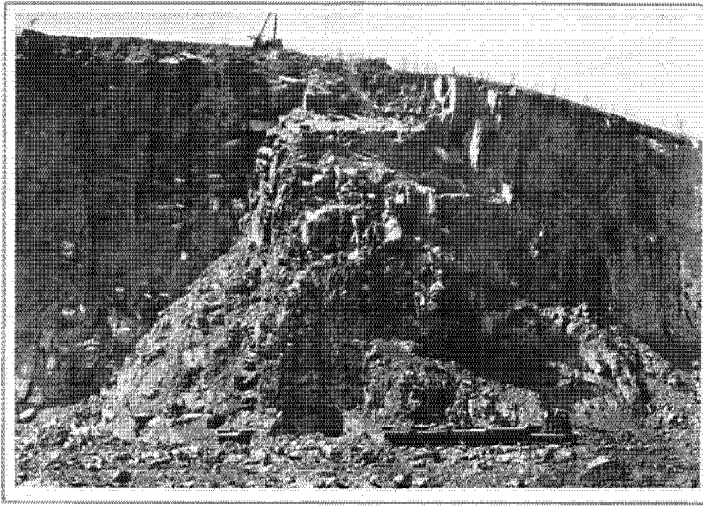
Not even the briefest article of this kind would be complete without mentioning some of the mighty labors performed by dynamite. It has been the foremost of all instruments in the final success of many great engineering projects. Though high explosives in the form of liquid nitroglycerin had been used successfully in tunnels on the Central Pacific and Union Pacific Railroads and in the

construction of the Hoosac Tunnel, the Chicago Drainage Canal, built in the years 1892 to 1896 and cut for thirteen miles through solid rock, was the first great construction project which depended for its success upon the use of dynamite. Next came the Panama Canal. No one will

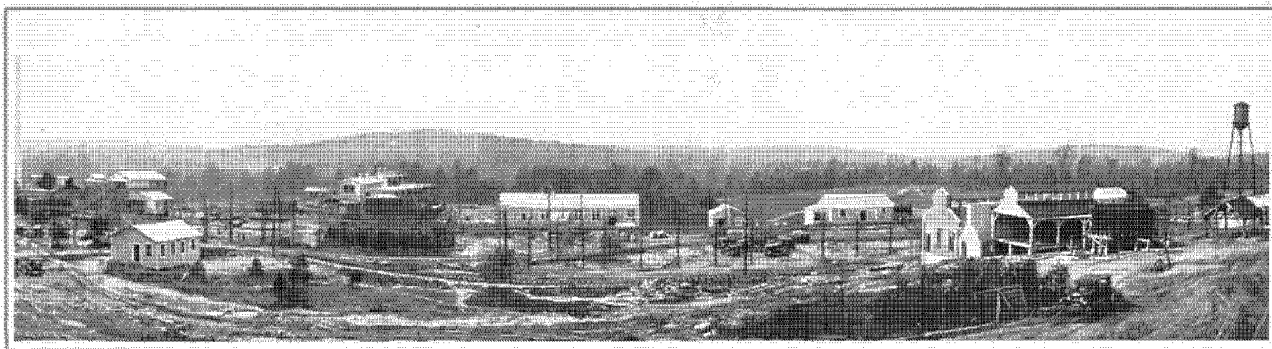
gainsay the fact that the greatest of all factors in carrying this gigantic undertaking to a successful conclusion was the application of suitable high explosives and blasting accessories to the difficult engineering problems involved. Between the years 1905 and 1913 sixty million pounds of explosives were utilized in this construction. The Shandaken Tunnel, approximately eighteen miles long, which brought to New York City an adequate water supply, was a large consumer of gel-

atin dynamite, especially designed for that particular work. Other large projects which relied on dynamite for their success were the New York subways, the Moffat Tunnel, and now the Cascade Tunnel on the Great Northern Railway, which upon its completion will be the longest railroad tunnel in the Western Hemisphere. The mining of coal, and the extraction from the reluctant earth of iron ore, copper, and other minerals, all so necessary to the every-day needs of modern industry, could be accomplished only by untold effort without the use of modern high explosives.

While the facts so briefly outlined in the foregoing form eventful chapters in the story, they are, after all, only indications of the history which is still being written from day to day, of the evolution of dynamite and its subjugation to the needs of civilization.



Trap rock quarries, such as the one pictured here, provide millions of tons of road-building material—but not until dynamite does its work



One section of the du Pont Company's new dynamite plant at Mineral Springs, near Birmingham, Alabama. The plant comprises more than fifty buildings in an area of 1280 acres, and has a capacity of 15,000,000 pounds of high explosives a year

FORTY-FIVE YEARS AGO

*Dynamite was then a new product, and the author of this article was private secretary to
Lammot du Pont, founder of the du Pont high explosives business*

THE foundations of the du Pont Company were firmly built by those well-known pioneers in the powder industry in America in 1802, but it is impossible to visualize adequately the immense value of the superstructure made possible by the marvelous foresight of Lammot du Pont, who was a profound student of explosives.

In 1880, realizing the important part dynamite was to play in the industrial upbuilding of America, he commenced the erection of the Repauno Chemical Works, now the largest dynamite plant in the world, and it was there he met his untimely death in 1884.

In the short space of four years, he had so ably conducted the business that the du Pont Company was placed in the lead of high explosives manufacturers—a position which has been retained ever since. That his vision of the future was well-founded is evidenced by the fact that sales of du Pont dynamite in the United States last year were over 5600 per cent greater than the sales reported for 1882, when he was in charge at Repauno, and equal to all the dynamite used in the rest of the world at that time.

Another evidence of the tremendous growth of the du Pont Company is that when I entered the employ of Lammot du Pont in 1882, there were only seven clerks in one room, and the president and myself in another, at 305 Walnut Street, Philadelphia.

Only seventeen years had elapsed since the close of the Civil War, during which time the public had been made fully cognizant of the personality and characteristics of President Lincoln, and during my intimate relations with Mr. du Pont, I came to recognize how closely he resembled our martyred president; his unusual height, his slightly angular figure, his beard, his deep set eyes, beaming with kindness and humor, and his absolute fairness, generosity, unusual shrewdness, and a remarkable sense of humor. Like Lincoln, he could always tell a story that was apropos of any subject under discussion. As an example of his generosity and humor, this incident is characteristic:

Wishing to send a telegram, he rang the bells of two telegraph boxes in the office to call the messengers. I asked him why he rang both, and he merely smiled and said, "Wait and see."

In a short time, the door opened and one little messenger boy rushed in and came to a halt before Mr. du Pont.

By GEORGE H. KERR



GEORGE H. KERR

"You got here first, didn't you?" "Yes, sir, I caught the elevator," replied the messenger. "Here is a dollar for getting here first."

Just then the second little messenger boy came in, all out of breath. "Well, you came last, didn't you?"

"Yes, sir," replied the second youngster, "I missed the elevator and had to run all the way up the stairs."

Mr. du Pont smiled broadly as he reached in his pocket. "Well," he said, "here is a dollar for coming last."

The circumstances connected with my entering Mr. du Pont's employ had an amusing aspect. The morning I was to take up my duties, he asked me to meet him on the steps of the Philadelphia National Bank. When we met, he entered the bank, drew a check for \$1,000, and introduced me to the cashier as his secretary. Cashing the check he handed me the money, telling me he was going West for a couple of weeks. He told me to go to his office and furnish it, pending his return.

I located the office, bought a handsome carpet, desks, chairs, and what was quite a rarity in those days, a typewriter, in addition to having the walls rather gaudily painted.

Mr. du Pont walked in one morning, and looked around. "Have you any of the money left," he asked.

"No," I replied.

"I didn't think you had—You're certainly h--- for pretty."

It was an expression I never forgot. Then he drew another check for \$1,000, told me to get it cashed, buy a safe and put what was left of the money in it.

Naturally, in accompanying Mr. du Pont on many of his trips, I came into contact with the majority of the men with whom he transacted business, but neither before nor since have I met a man who was so universally admired, respected and loved as he was.

Mr. du Pont had frequently told me that anyone who visited a high explosives plant, without having to do so, was a fool. In March, 1884, a Mr. Ackerson, representing the Meachem Arms Company, of St. Louis, brought to Philadelphia a cartridge of competitive dynamite which, it was suspected, infringed on the patents held by us at that time. Mr. Ackerson insisted on visiting the works, to the chagrin of Mr. du Pont who made every effort to dissuade him, but was too courteous to refuse to go with

(Continued on page 35)

THE IMPORTANCE OF CHEMISTRY IN DU PONT INDUSTRIES

*How a great family of products has been developed from relatively few raw materials.
The whys and wherefores are discussed in this illuminating article*



THE wide ramifications of diversified chemical manufacturing industry, as exemplified in the processes and products of the du Pont Company, are usually more or less a mystery to the layman. He is inclined to be somewhat appalled by chemical technology when, as a matter of fact, these relationships, divested of chemical nomenclature, are quite clear, straightforward, and easily understood.

This company manufactures so many different products whose fundamental relationships are not at all obvious to one unfamiliar with chemical manufacturing, that it gives rise to the thought that these are totally different lines of business. As a matter of fact, the products of the du Pont Company afford one of the most interesting examples of chemical kinship.

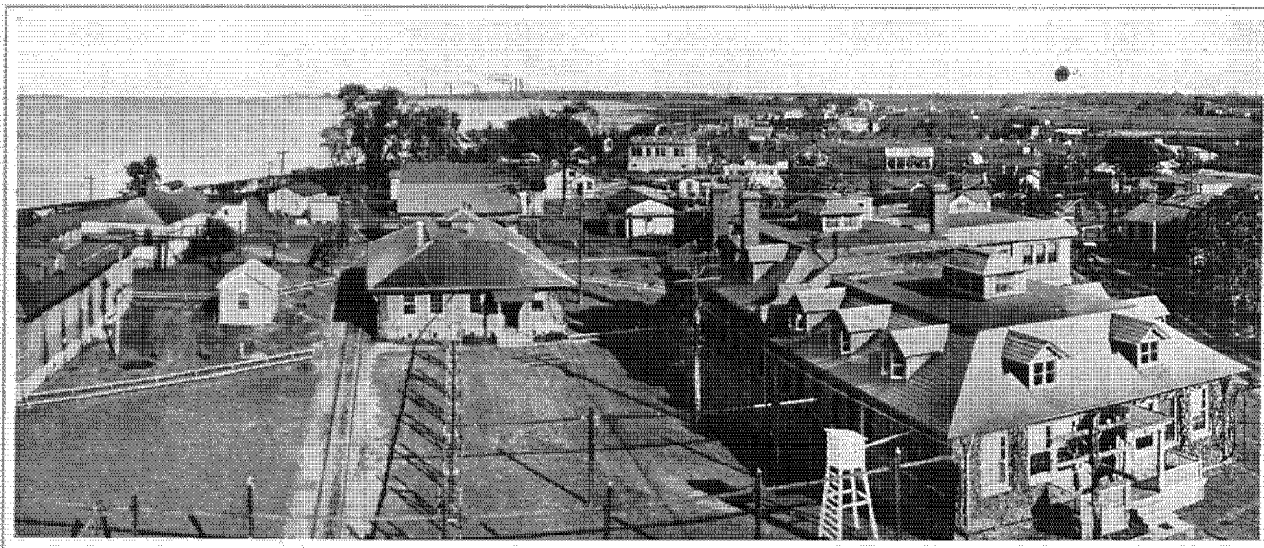
E. I. du Pont de Nemours & Company, as is generally known, began business as a purely explosives manufacturing concern. The manufacture of black sporting powder comprised this company's first business. For a good many years, blasting powder, sporting powder, and powder for military purposes was all of the black variety and was made by incorporating a few essential ingredients, charcoal, sulphur and saltpetre. In 1846, Schönbein

By DR. CHARLES M. A. STINE
*Chemical Director
E. I. du Pont de Nemours & Co., Inc.*

discovered that when ordinary cotton is treated with nitric acid, under the proper conditions, a chemical reaction occurred resulting in combination between the

nitric acid and the cotton and the formation of a material which burned with explosive violence under certain conditions. In 1863, Alfred Nobel discovered that when glycerin was treated with nitric acid, a chemical reaction took place which resulted in the formation of a highly explosive oil.* In 1856, W. H. Perkin discovered that when he treated crude aniline sulfate (mixture of sulfates of toluidine and aniline) with potassium dichromate and sulfuric acid, a precipitate, aniline black, resulted. From this precipitate, by extraction with methyl alcohol, he obtained aniline blue or mauve. Industries founded on these chemical reactions have been predominantly important in determining the financial positions and prosperity of nations, have resulted in the creation of balances of trade, have determined the outcome of wars, and have been of the utmost significance in determining world history and national development. The fact that Germany appropriated, and for many years practically monopolized, the synthetic color industry, gave her a certain chemical pre-

*[Ascanio Sobrero (1846) was probably the first to make this discovery. Alfred Nobel, however, was the first to use nitroglycerin with a detonator.]



A partial view of the Eastern Laboratory area at Repauno Works, Gibbstown, New Jersey, where research work on high explosives has been conducted for many years. The original laboratory is shown in the center of the picture. At the extreme left is the analytical laboratory, and in the right foreground, the administration building, headquarters of the laboratory staff

eminence and tremendously stimulated chemical research both in the universities and in the factories. In its total effect, the importance of this can scarcely be overestimated, and it is universally recognized to have been a decisive factor in her industrial development.

The development of cheap, abundant supplies of commercial high explosives, safe when properly handled, and chemically stable, and, therefore, safe upon prolonged storage, and the specialization which has taken place in the manufacture of various kinds of high explosives adapted to specific requirements, have been decisive factors in our own national development, because the wide extent of territory comprised within the United States has necessitated a tremendous amount of railroad and highway construction in order that interstate commerce might be facilitated. Then, too, the mining of coal and of metals depends to a very important extent upon the adaptation of commercial high explosives to the highly specialized requirements of these different types of mining. Safety explosives for coal have been the subject of much attention in the research laboratories of the du Pont Company and important developments have taken place not only in these, but in all commercial high explosives. Abundant supplies of cheap coal, iron and copper in a mechanical age, where electricity and steam and the internal combustion engine are prime movers, are, of course, factors of the first importance in national prosperity.

It is modern applied science which creates such mechanisms as that which allowed a Lindbergh to wing his arrow flight from New York to Paris in the time that it took our great-grandfathers to travel from New York to Trenton. All the tremendous mechanical developments of the last few decades depend to an important degree upon the availability and cheapness of abundant supplies of fuel and of iron, copper, vanadium, barium, chromium, aluminum, magnesium, tin, zinc, and other base metals.

The development of applied chemistry has been greatly stimulated in the United States by the activities of the du Pont Company, primarily as a high explosives manufacturer, and subsequently as a large and growing chemical manufacturing concern producing a wide variety of chemically related products. The manufacture of sulfuric acid from pyrites, or from sulfur, and of nitric acid from Chilean sodium nitrate, and the combination of these acids for the manufacture of nitroglycerin and of

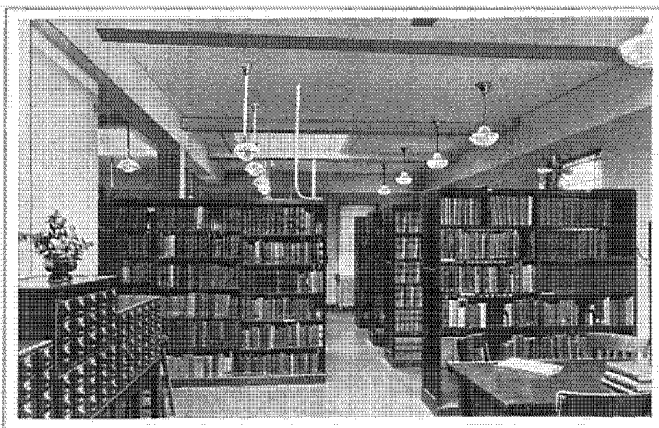
nitrocotton, and of other nitrated materials, such as the coal-tar derivatives, were the initial steps which the company took in what has now become a diversified chemical industry.

We manufacture various products from cellulose or cotton as a raw material. The manufacture of these products involves dissolving the compounds in solvents like ether and alcohol in order to obtain a jelly-like material. The development of various compounds of cellulose, and of the various types of solid and liquid solvents of these compounds were logical steps in our development of such products as Pyralin, Fabrikoid, spray and brush Duco.

In our development of propellant powders, we required diphenylamine as a stabilizer and at once we were interested in aniline, which is the basic material for the production of diphenylamine. But aniline is made by treating nitrobenzene with iron and hydrochloric acid, so that our need for aniline was another angle to our interest in the nitration of aromatic hydrocar-

bons of coal-tar origin. From this and from our development of nitrated aromatic compounds in connection with the manufacture of low-freezing dynamites, there followed closely and almost immediately our production of nitrobenzenes, nitronaphthalenes, and nitrotoluenes in wide variety. These materials, together with aniline, diphenylamine, nitroxylenes, chlorbenzene, nitrated chlorbenzenes, and the nitrated phenols, such as picric acid, represented our first production, not only of materials which were in those days very important in the explosives business, but also of materials which were logically a part of the foundation of the synthetic dye business.

The manufacture of acids, heavy chemicals, and dyes is closely bound up with the manufacture of pigments and lakes, and it was logical for us to become interested in the development of pigments and heavy chemicals. In connection with the manufacture of nitrocellulose solutions for coating fabrics and the use of pigments and colors of various types in these solutions, and in connection with the use of drying oils for various types of waterproof, coated fabrics, the du Pont Company has long been acquainted with the properties and methods of handling such materials as linseed and Chinawood oils. The manufacture of lacquers and of photographic films were two avenues of approach to an extensive acquaintance with fast-drying pyroxylin solutions, a wide variety of solvents, materials for gelatinizing pyroxylin, gums, drying oils,



Libraries are essential in research work. Du Pont chemists are well equipped in this respect, with six libraries containing many thousands of books, technical and trade journals and patents. The view here shows a section of the Experimental Station Library at Henry Clay, Delaware

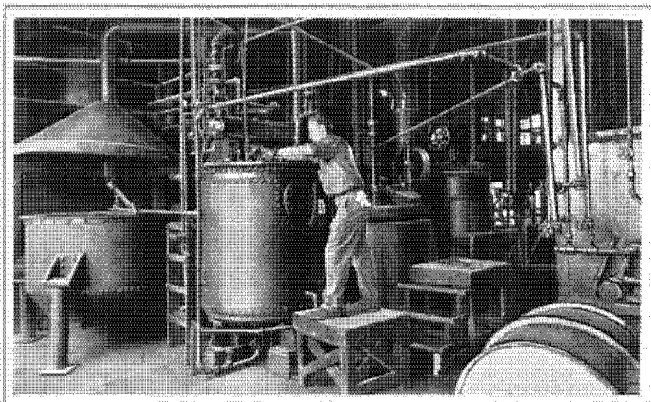
and the like. Our modern paint and varnish business is founded upon composite knowledge and long experience with all these various ingredients, namely, heavy chemicals, pigments, lakes, dyes, solvents, pyroxylin, drying oils, gums, colloiding agents, etc., and an extensive knowledge of the technique of manufacture based upon many years of experience. In fact, the du Pont Company has become a determining factor in the modernization of the paint and color industry. This time-honored industry had its beginnings in those by-gone millenniums when the soldier, the statesman and the ruler first attempted to record their achievements and used this pictorial record to enliven and beautify and dignify the interior of public buildings with water colors and with crude mineral pigments rubbed up in oils. The paint and varnish business for many years lagged behind some of the more up-to-date branches of chemical industry in its failure to completely apply modern scientific methods to the improvement of its products and to the development of new processes and of new products; our company is attempting to follow the same methods in this business which it has successfully applied in the other lines of chemical industry which have heretofore comprised its activities.

As the du Pont Company's business grew and the logical interests of the company broadened and ramified, our consumption of sodium nitrate for the manufacture of nitric acid for a great many purposes tremendously increased. We were also large consumers of so-called "powder liquor," which is an impure aqua ammonia used for the manufacture of ammonium nitrate, an important ingredient in high explosives of various types. This resulted in making us very large consumers of fixed nitrogen, and led, logically enough, to the development of this phase of the du Pont Company's activities; namely, the fixation of atmospheric nitrogen in the form of ammonia.

The du Pont industries consist, therefore, of a number of very closely related chemical processes producing a very large number of chemical products, some of which, so far as their appearance is concerned, show little indication of their family relationship. The proper handling of these various chemical processes, after they have been developed—known as chemical control—and the development of new processes and products, comprise the activities of the du Pont Company's technical departments, and, obviously, they are of primary interest to du Pont chemists. Chemistry is not like a dead language such as Latin or Greek, the development of which has ceased and which can, therefore, be learned once for all. On the other hand, chemistry

is a very live and growing science. In order that the du Pont Company may keep properly abreast of the developments in the various lines of chemical industry in which we are engaged or which affect our business, it is essential that continual attention be given to the application to the manufacturing problems of the company of the new knowledge which is accumulated in the spheres of chemistry and physics.

These, then, constitute the duties and activities of the engineers and chemists which the du Pont Company employs—to insure the uninterrupted production of certain chemical products in properly designed apparatus assembled into efficient manufacturing units which we know as "plants;" to insure that these chemical products are at all times of the highest quality and entirely uniform; to insure that the processes used are as economical and efficient as possible; to improve and develop apparatus; to improve processes or devise new processes; to improve the quality of existing products; and to devise



Semi-works "set-up" at Deepwater Point, New Jersey. The operator is making a golden orange dye with small-scale equipment, a preliminary step before undertaking its manufacture on a plant scale.

new products, in order that the du Pont Company may be kept not merely abreast of, but in advance of, its alert and progressive competitors.

The intrepid courage of Lindbergh was effective in achieving his history-making flight from North America to Europe because of the unfailing functioning of a very intricate mechanism—the modern airplane—built and equipped through the application of many scientific developments to the problem of aerial navigation. The modern airplane is a veritable epitome of applied science in its design, its structural materials, its power plant and its instruments for navigation. The courageous, adventuring spirits of today, like those of a by-gone day, build and equip their ships to advance the art of aerial navigation, or to seek out new trade routes, discover new lands and initiate new commerce, so the modern business man of courage and of vision builds and adequately equips his adventuring argosy in the form of research projects. These research undertakings depend very largely for their success upon a complexity of scientific development along a great many various lines of applied science, in a fashion very similar to the way in which the modern liner calls upon a great many branches of theoretical and applied science for its construction and equipment. It is well recognized today that it is not sufficient that a corporation be managed with courage and with financial ability, but there must be included, too, a vision which recognizes the necessity for a continual application of new scientific developments to its manufacturing problems.

(Continued on page 23)



D U P O N T L A B O R A T O R Y F A C I L I T I E S



A FEW years ago du Pont advertising featured the symbolic figure of the chemical engineer holding up a test tube. It was to convey the idea of the preëminent importance of chemistry in du Pont industries. The illustrations accompanying Dr. Stine's article, and those on the following pages, are intended to convey a more definite impression of that fact.

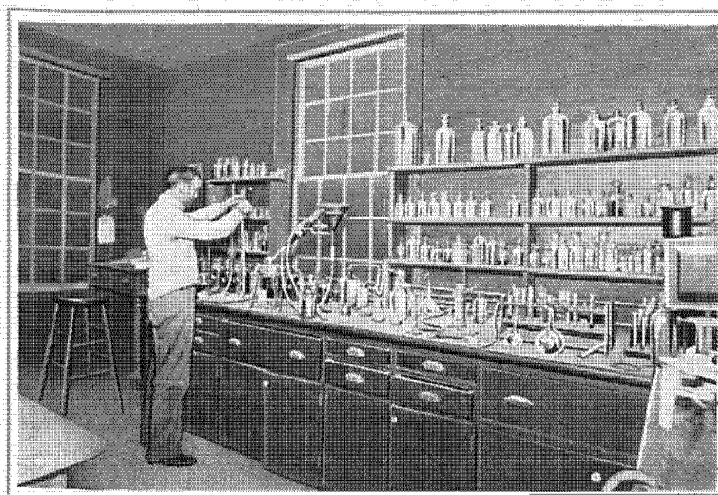
Research Laboratories: These are maintained in a number of locations by the company's industrial departments to take care of the preliminary stages of work. The central Chemical Department maintains research laboratory facilities at the Experimental Station to serve these departments. Here new processes and products are investigated for the Development Department and for certain of

the company's subsidiaries as well. Here, also, certain types of fundamental research are conducted. These facilities are constantly expanding.

Semi-works Facilities: When a process reaches the development stage, the investigation takes the form of actual production on a scale intermediate between the laboratory and a full-size plant. This is known as "semi-works manufacture." Practically every process developed by the company is tested in this way to determine the best working conditions and to secure indispensable information about engineering design. Semi-works facilities are available in connection with each research laboratory.

Control or Works Laboratories: These provide facilities to assure control of the processes so that the yield and quality of du Pont products shall always be safeguarded. In addition to the analytical laboratory space, it is frequently necessary to provide facilities for a certain amount of investigation in connection with going processes, so that the plant supervisor may be assisted in straightening out current difficulties in his work.

Technical Libraries: Excellent library facilities are provided at a number of the laboratories, because in the proper conduct of research work it is essential to draw upon many sources of information. In addition, a large technical library is maintained in the Du Pont Building at Wilmington, Delaware. This library contains business, statistical, engineering, chemical and a certain amount of general administrative data.

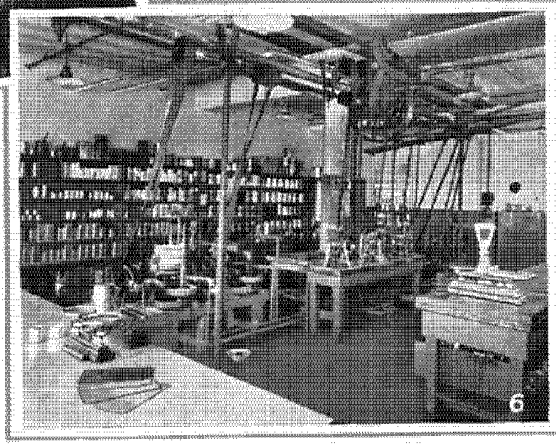
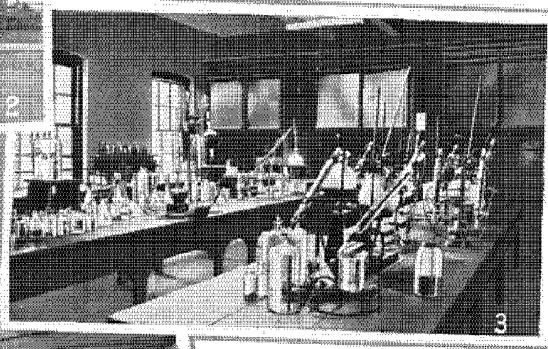
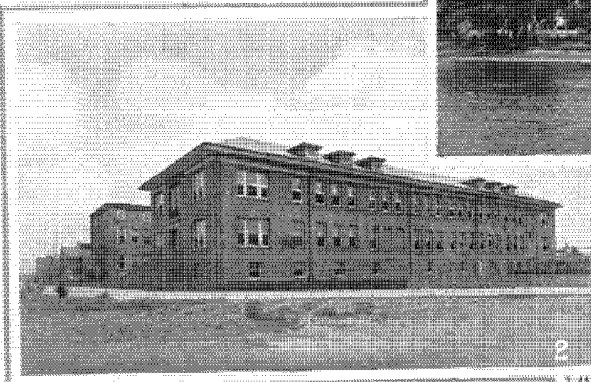
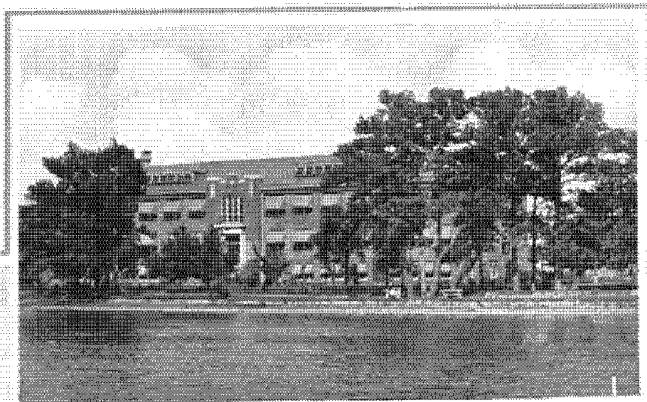


Above—Interior of the Repauno Laboratory, from a photograph made in 1893. An exterior view of this building is shown on page 16, and referred to as the "original laboratory" at Repauno. The du Pont Company conducted its first research work on high explosives in this building

Right—One of the chemical laboratories at the Experimental Station near Wilmington, but not the first one. E. I. du Pont de Nemours himself established the first du Pont laboratory in the Old Refinery building where saltpetre was purified for powder-making under his personal direction



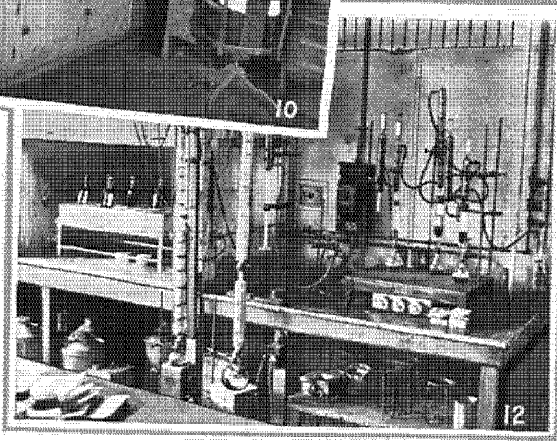
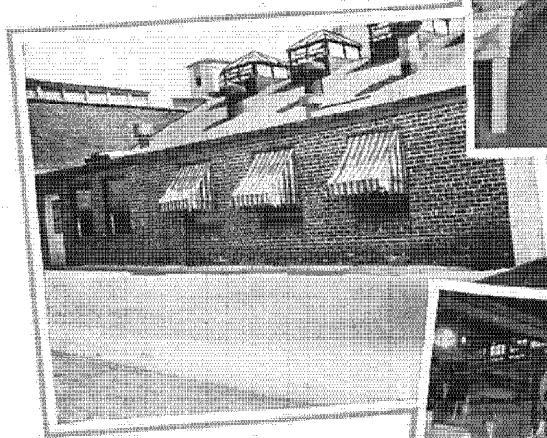
RESEARCH LABORATORIES



1. Technical Laboratory, Deepwater Point, New Jersey—
Dyestuff Applications
2. Jackson Laboratories, Deepwater Point, New Jersey—
Dyestuff Research
3. One of the Laboratories at the Experimental
Station, Henry Clay, Delaware

4. Parlin Laboratory, Parlin, New Jersey—
Pyroxylin Solutions
5. Du Pont Viscoloid Co. Laboratory, Arlington,
New Jersey—Pyralin
6. Flint Laboratory, Flint, Michigan—Paints,
Varnishes and Duco

RESEARCH LABORATORIES



7. Du Pont Rayon Co. Laboratory, Buffalo, New York—Rayon

8. Philadelphia Laboratory—Paints, Varnishes and Duco for Household Use

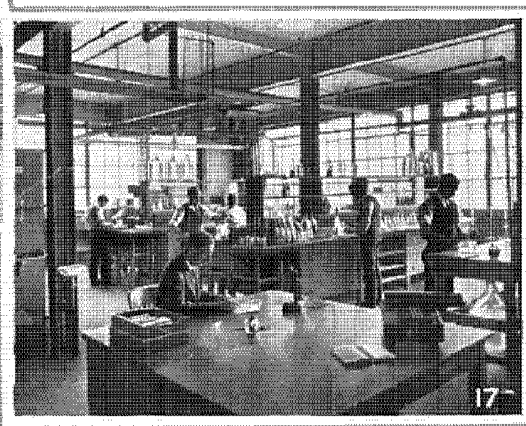
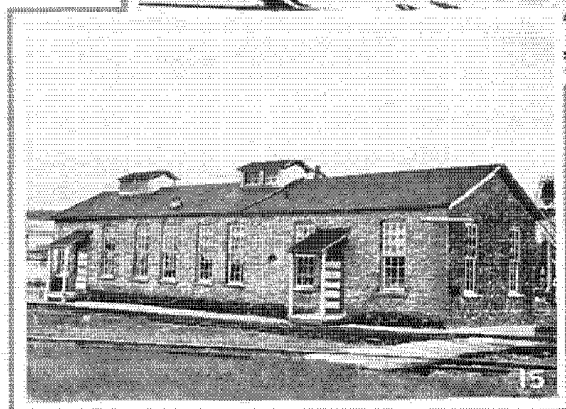
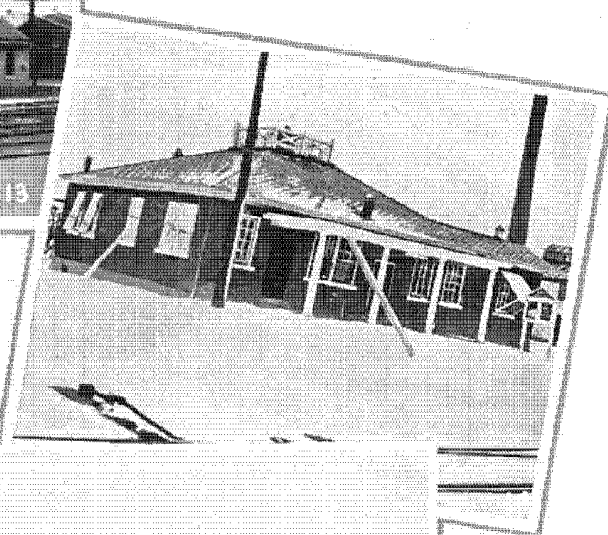
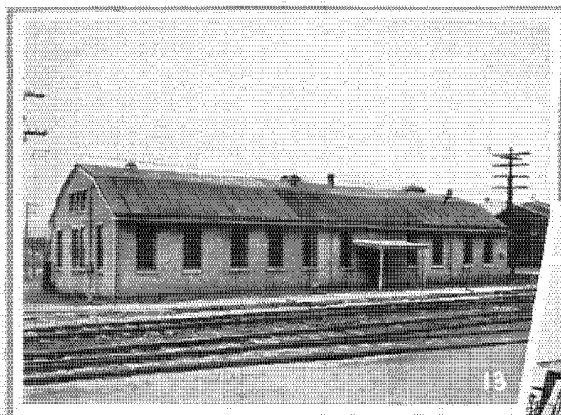
9. Fairfield Laboratory, Fairfield, Connecticut—Rubber-coated Products

10. Meadows Laboratory, Newark, New Jersey—Lithopone, Dry Colors and Pigments

11. Accelerated Aging Test Equipment at Experimental Station, Henry Clay, Delaware

12. Fabrikoid Laboratory, Newburgh, New York—Pyroxylin-coated Fabrics

PLANT CONTROL LABORATORIES



13. Repauno Acid Laboratory, Gibbstown, New Jersey—
Commercial High Explosives
14. Barksdale Laboratory, Barksdale, Wisconsin—
High Explosives
15. Louviers Laboratory, Louviers, Colorado—
High Explosives

16. Semi-Works Laboratory, Deepwater Point,
New Jersey—Dyestuffs
17. Interior Cellophane Laboratory, Buffalo,
New York—Cellophane

THE IMPORTANCE OF CHEMISTRY IN DU PONT INDUSTRIES

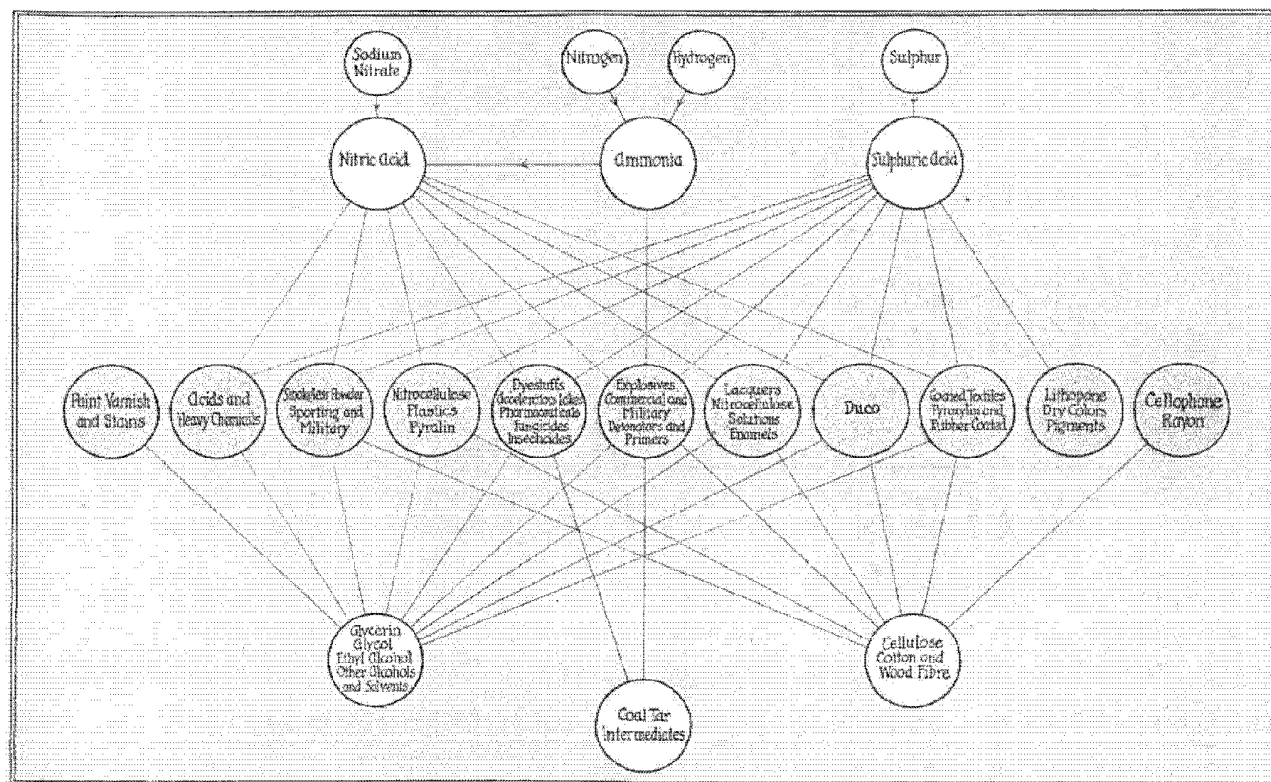
(Continued from page 18)

But all this is part of a greater and more interesting picture of national progress and prosperity. Hundreds of thousands of men labored to get out the great blocks of stone and transport and place them in the erection of the pyramids of Cheops, but modern high explosives split the granite blocks from the face of the quarry, and when they have been shaped by machinery, they are transported easily and quickly over highways and railways graded and constructed with the aid of explosives, and upon steel cars or steel automobile trucks, in this age of steel when mining of great quantities of metalliferous ores has resulted in an unprecedented consumption of commercial high explosives.

A Roman emperor spent princely sums for his royal garments of Tyrian purple, but the modern synthetic color industry makes available to our choice, a richness and variety of color and shade in garments and textiles undreamed of in those by-gone days. Solomon brought ivory from the Indian and African jungles for the enrichment of his palaces, and articles of ivory were part of a princess' dowry, but today modern synthetic ivory, far more beautiful in shape and in richness of embellishment, is found in practically every home in the land. But space prohibits the multiplication of examples of this sort.

It is the large investment of the modern industrial corporation in manufacturing facilities and in applied science, and the composite effort of great numbers of variously trained employes—specialists in various lines—which have brought about the improvements in general health, comfort, and living conditions, which we, the fortunate citizens of the United States, have come to take as a matter of course. They have made forms of transportation, which were a luxury yesterday daily necessities available to every man; they have lessened the number of hours of labor which men must devote to the provision of the prime necessities, such as food, clothing and shelter; they have increased the amount of leisure which man has at his disposal. If this increased leisure is selfishly devoted entirely to pleasure, we must fear the deterioration and eventual disintegration of this republic—this experiment in government by the governed—but if, as we hope, it shall result not entirely in the inordinate love of ease and pleasure, then we may look forward to such an unexampled progress in science and the moralities as the world has never known. The control of disease in the animal and vegetable kingdoms, the much more complete application of science to agriculture, a tremendous and universal improvement in living conditions, the most significant improvement in man's general health and longevity, all follow logically from the proper application of increased leisure to research and investigation of these problems.

SHOWING THE KINSHIP OF DU PONT PRODUCTS

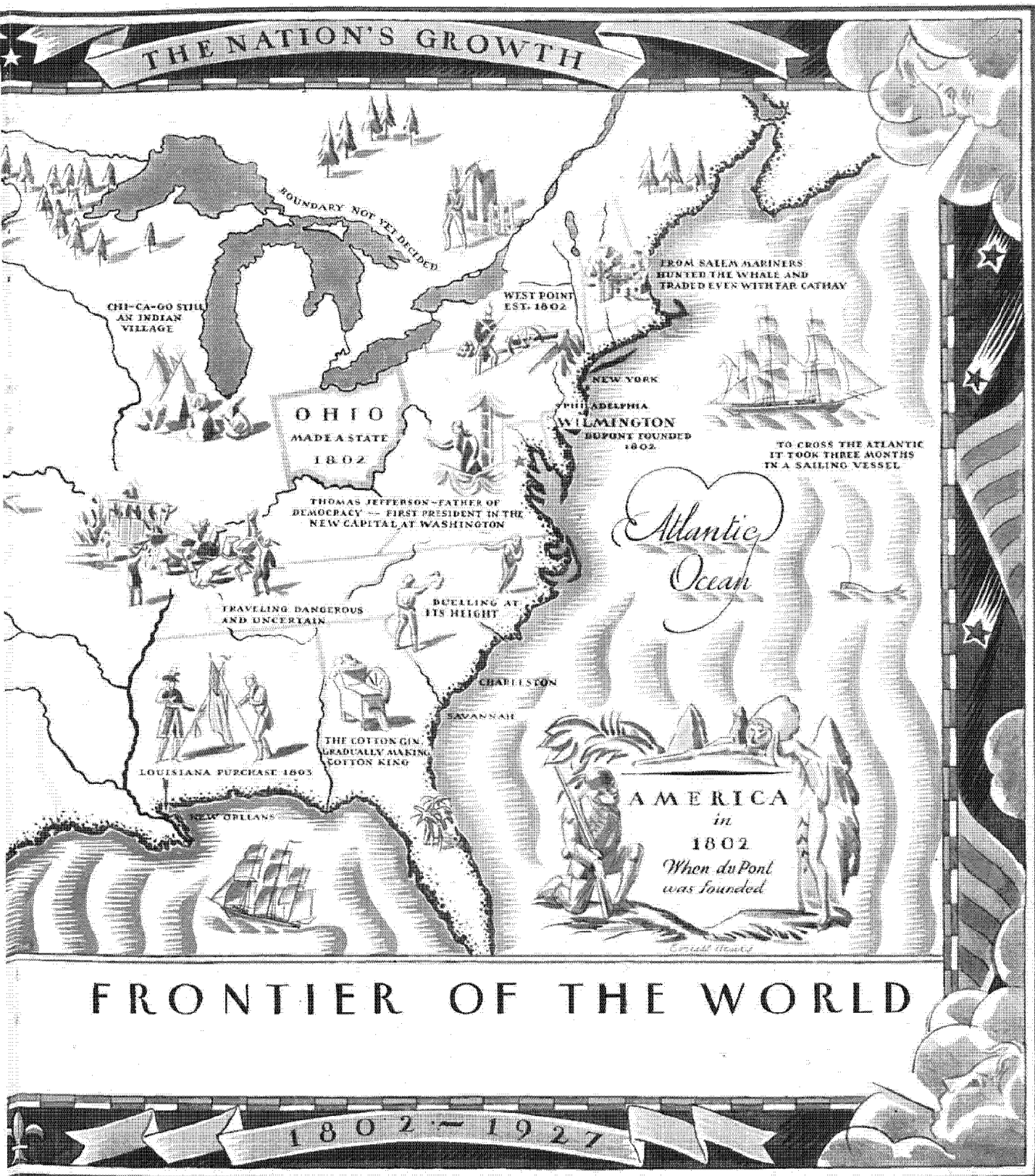


DUPONT'S GROWTH IS



WHEN AMERICA WAS THE

1802 - 1927





THE DEVELOPMENT OF MILITARY POWDERS



Since 1802, in every war in which the United States has engaged, its soldiers and sailors have been supplied with powder equal in quality and effectiveness to the world's best at the time

THERE is an inherent tendency in mankind to perfect its weapons. The Stone Age inhabitants of what is now Germany imported jade axes from Central Asia, because jade takes a better edge than flint. Transporting stone from the Desert of Gobi to Germany, even today, is difficult, and more so then, but these weapons were needed—and procured.

When E. I. du Pont arrived in America in 1800, the American rifle had proved at Saratoga, Kings Mountain and other battles its superiority over the English smooth-bore, but the powder was so poor that he decided to manufacture a better product. His former service to the French Government powder monopoly enabled him to secure drawings and explanations of the French machinery, and offers of trained workmen to come to America to help him establish his powder mills. The machines first set up along the Brandywine in 1802 were made in the government works at Essonne, France, and represented the perfection of powder-making equipment at that time.

In 1803 du Pont powder was tested by the United States Government for use aboard the frigates sent to Algeria to suppress the Barbary pirates. This powder was so superior to all others that Mr. Dearborn, then Secretary of War, announced on July 4 that in future Mr. du Pont would do all the Government work.

E. I. du Pont, writing to his father about this, also mentioned having made 40,000 pounds of powder for the Spanish Minister — apparently the company's first export business.

During the War of 1812, the Brandywine mills were well enough established to supply 700,000 pounds to the Army, in addition to other supplies for the Navy. Some of this powder was used by Commodore Perry in the engagement on Lake Erie.

The Mexican War—1846-1848—required special effort by the du Ponts to meet the needs for military powder and at the same time to supply the growing industrial demand.

In 1846 Schönbein patented the substance now known

By A. FELIX DU PONT

General Manager, Smokeless Powder Department
E. I. du Pont de Nemours & Co., Inc.

as guncotton, and even at that early date ineffective efforts were made to use it as a propellant. Alfred du Pont, using a formula of his own, also manufactured

some guncotton and wrote of his experiments. Although he opposed its use, he seems to have been the first to notice, or at least to record, that the rate of burning of guncotton is proportional to the pressure, basing his observation on experiments made in a partial vacuum.

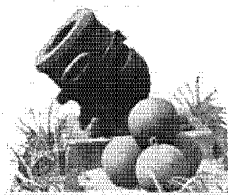
The reputation of du Pont powder was such that during the Crimean War in 1854, the British Government bought large quantities of it. The profit from this business carried the company through the panic of 1857, so that with strengthened finances it was in a position to meet the demands of the Civil War a few years later.

At that time black powder had been perfected in purity and dryness, but no attempt had been made to alter materially the granulation or ballistics; however, the development of iron-plated ships by the Confederates necessitated a projectile with sufficient velocity to crush or penetrate the armor. Captain Rodman, U. S. Army, made a study of breech pressures and with the assistance of Lamont du Pont developed Mammoth Powder, the grains of which were sometimes as large as three inches in diameter. These grains by burning slower developed better velocity and kept the pressure within the safe limit of the guns. It was with this powder the *Monitor* fought the *Merrimac*.

The land fighting in the Civil War did not indicate any great superiority of the powder used by either side, but in the celebrated naval duel between the U. S. S. *Kearsarge* and C. S. S. *Alabama* the superiority of du Pont powder

over the English powder of the *Alabama* was clearly shown. In the sternpost of the *Kearsarge* was found one of the *Alabama's* unexploded shells—a notable example of the small details which make history.

As far back as 1876 the du Pont Company experimented with red charcoal, which was higher in oxygen and hydrogen than black charcoal and ignited more readily. This



This old eprouvette was used for testing du Pont gunpowder in the early days. The four balls nearby were shot from the mortar by weighed loads of powder, and the distance of flight was carefully measured to determine the strength of the powder. For many years this was the approved test.

was the basic idea of the cocoa powder used as a propellant in large guns up to and including the Spanish War.

Following rumors that the French and other European nations had developed a brown powder superior to that of domestic manufacture, Alfred I. du Pont went to France, England and Germany to investigate its merits. On his return he declared it was no better than the du Pont product. He did, however, report that prismatic powder of Coopal & Company in Belgium was superior to the other European powders, and under strong pressure from the U. S. Government the du Pont Company purchased the American rights to produce it.

When the United States declared war on Spain in April, 1898, the powder supply was in a deplorable condition; the Navy had not enough for a two-hour engagement. This was not due to neglect but rather to the belief that black powder was obsolete and smokeless powder improving so rapidly that it was not desirable to accept any standard of excellence at that time. In July, the Government ordered 1,000,000 pounds of brown prismatic powder for the Navy to be delivered at the rate of 20,000 pounds a day. Incidentally, the only smokeless powder used in naval guns was bought in England for use aboard the *New Orleans*, an English-built ship.

For several years Francis G. du Pont had devoted his time to the construction and operation of the Moor black powder mills near Keokuk, Iowa, but as soon as they were in successful operation he devoted all of his energy to the development of military smokeless powder, making a large number of experiments of his own, and trying out numerous patents offered to the company.

Since desirable plant sites were no longer available along the Brandywine, the company purchased a large tract at Carney's Point, New Jersey, across the Delaware River from Wilmington, and built a wharf there in April, 1891, as well as experimental laboratories. In November, 1893, the military smokeless powder was considered of sufficient excellence to send samples to different cartridge-loading plants for test, and in June, 1894, shotgun smokeless powder, developed by Francis G. and Pierre S. du Pont, was ready for market. In the spring of 1895 the company bid

on 20,000 pounds of smokeless rifle powder for the U. S. Government, and the following year received a Navy Department order for 100,000 pounds of smokeless cannon powder to be made by the Navy formula. Subsequent co-operation with the Army and Navy developed a more satisfactory formula. The report of the Chief of Ordnance, U. S. A., for that year refers to contracts with the du Pont Company for smokeless powder for the .30 rifle, 3.2 field gun, 3.6 and 7-inch mortars and 8-inch rifle.

In 1898 the Army decided that a suitable composition for heavy sea-coast guns should contain 75 per cent nitrocellulose and 25 per cent nitroglycerin. The multi-perforated grain had been tried with 1, 17, 19 and 37 per-

forations, as well as powder in strips and flat squares, and the company adjusted a size of grain to all the new armament in the service.

In 1899, double-base powder was abandoned, due to burst guns and its poor storage properties. This, together with the untimely death of Captain Stuart, U. S. A., at Carney's Point, delayed the manufacture of smokeless powder, but in 1900 the Government placed various contracts for more than 1,000,000 pounds of it.

In 1902, the company was incorporated and other plants were acquired at Haskell and Parlin, New Jersey, and at Santa Cruz, California.

An outline of the World War production would require more space than this entire article, so that a brief summary must suffice. In 1914 our military plants had an annual capacity of 8,400,000 pounds of smokeless powder which was increased during the war to 440,000,000 pounds.

The achievement of building and operating the plant at Old Hickory, Tennessee, is covered elsewhere in this number. The plant at Hopewell, Virginia, for the production of nitrocellulose was built entirely to meet war demands. The Carney's Point plant was expanded to sixty-seven times its pre-war capacity, while those at Haskell and Parlin were expanded to twenty-four and forty-seven times, respectively.

The value of this powder supply to the Allies and later to our Government in bringing about a successful termination of the war need not be dwelt upon here; it is too obvious to require further comment.



E. I. du Pont de Nemours discussing the location of the first du Pont powder mill with Thomas Jefferson, President of the United States, his friend and customer. From a painting by S. M. Arthurs.

HOW COATED TEXTILES HAVE SERVED

A review of the development of Fabrikoid and du Pont rubber fabrics—products that possess a wide range of usefulness to manufacturers



THE chemical engineer, by waving his magic wand over ordinary cotton, may completely change its form and usage. It may be transformed into an explosive powerful enough to sink a battleship, into a dainty mirror for milady's dressing table, into Duco for finishing automobiles, or into the covering of a fine book.

Of the various transformations none is more interesting than the turning of cotton into Du Pont Fabrikoid, which has become such an important product for use in place of leather and in many other new and original fields. Each year the Newburgh plant produces millions of yards of Fabrikoid, which is used principally for upholstering automobiles and furniture, covering closed car decks, manufacturing high-grade luggage and wardrobe trunks, bookbindings, wall coverings, and novelty products.

Fabrikoid is built of, as well as on, cotton, for both the coating and the base fabric are of the same material, although in widely different forms. The fabric used is always cotton, its weight and construction depending on the use to which the finished material is to be put.

The coating is a cellulose-nitrate composition, technically known as pyroxylin. This "jelly" is colored with mineral pigments which have been finely ground in pure castor oil, making the finished product soft and pliable throughout its life. The colored jelly is applied to the base fabric by means of a "doctor knife," in a specially-designed coating machine, and the material is built up coat by coat until the desired weight or thickness is attained. Afterwards it is embossed and finished in grains which may either simulate natural hides or be in special designs and effects. Besides its artistic and attractive appearance, Fabrikoid is waterproof, washable, grease-proof, scuff-proof and astonishingly resistant to wear and weather.

Fabrikoid is the result of constant development, dating

By N. P. WESCOTT
Manager, Fabrikoid Division,
E. I. du Pont de Nemours & Co., Inc.

back to 1895 when the American Pegamoid Company was incorporated at Hohokus, New Jersey. This company, while manufacturing some coated textiles, was engaged principally in waterproofing various commodities with pyroxylin by a method then known as the Pegamoid process. In 1898 the name was changed to The New York Leather & Paint Company, and, in 1900, the plant was moved to Newburgh, New York, and the corporate name was changed to The Fabrikoid Company.

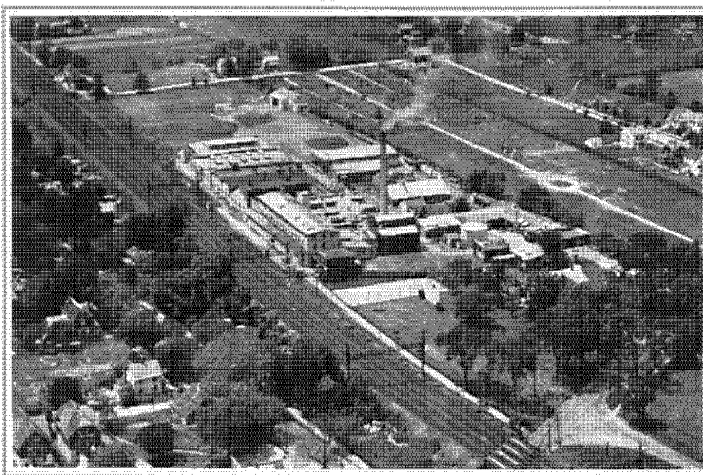
About this time the automobile industry was rapidly coming to the front, and with its increased production came a corresponding demand for leather for upholstery. As a result, the price of leather and leather products went skyward. However, rapid progress in the development of Fabrikoid led quickly to its adoption by many of the

automobile manufacturers, thus reducing the pressure on the price of leather and leather articles.

Meanwhile the du Pont Company had become interested in the manufacture of cellulose-nitrate products other than smokeless powder, and had established an experimental unit for developing pyroxylin-coated fabrics. In 1910, in order to extend activities in this field, the company purchased the Fabrikoid Company in its entirety. The name

was changed to The Du Pont Fabrikoid Company, under which title it operated until 1921, when it became the Fabrikoid Division of E. I. du Pont de Nemours & Company.

Still greater progress was now made in perfecting Fabrikoid and extending its use into new and different fields. Recent years have witnessed developments in finishes and qualities once undreamed of. Among the newer of these is Nemours, carrying special designs created for the individual user; Ponchee, with varied color effects and patterns; Fabbkote, in which a high-grade pyroxylin coating is applied to a tough paper base and finished in many of the popular Fabrikoid grains; Dekoart, a special pyroxylin-impregnated fabric for tops of convertible and sport cars; and Muralart, a new and unusual wall covering—



The rubber products plant of the du Pont Company at Fairfield, Connecticut. It was established more than forty-five years ago by the Fairfield Rubber Company, then the leader in the carriage cloth field.

creations possessing all the utilitarian merits of Fabrikoid.

Another important development at Newburgh that has revolutionized the field in which it is used is du Pont Tontine—the first and only completely waterproof and washable shade cloth yet developed. It is impregnated with pyroxylin, the same material that makes Fabrikoid so rugged, and is not only waterproof and washable, but will not pinhole, crack or peel.

The recent creation of a service division at the Newburgh plant places at the disposal of manufacturers using Fabrikoid a complete art and technical service. Here the company's artists and technicians design finishes and grains to meet the specific needs of industries and of individual manufacturers. Here also are developed new designs, new finishes and new ideas.

In addition to the Newburgh plant, the du Pont Company owns and operates a plant at Fairfield, Connecticut, where practically all kinds of rubber-coated fabrics and a complete line of gum rubber products are made.

The origin of the Fairfield plant goes back to 1879 when the Fairfield Rubber Company was organized to manufacture rubber clothing and carriage cloth. In the days of the horse and carriage there was no better carriage cloth made than Fairfield Rubber, and it was natural that, with the advent of the automobile, many manufacturers should adopt it as the topping material for their cars.

In 1916, in order to offer to the automobile trade a complete line of rubber and pyroxylin-coated fabrics, the du Pont Company purchased the Fairfield Rubber Company. Again, du Pont control and operation resulted in a tremendous expansion, and a complete line of top materials was developed for both closed and open cars, the leader now being du Pont Everbright Pontop, a rub-

berized fabric of unique durability for closed car decks.

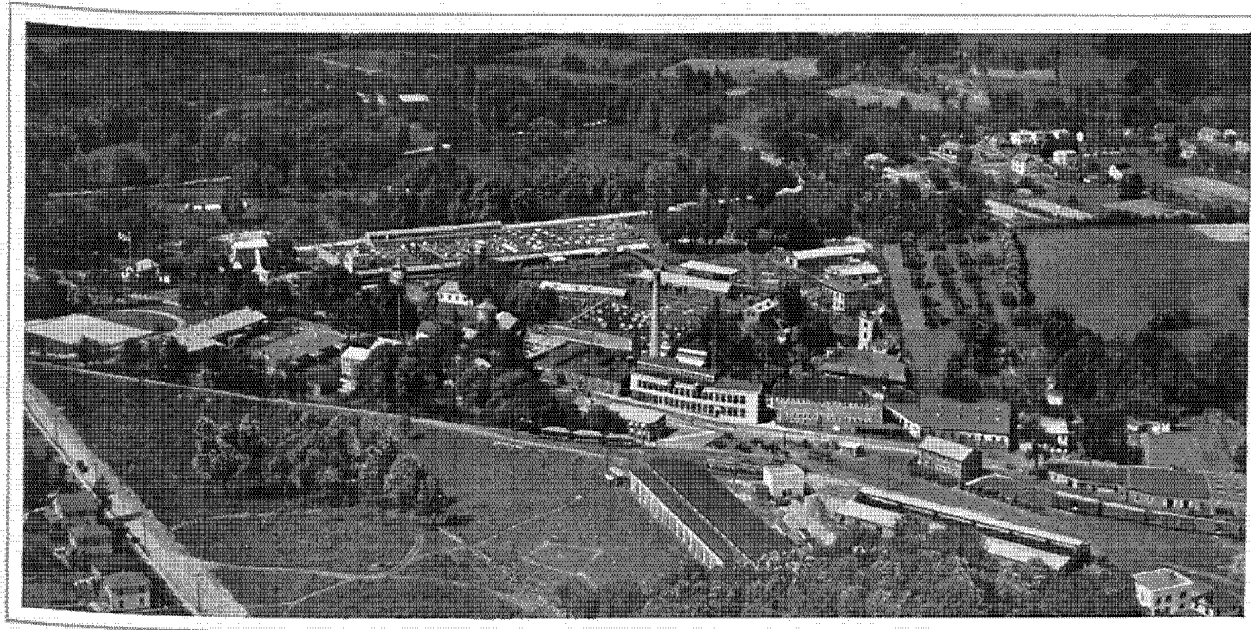
Developments at the Fairfield plant have grown to include, in addition to its line of top and deck fabrics, practically all types of rubber-coated fabrics. One of the newer developments has been the creation of an extensive line of attractive rubberized fabrics for raincoats, street and sport wear, marketed under the name "Du Pont Fairfield Fabrics," and supplied in plain colors and in the new alligator designs now so much in vogue.

A complete line of rubber sheetings for hospital and household use is also manufactured, together with gum rubber specialties.

Another product is du Pont Ventube, a flexible tubing now used for auxiliary ventilation in coal and metal mines, and for tunnel work in all parts of the United States and in many foreign countries. Through the development of Ventube, du Pont was able to offer the mining industry the first scientifically-constructed flexible tubing for underground use. A special chemical treatment renders it resistant to fungus, acid waters, dry rot and vitiated air.

Du Pont Rug Anchor is still another important product of the Fairfield plant. This fabric, when laid coated side down under rugs, holds them firmly in place, no matter how small the rug or how slippery the floor—and does this without injuring either the floor or the rug.

At Fairfield a service division functions in the same way as the one at Newburgh. Du Pont chemists at both plants are constantly developing new materials for the needs of industry, and as a result, these two factories are in position to supply manufacturers with a wide variety of coated fabrics for their ever-changing requirements. Pyroxylin or rubber-coated textiles—du Pont can supply them, now and in the years to come.



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Du Pont Fabrikoid is manufactured at Newburgh, New York. This airplane view will give you some idea of the plant layout

DU PONT PROGRESS IN THE PYROXYLIN INDUSTRY

How a business acquired as a side line twenty-five years ago has grown to be an important branch of the company's activities



THE Chemical Products Division, now operating two large plants at Parlin, New Jersey, and Flint, Michigan, and supplying pyroxylin products to a world-wide market, dates back to a modest beginning as an outgrowth of the du Pont Company's smokeless powder business.

Shortly after the Spanish War the International Smokeless Powder & Dynamite Company was organized for the primary purpose of manufacturing smokeless powder, then a comparatively new product. As indicated by its name, the company anticipated the manufacture also of dynamite; but this proposition was dropped in favor of pyroxylin preparations, and the corporate name changed to International Smokeless Powder & Chemical Company.

When the du Pont Company bought the International in 1902, the latter's plant at Parlin had a capacity of 7500 pounds of smokeless powder daily, but its pyroxylin business was very much of a side line, employing only a handful of people, the sales force, for example, consisting of just one man and a stenographer.

Smokeless powder was no novelty to the du Pont officials who took charge of the newly acquired property, but the pyroxylin business was different from anything they had previously experienced. At first they were curious, then skeptical, and finally convinced that it was a business of the future, worthy of cultivation; also, that it was a very logical expansion for the du Pont Company's activities, because of its utilization of much of the same raw materials, plant equipment, manufacturing processes and technical knowledge as required for the production of smokeless powder.

A systematic program of development resulted in the steady growth of the business. It appears somewhat prophetic of later events that the men engaged in the nursing of this infant industry were never satisfied to accept things as they were simply because they had always been so. On the contrary, they were always seeking new and better materials and methods to replace old ones with increased efficiency or reduced cost, and much of the early growth of the business was based on constructive work of this type.

Pyroxylin is a variety of nitrocellulose that has the property of dissolving in certain liquids. It is made by treating cotton linters with a mixture of nitric and sulphuric

By J. J. MOOSMANN
*Manager, Chemical Products Division,
E. I. du Pont de Nemours & Co., Inc.*

acids. The solvent liquids are made by treating various alcohols with acetic acid. When the solvents evaporate, which they do very quickly, a trans-

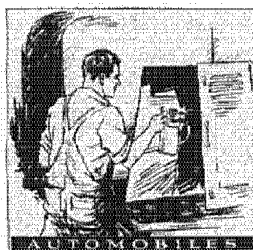
parent film of pyroxylin is deposited on the article to which the solution has been applied. Oils are added to obtain flexibility, and pigments or dyes to produce colored effects, when these characteristics are desired.

Fabrikoid, which, by the way, was one of the earliest commercial uses of pyroxylin on a large scale, is a good example of the type of product requiring a pyroxylin film that is both flexible and colored. Practically all bright metal articles, such as brass door knobs, hinges, lighting fixtures, and the like, are protected from tarnishing by a thin film of transparent pyroxylin deposited by the type of solution generally known as "lacquer." Tool handles, pencils, toys, Christmas tree lights and ornaments are examples of products where a colored but not necessarily a flexible pyroxylin film is required.

In the case of Fabrikoid, the pyroxylin film is a necessary part of the finished product, since it is the means of imparting to a fabric the appearance and many of the other properties of leather; in the case of bright metal objects, it is simply an invisible film to protect them from air and moisture; while in the case of toys it constitutes the finishing coating on an otherwise completed article. Other uses of a different character are as a waterproof cement for leather belting, especially adapted for machinery belts that must operate under water or in dampness such as is often found in dye houses and laundries; or as the tough coating that protects from breakage, during transportation and handling, the delicate thorium oxide that forms incandescent gas mantles, the protective coating being the film that is burned off when the mantle is put into service; or as a carrier for the bronze powder used in the manufacture of "gold" picture frames and the imitation gold-leaf used principally for the lettering of book covers.

These are only a few illustrations of the diversified uses of pyroxylin in solution form; but in every case the reasons for using pyroxylin in preference to other materials are very much the same; namely, the speed with which the solution dries, and the tough and waterproof film—thin, pliable and transparent—that it deposits.

On the other hand, it was one of these characteristic features of pyroxylin that, until a few years ago, prevented



it from becoming a serious competitor of paints and varnishes on a large scale in industrial finishing. That feature was the thinness of the film deposited by the thickest solution it was practicable to use. The film thickness could not be increased by adding more pyroxylin to the solution, because that would make the solution too thick or viscous to flow through the spraying machines by means of which—on account of the speed of evaporation—pyroxylin solutions are usually applied.

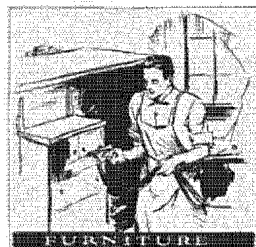
Finally, after many years of chemical research and experimental work, this problem was solved by the production of a pyroxylin solution, the viscosity of which was very much lower than any previously known in commercial work without impairing the strength and durability of its film. This resulted in workable solutions that deposited in one application a film equaling in thickness that deposited by three coats of the best solutions previously available.

The new product, specifically, was the result of a long search for a more durable automobile finish than the colored varnishes then in general use. It proved to have so many advantages over other finishing materials that it was given the distinctive name of Duco, and was first used in commercial production by the Oakland Motor Car Company in the fall of 1923. At this writing, not quite four years later, the fact that this type of finish is being used on at least 95 per cent of all the automobiles manufactured in this country, as well as those of a great many foreign manufacturers, is convincing evidence of its economic value.

Few people realize it was the invention of Duco that made possible the colorful cars of today. With the finishing materials formerly available the use of bright colors was not practicable in large production. They could be had only as special jobs at considerable additional cost in the so-called custom shops, and could not be expected to give more than about six months' service without beginning to show signs of distress. Today even the most moderate priced cars come to market with finishes not only



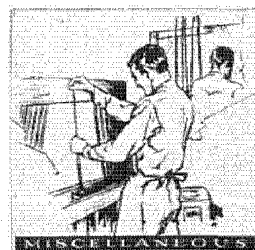
rivaling in beauty the most artistic productions of exclusive custom shops but also far exceeding in durability the black and other somber hues that used to come from the ovens of the large production plants. Notwithstanding these advantages, the cost to the automobile purchaser is actually less than that of the finishes formerly used, in addition to which he is freed from the additional expense of periodical refinishing to keep the appearance of his car in good condition. Further savings to the car owner accrue



from the fact that a Duco finish is less susceptible to injury from accidents and abuse, and does not require such frequent washing to maintain its good appearance.

The thicker film deposited by Duco enabled it to compete on a labor-saving basis with varnish for furniture finishing. Whereas eight or ten coats of the old-type lacquers would have been necessary to deposit a film comparing favorably in appearance with the average varnish finish, thus rendering their use impracticable, three applications of Duco will produce this result. Its use in the furniture industry is constantly increasing, and many progressive manufacturers are now offering their customers the characteristic Duco advantages of a tough and durable finish that does not easily scratch, check or crack with age, or become sticky in warm, moist weather.

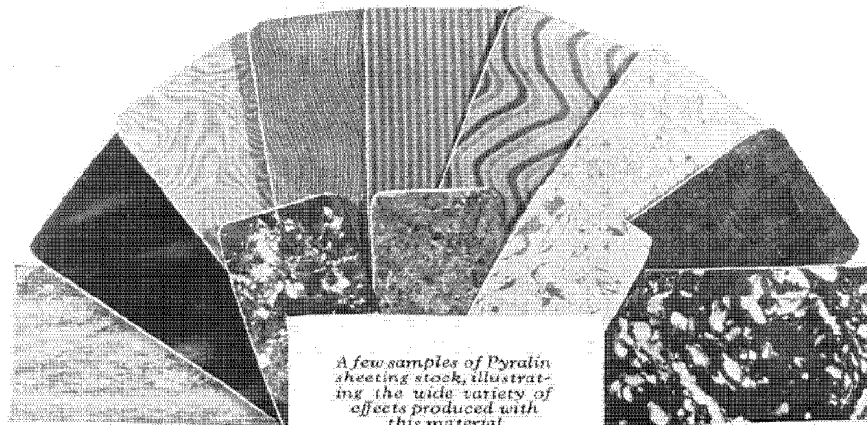
In the Chemical Products Division the du Pont Company places at the disposal of industry generally a staff of men who have been specializing in pyroxylin technology as applied to industrial usage for more than twenty-five years, back of which is the extensive du Pont experience in related branches of chemistry and engineering. The kind of research and experimental work that resulted in the development of Duco is constantly going on, approximately 75 chemists being employed in this division alone in such activities and in the control of factory production and assisting industrial consumers in application problems.



The growth indicated by these figures cannot be all luck or accident, but must be due to real service that is advantageous to those whose business has made this expansion possible. Acting as it does as the distributor of the industrial products of the du Pont Company's paint and varnish plants, the Chemical Products Division is in the position of being able to serve all branches of industry with the type of finishes best suited for their requirements without any temptation or incentive to favor itself at the expense of the customer.

THE CENTENNIAL CELEBRATION

IT seems appropriate to record briefly what took place on July 4, 1902, in the vicinity of the Brandywine Mills, when members of the du Pont family, company employes and their families and other invited guests—about three thousand in all—assembled to celebrate the first one hundred years of du Pont manufacturing activity in Delaware. Dancing, target-shooting, music and fireworks were features of that memorable day. A few days later employes' committees of the Brandywine Mills and of the Carney's Point plant formally expressed their appreciation for the day of pleasure in beautifully engrossed sets of resolutions which were framed, and are still displayed in the company's executive offices.



IN THE FIELD OF PLASTICS

The Du Pont Viscoloid Company's products are used extensively in the nation's industries. How this organization developed is the theme here



WITH a background of more than a century of manufacturing experience, and with technical skill in the chemical transformation of cotton—or cellulose—into products of vital importance to the nation, it was logical for the du Pont Company to extend the scope of its activities in fields closely allied to the others it had previously developed.

The pyroxylin plastic industry seemed to offer a splendid opportunity for the application of this knowledge and experience. Accordingly, one of the first steps in the company's program of expansion was the acquisition in 1913 of the Arlington Company, of Newark, New Jersey. At that time there were three other concerns engaged in the business—the Celluloid Company, organized in 1870; the Fiberloid Corporation, organized in 1891, and the Viscoloid Company, established in 1901.

Pyroxylin plastic is produced by means of a series of rather complex chemical processes from a mixture of cam-

By C. K. DAVIS
*General Manager, Leominster Works,
Du Pont Viscoloid Company, Inc.*

phor, alcohol and nitrocellulose. Just as chemical genius has developed delicate and varied colors and perfumes from coal tar, so are these ordinary cellulose substances converted into a material like glass or amber; like stone or wood or rubber; like horn, shell or pearl; like ivory or semi-precious stones; or what you will. Its capacity to duplicate or improve upon the structural qualities and properties of natural materials is truly marvelous.

It can be cut, sawed, carved, stamped, pressed, molded, ground, turned, stretched, shrunk, polished, and can be assembled to an extent far surpassing any of its natural competitors. Its coloring is the entire spectrum; its pattern or dress is as changeable as the whims of style.

The foregoing will perhaps suggest that the production of this unique material offered promising possibilities to the men who established the Arlington Company in 1883. The company was known to the trade under this name until 1917 when it became a division unit of the du Pont Company. About that time large quantities of Pyralin



The Arlington Works of the Du Pont Viscoloid Company at Arlington, N. J., where extensive facilities are maintained for the production of Pyralin. The inset picture, showing the plant as it existed in 1895, affords an interesting contrast.

were being produced at the Arlington plant to meet both the normal and abnormal demands for it during the war and for many months afterward. The next few years witnessed frequent changes in the organization, management, policies and products, in order to restore the business to a peace-time basis. That accomplished, the management was successful in bringing the organization to a high point of efficiency and to a position of leadership.

At this point it may be well to sketch briefly the background of the Viscoloid Company, which was established in 1901 at Leominster, Massachusetts, and was the outgrowth of a business launched early in the 19th century. The production of horn goods was its principal activity; and its entry into the pyroxylin plastic field was the result of a steady decline in the supply of horn, due to the elimination from the prairies of the scrawny long-horn cattle which were killed principally for their horns, hoofs and hides. When refrigerator cars and ships, and growing population made the production of food products of greater importance, then horn disappeared, first from the Middle West, then from California, and finally from Argentina. The town of Leominster had been the principal horn-comb producing center in the world, and was a logical place to manufacture the material which was to replace horn in the industry. The Viscoloid Company soon developed into an important producer of pyroxylin plastic articles, particularly combs and hair ornaments. Leominster today is still the American center of the comb and hair ornament industry.

Although the du Pont and Viscoloid companies both produced pyroxylin plastic, known as Pyralin and Viscoloid, respectively, and essentially of the same composition, the fabricating divisions of these companies produced articles that were very dissimilar in type. Recognizing the obvious economic advantages to be gained by a consolidation of the two interests, the Du Pont Viscoloid Company was formed in 1925, as a subsidiary of the du Pont Company, thus unifying the two most progressive

organizations in the industry, and resulting in a more complete and extensive line of products than was offered by any other manufacturer.

Prior to this time the Pacific Novelty Company, organized in 1891, acted as a distributor for a large portion of the Viscoloid Company's fabricated articles. Since it was desirable to continue this close association, the sales organization was merged, in 1926, with the Du Pont Viscoloid Company, thus completing the consolidated organization.

Today, the Du Pont Viscoloid Company is as important in its field as the parent company is in the explosives industry. Its two plants produce more than one-third of all the pyroxylin plastic made in this country in the form of rods, sheeting and tubing. The efficiency of the personnel, the millions of dollars invested in modern equipment, and the national sales and service organizations are all in harmony with this position of leadership.

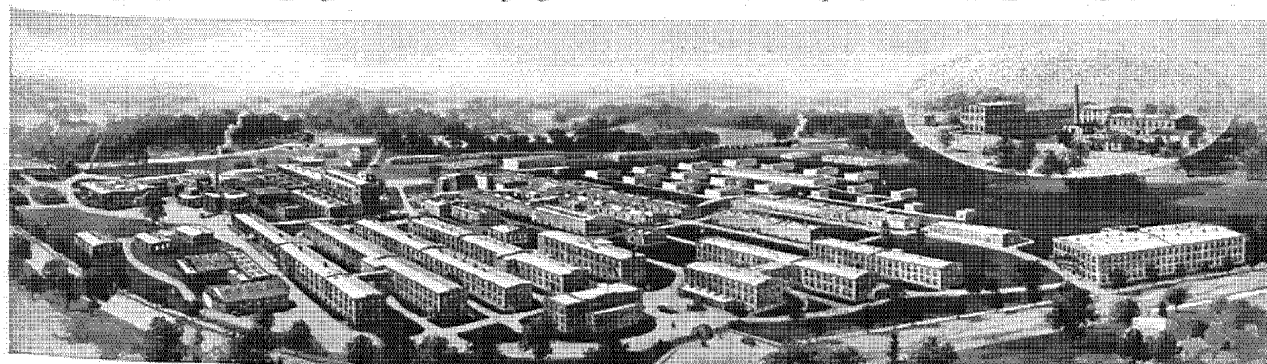
Comparatively few people realize the wide range of usefulness of Pyralin and Viscoloid, reaching as they do into every level of life, into every industry, into every home, to every person. The industry

caters largely to the *ladies* and the *babies*. Among the varied articles of feminine appeal are toilet sets, hair ornaments, umbrella handles, belt buckles, shoe buckles, hat ornaments, manicure sets, bag frames, and bracelets; for the children, sanitary teething rings, rattles, brightly colored toys, napkin rings, and infants' toilet sets of pleasing design. Other important uses of the material include transparent sheeting for automobiles and other types of stock for the manufacture of wood heels, unbreakable fountain pens and pencils of every color, toothbrush handles, optical frames, knife-handles, bathroom fixtures, advertising novelties and souvenirs. The list is far from complete, but it suggests the wide range of products that are made wholly or in part of pyroxylin plastic.

In helping to supply the nation with a material used so extensively in the arts and industries, the Du Pont Viscoloid Company is rendering an important service.



Pyralin toiletware is accepted as the standard of excellence by all discriminating buyers



The Leominster Works of the Du Pont Viscoloid Company at Leominster, Massachusetts, the center of the comb-manufacturing industry in this country. In the oval may be seen a view of the original plant, from a photograph made years ago

DU PONT ENGINEERING

Recounting the activities of an organization that has rendered the company and, during the World War, the nation a conspicuous service



WITH the company's 125th anniversary the du Pont engineering organization comes into its 25th year, and while it is relatively young its service record is paralleled by few branches of the company.

Prior to 1902 each operating department built its own plants. In January of that year, however, an engineering branch was organized as a division of Eastern Dynamite Company which, later, became a part of the present organization. The department grew from a small nucleus of engineers and workmen to an organization in 1914 having an engineering staff of 120 and a payroll force of 800. From time to time it took on engineering and construction work of the various branches of the company and combined other engineering sections with it.

During the period 1903 to 1914 plants were designed and constructed as follows: Sterling, Alabama; Barksdale, Wisconsin; Du Pont, Washington; Louviers, Colorado; Newhall, Maine; a plant for the Brazilian Government near Piquet, Brazil; Hartford City, Indiana; extension to Pompton Lakes, New Jersey; Senter, Michigan; Georgetown, South Carolina; Atlas, Missouri; Hopewell, Virginia; Bacchus, Utah; Penniman, Virginia; Ramsay, Montana; a black powder plant and the reconstruction of a dynamite plant at Pinole, California.

In the fall of 1914 the war construction program loomed up. The following year the engineering force was able to undertake quickly the major program of plant design and construction to meet the colossal requirements of the Allies and, later, of the United States. Large design and supervisory forces were placed at work in the Wilmington Office. Construction forces were organized and the work was pushed with vigor at Hopewell, Virginia; Carney's Point, Haskell, Deepwater Point, Repauno, and Pompton Lakes, New Jersey, and at Barksdale. The smokeless powder plants were quickly expanded. These, with another plant operated later on, provided a capacity nearly one hundred times that of

By E. G. ACKART
Chief Engineer,
E. I. du Pont de Nemours & Co., Inc.

pre-war days. Large extensions were also made to the high explosives plants.

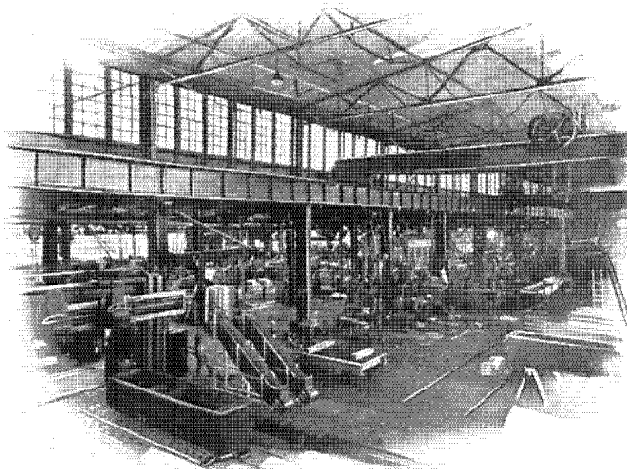
In 1917 the major portion of the war program for supplying the Allies was completed and the working force partially demobilized. At this time the department completed the design and construction of a Fabrikoid plant at Toronto, Canada, for Canadian Explosives, Ltd., and designed and built Oficina Pena Grande, near Iquique, Chile—for the recovery of nitrates from ore.

When the United States entered the war in 1917 it was necessary to organize on an even larger scale than before, for the program included the design and construction of Old Hickory smokeless powder plant near Nashville, Tennessee; the Penniman shell loading plant near Williamsburg, Virginia; sulphuric acid and nitric acid plants for the Government at Indian Head, Maryland, and considerable work on a T. N. T. plant at Ives, Wisconsin. In addition to the du Pont Company work, plants were built for the Hercules Powder Company, notably the cordite plant at Kenil, New Jersey.

Until then the Hopewell (Virginia) guncotton plant had been the outstanding piece of construction, both with regard to speed and size. However, the design and construction of the Old Hickory plant took first place. This work ranks as the greatest achievement of the engineering organization—the building of the largest smokeless powder plant in the world.

The contract, signed January 29, 1918, called for the erection of a plant capable of producing 900,000 pounds of military smokeless powder in each day of twenty-four hours. There were to be nine complete units, each of 100,000 pounds daily capacity; and for designing and constructing this plant the Government was to pay the company one dollar

profit. Seven miles of railroad, to carry building materials to the plant site, was constructed in twenty-nine days. Ground was broken for the erection of the plant March 8, and the first finished powder was granulated July 2—116 days later—121 days ahead of the



A section of the Wilmington Shops. Here, during the war period, special machinery costing \$43,000,000 and powder boxes costing \$20,000,000 were built. Special machinery of many types for the manufacture of explosives, ammonia, rayon and other products is constructed in these shops, which operate as a part of the du Pont engineering organization.

contract requirement. The second powder unit began manufacture on July 24; the third, August 20; the fourth, September 3; and the fifth, September 24.

The sixth unit was ready on November 11, Armistice Day, but was not operated. At that time the seventh powder unit was about 98 per cent complete, and the eighth and ninth units were approximately 60 per cent complete. The entire plant was about 93 per cent complete—in eight months—at a cost of \$85,000,000.

The department personnel reached its peak in August, 1918, when there were approximately 2,500 salaried staff employes and a payroll force of approximately 50,000. The war activities of this organization included construction work amounting to \$225,000,000.

Among the related projects were: power houses with full capacity of 200,000 boiler h. p.; pumping stations with a capacity of 305,000,000 gallons a day, exceeding the combined daily water consumption of Philadelphia and Boston; plants capable of filtering and purifying daily 175,000,000 gallons of water; refrigeration apparatus with a capacity of 9,350,000 pounds of ice a day; railroad yards capable of handling 1,600 cars at one time; one hundred miles of standard gauge and two hundred and eight miles of narrow gauge railroad, and 10,790 individual dwellings. These, with the accompanying hotels, boarding houses, women's dormitories and bunk houses, were capable of housing 65,000 persons.

Du Pont engineers also built 570 community buildings, such as those to house the Y. M. C. A. and Y. W. C. A.; cafeterias, school houses, lodge halls, post offices, drug stores, banks and railroad stations, a total of 11,360 buildings, costing, altogether about \$37,000,000.

At the height of the war work, in August, 1918, the outlay reached nearly \$900,000 a day. The rate of yearly expenditures was three times as great as that made for the construction of the Panama Canal.

Toward the close of the war construction was begun on the Dye Works at Deepwater Point, New Jersey, and since then a number of major additions have been made, including the plants for the manufacture of tetraethyl lead.

After the Armistice it was necessary to demobilize the great army of workers quickly. To accomplish this without demoralization was a difficult task. Accordingly, considerable outside work was undertaken to avoid disrupting the forces. For example, \$60,000,000 of design and construction work was done for the General Motors Corporation, including the huge Cadillac plant at Detroit and 1,500 dwellings at Flint and Pontiac, Michigan.

Since the war the organization has completed the following work for the du Pont Company and subsidiaries: A rayon plant for the Du Pont Rayon Company at Buffalo, New York; a high explosives plant at Calama, Chile, for the Compania Sud-Americana de Explosivos; additional plants for the Du Pont Rayon Company at Buffalo and Old Hickory; a synthetic ammonia plant for Lazote, Inc., near Charleston, West Virginia; an industrial alcohol plant at Deepwater Point, New Jersey, for the Eastern Alcohol Corporation, and a

new high explosives plant near Birmingham, Alabama.

The scope of engineering services rendered covers a more varied line of manufacture and processes than can probably be credited to any other corporation in the country. Plant site studies are made involving analyses of freight rates on incoming raw materials and outgoing finished products, topography, labor conditions, water and power supply, climatic conditions, and so on. Complete architectural and structural layouts are made of factory buildings, offices, laboratories and shops. Complete designs are made of process equipment, fire protection, heating, lighting and ventilating, together with layouts of power plants and distributing systems which supply steam, electricity, refrigeration and compressed air and water as required.

Operative and mechanical research engineers study the company's various processes, become familiar with details of all plant operations, improve old and develop new mechanical and power equipment to increase plant operating efficiency; they also cooperate with other technical departments in developing new manufacturing processes.

This work calls for specialists in nearly all lines of engineering. Consequently, on the staff are construction engineers, civil, mechanical, electrical, power and mechanical research engineers, architects, structural and machine designers, heating and ventilating engineers.

The du Pont engineering organization possesses the knowledge and experience which enabled it to set up a remarkable record during the war and also to carry out the design and construction work required for the company's individual departments and its subsidiaries.

FORTY-FIVE YEARS AGO

(Continued from page 15)

him when he continued to insist. They met next morning, and proceeded to Repauno. At 10:00 o'clock, a telegram was handed to me in the office, stating that President Lamont du Pont, Superintendent Walter N. Hill, nitroglycerin-makers Norcross, Norton and Ley, and a stranger named Ackerson, had all been instantly killed in an explosion.

I was crushed. I realized his untimely death had stilled a master mind; all who knew him had lost a friend.

As this calamity had taken the lives of all the practical manufacturers of dynamite at Repauno, matters were very chaotic until Mr. Willard, manager of the Hercules Company of Cleveland, came on with Mr. Willson, his superintendent, and rebuilt the Repauno Works.

William du Pont succeeded Lamont du Pont and in July, 1885, moved the offices to Wilmington. The staff of clerks had then been increased to about ten or twelve.

As I look back and realize I have had the rare privilege of an acquaintanceship with six of the eight presidents of the company, and an opportunity to see the three little sons of Lamont du Pont—Pierre, Irénée and Lamont, Jr.—grow up to be successful business men, honored, respected, and useful citizens, I can repeat with the Psalmist "The lines are fallen unto me in pleasant places."

APPLYING SCIENCE TO PAINT

Chemical research and control, as practiced by the du Pont paint and varnish organization, have given new impetus to an old and useful industry



THE du Pont Company first became interested in the paint business in 1917 through the acquisition of Harrison Brothers & Company of Philadelphia, a concern rivaling du Pont in age and a leader in house paints and oil colors.

After a study of the opportunity in the industry, the company then acquired several other important concerns, including the Bridgeport Wood Finishing Company of New Milford, Connecticut, the Chicago Varnish Company of Chicago and the New England Oil, Paint and Varnish Company of Everett, Massachusetts.

A COMPLETE LINE ESTABLISHED

The Bridgeport Wood Finishing Company was noted for its line of fillers, stains and finishes of acknowledged quality and leadership. The Chicago Varnish Company manufactured a line of varnishes with an enviable reputation for more than fifty years of continued use. Through the purchase of these various companies, each outstanding in its specific field, the du Pont Company quickly established a complete line of paints, varnishes, enamels, stains, and finishes, each of which was of long recognized quality.

The acquisition of these organizations, which coupled an aggregate of 327 years of paint-manufacturing experience with the du Pont Company's 125 years of broad chemical and research knowledge, quickly brought into the paint industry hitherto unknown facilities and experience.

During the first few years, while the du Pont Company was standardizing materials and qualities, each acquired line was marketed individually. Then in 1922, the leading items of each line were welded into one line of finishes for every household and industrial use and marketed under the du Pont oval.

From the beginning of the company's connection with the paint industry, the full facilities of its research organization, and control methods, were applied, which resulted in giving to the public a new standard of value in finishing materials and finishing methods. Old products have been improved and new products have been and are being created. New types of testing methods and recording apparatus have been developed, many of them new to the industry and still exclusive with du Pont.

By J. W. ELMS

Manager, Paint, Varnish & Lead Division,
E. I. du Pont de Nemours & Co., Inc.

These contributions to the industry have done much to displace the old "rule-of-thumb" methods with the certainty of chemical precision and mechanical accuracy. Notably among its accomplishments is Duco, the result of the company's vision, vast resources in chemical knowledge and manufacturing experience. This product brought about entirely new results in entirely new ways. It provided a product to the industry which not only effected greater durability under most trying conditions, but also resulted in greater economy. It gave to the American public a type of product which people everywhere were waiting for, a finish which dried quickly instead of taking hours and days, a finish that anyone could use, and the means whereby—almost overnight—an entirely new era in home decoration has been created.

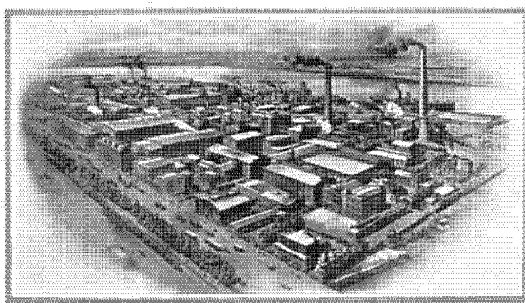
People who heretofore objected to painting now find joy in using Duco. It has opened for the householder new vistas of color harmony. No development in the history of the painting industry has been so remarkable or so revolutionary as this.

PRESCRIPTION PAINT SERVICE

Another notable example of the du Pont Company's contribution to the industry is the du Pont Prescription Paint Service which for the first time applies engineering practices to factory maintenance. Actual surveys of plants are made under the supervision of du Pont engineers; conditions peculiar to each plant are noted, and definite recommendations are made as to the products best suited for various purposes, the best methods for their application, and the proper painting schedule. As a result, plant upkeep, as far as paint products are concerned, is placed on a precision basis, resulting in greater protection at less cost.

Along with the creating of Duco and with the development of the Prescription Paint

Service, the du Pont Company has pioneered toward the simplification of its paint lines. While research work and manufacturing methods are being constantly developed and improved, markets are being constantly studied, and distribution is being developed in order that the public may receive these products not only of uniform high quality but also as economically and conveniently as possible.



The du Pont plant at Gray's Ferry, Philadelphia, Pa. Ten years ago it was purchased from Harrison Brothers & Co., one of the oldest paint manufacturers in the country

PIGMENTS AND HEAVY CHEMICALS

In name they mean little to the average man; but if their manufacture suddenly ceased, he would be deprived of many actual needs and comforts

THE business suggested by this title is the outgrowth of an enterprise which had its beginning in 1793, when John Harrison, a young chemist, started to produce sulphuric acid in a little shop at Third and Green Streets, Philadelphia. At that time this acid was concentrated in fragile glass containers—a highly dangerous operation. Later he substituted for his glass retorts a costly platinum container, which not only eliminated the breakage hazard but also increased the efficiency of his process. His business grew and his sons enlarged it. So it was when the du Pont Company purchased the Harrison Brothers & Company in 1917, the accumulated facilities of a great manufacturing organization were acquired with an extensive line of chemical products.

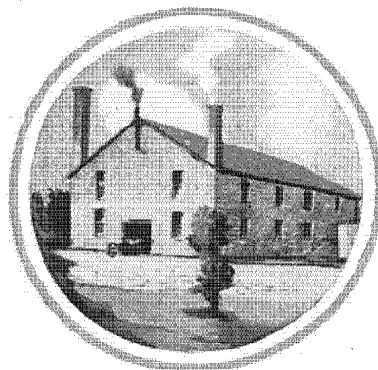
Sulphuric acid is used either directly or indirectly in practically every industry. Its importance is well illustrated by an occurrence many years ago.

Sulphur, its basic ingredient, was not produced in America then; it was brought from Sicily in sailing vessels.

One of these ships, caught in a violent storm at sea, was swept far off its course and, six weeks later, was given up as lost. Sulphur supplies became perilously low and the acid plant faced a shut down. Textile mills depending upon its output also faced suspension. A storm at sea had really endangered the industrial welfare of the United States. Fortunately, the vessel weathered the storm and made port in time to permit continuance of production. Such an emergency could not exist today, for the chemical industry is now widespread and various supply sources have been developed.

To this original Harrison product, later were added nitric, muriatic, acetic and lactic acids; strontium nitrate, alums, and lithopone. Since the du Pont Company acquired the business, these products have been refined and others—among them anhydrous sodium sulphate, barium chloride, dry colors and alumina hydrate—have been added. During the World War, Harrison Brothers & Company came to the rescue of American railroads in a way that permitted them to continue operations on a safe basis. Prior to 1914, all strontium nitrate used in the manufacture of railroad fuses or red safety flares came from Germany. When importations stopped, only meager supplies were available, and manufacturers of fuses went to Washington for help. They were told that Harrison Brothers of

By E. C. THOMPSON
*Manager, Pigments and Heavy Chemicals Division,
E. I. du Pont de Nemours & Co., Inc.*



John Harrison was the first to manufacture sulphuric acid in America. This view shows his acid plant at Kensington, Philadelphia

Philadelphia might undertake to produce strontium nitrate. Soon afterwards, the company was producing adequate quantities of this chemical.

Along with the purchase of the Harrison Company, the du Pont Company also acquired valuable processes for the manufacture of lithopone and dry colors. Beckton White lithopone—the first product of its kind to be

manufactured in America—was being utilized in the manufacture of linoleum, paints, shade cloth and other products. It is a white pigment. At that time its principal drawback was the fact that its snowy whiteness lacked stability under the influence of sunlight. Accordingly, research chemists applied themselves to the problem of perfecting lithopone in this respect. Careful study disclosed the trouble and suggested the remedy which has since been applied. Du Pont lithopone is now light stable. This may be cited as one of the contributions made by chemistry to the consuming industries.

Although the average man has little or no direct contact with pigments and heavy chemicals, he is nevertheless dependent upon them for many things essential to his daily life.

The glass in the windows of his home has salt cake in it; leather in his shoes may be tanned with the aid of lactic acid; his drinking water is purified by alum; barium chloride helps the refining of the sugar in his morning coffee. The pickles he eats, the smokeless powder he shoots, his spectacle frames and his freshly-laundered linens employ acetic acid in their production. His cravat is decorated by colors produced with the aid of muriatic acid; his favorite magazine, by engravings etched with nitric acid.

The blue stripe in his shirt and his tan socks are dyed through the use of anhydrous sodium sulphate. His automobile tires, the paint on his house and the linoleum on the floor have lithopone as an ingredient. His surroundings would be drab, indeed, if it were not for dry colors, which add beauty to all painted surfaces. Even his Fourth of July celebration would be hardly complete without crimson fireworks made from strontium nitrate.

This list could be extended indefinitely, but the foregoing examples of the multiplicity of uses for these relatively unfamiliar products sufficiently attest their economic importance to the many and varied manufacturing industries of America.

THE ACHIEVEMENTS OF A DECADE IN THE DYESTUFFS BUSINESS

The du Pont Company has been helpful in developing an industry of great importance to the nation in times of peace and war

"PEACE hath its victories no less than war." The du Pont dyestuffs industry, into which the company was led during the World War, has now reached a stage of development where it can supply the consuming industries of the United States with a very large percentage of their needs of dyestuffs.

Prior to the great war, synthetic dyes for the whole world were almost all made in Germany, and it was not until the war interfered with imports that the American public realized the great dependence of numerous industries in the United States upon these essential materials. We ordinarily think of dyes as being used in the textile field only, but, as a matter of fact, to the leather, paper, paint, ink and many other industries, a supply of synthetic dyestuffs is just as indispensable. Although the value of the dyestuffs in most finished articles is an extremely small percentage of the total value of the articles themselves, it is estimated that \$6,000,000,000 of production in this country is dependent on the dyestuffs industry.

We can all remember the excitement caused during the early days of the war when it was reported that dyestuffs were becoming scarce because they could not be secured from Germany. People were led to believe that we would all be forced to wear white clothing. Due to the foresight and enterprise of the du Pont Company and other companies which undertook the creation of a dyestuffs industry in this country, this catastrophe—for it would have been a catastrophe—was happily averted.

For a year or two after the United States entered the war in April, 1917, the development of the industry was greatly handicapped because all the resources of the country, both human and material, were concentrated on the one task of winning the conflict. Equipment and raw materials were hard to get; a properly trained personnel still harder. These men had to be developed, processes had to be worked out and special equipment had to be manufactured, which at times seemed to present almost insuperable obstacles. The du Pont Company never faltered, however, in its plans to meet the emergency, and it stands today ready to serve the thousands of consumers of dyestuffs in the same way it has always served the industries dependent on its varied line of products.

This year the du Pont Company celebrates the 125th anniversary of its founding. By a coincidence the same year marks the 10th anniversary of its entrance into the

By E. G. ROBINSON

Asst. General Manager, Dyestuffs Department
E. I. du Pont de Nemours & Co., Inc.

dyestuffs industry. Ten years does not seem a very long time in comparison with the long life of the company, but developments move much more rapidly

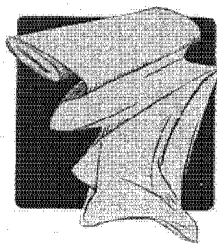
these days than they did during the first half of the past century. Accordingly, the du Pont dyestuffs business at ten years of age is mature and well developed instead of being still in its childhood.

The company was more than fifty years old when the first synthetic coal-tar dye was produced. As happens in many such discoveries, this first dye was obtained accidentally by an Englishman named Perkin while he was experimenting for the production of an entirely different material. Although this discovery occurred in England, the Germans were quick to seize upon it and to develop additional dyes, so that for many years the dyestuffs industry in Germany was preëminent. We do not know how long a time elapsed before the Germans realized the organic chemical industry was a powerful weapon to secure for them a coveted "place in the sun," but we do know that they taught the rest of the world a never-to-be-forgotten lesson when they loosed their first cloud of poison gas against the Canadians at Ypres in 1915.

NATIONAL SECURITY

The introduction of poison gas warfare has demonstrated that the security of a nation from aggression is dependent upon its having a well-developed organic chemical industry. It is now well understood that dyestuffs equipment and personnel can be—as in Germany's case they were—quickly turned over to the manufacture of poison gas. The world would be unsafe if the organic chemical industry were concentrated in the hands of any one nation. This has been recognized by our Government, and the present stage in the development of the American dyestuffs industry is possible only as a result of tariff legislation sponsored by far-seeing textile manufacturers.

This is the age of chemistry. We have had our mechanical age, our steel age, and our electrical age, but the age of chemistry in this country is just beginning. Only a few years ago the word "chemist" suggested the corner drug store, but in the past few years we have awakened to the fact that chemistry is exerting a powerful influence on all phases of our daily life. There is probably no industry which is not dependent more or less directly upon the science of chemistry.



The du Pont Company is a chemical company. For more than a century its activities were confined to the manufacture of explosive products. More recently other branches of chemical industry have been included, and now for ten years the company has been developing the most complicated of all—synthetic organic chemicals.

NOT DYESTUFFS ALONE

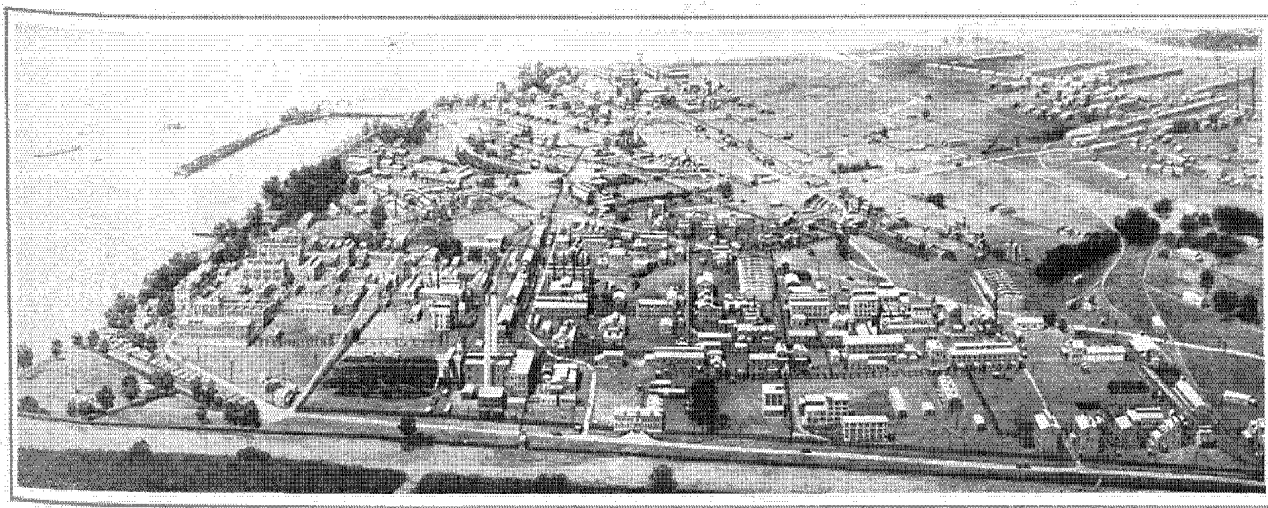
There seems to be no limit to the organic compounds which can be produced, or to the varied ways in which they can be used in serving other branches of industry. We perhaps think first of dyestuffs as samples of synthetic organic chemical products, but the field is not confined to these; continual developments are being made of closely allied compounds useful for other purposes than the creation of color. An instance is furnished by the group of rubber accelerators which today are used almost universally to shorten the time required for vulcanizing rubber products. The du Pont Company produces a varied line of them in order to meet the different needs which arise in the manufacture of different classes of rubber articles. These accelerators, by decreasing greatly the time required for vulcanization, increase the factory output. Millions of dollars of additional investment in rubber factories would be required if these accelerators were not available.

Organic compounds of another important class are the flotation agents. In some mysterious way they possess the property of selecting the valuable portion from a mixture of finely-ground ores and useless materials, and of rejecting the useless part. These flotation agents, which in many cases are closely related chemically to the dyestuffs, have saved enormous sums through increasing the efficiency of ore recovery, and in many cases they have made it possible to recover large values from piles of tailings which had been previously rejected.

In connection with its other organic chemical developments, the du Pont Company has recently developed and

placed on the market a line of seed disinfectants known as Semesan compounds. These are organic mercury derivatives, and their value lies in their ability to increase the yield of agricultural crops by preventing the ravages of plant diseases. Disease germs are carried by all varieties of seed and, if allowed to develop unchecked, they sap the vitality of the seedling and in many cases kill it before it can reach maturity. Treating seeds with Semesan before they are planted greatly increases the percentage of healthy plants obtained. As these seed disinfectants come into general use by farmers and growers they will increase crop yields per acre and diminish the losses which result from weakened, diseased plants unable to bear fruit. This is only another of the marvels which synthetic organic chemistry has produced.

Another development which applies to the automobile industry is the manufacture of tetraethyl lead. In the design of an internal combustion engine there is a limit to the compression under which it can be run, on account of the tendency to cause high-velocity explosions or detonation in the cylinders. This produces the phenomenon known as "knocking" and results in loss of power and injury to the motor. The General Motors Corporation discovered that the addition to gasoline of very minute quantities of tetraethyl lead would eliminate this tendency and permit the development of motors of greatly increased efficiency. Ten years ago this compound was a laboratory curiosity; now it is being produced in large quantities by the du Pont Company at its plant at Deepwater Point, New Jersey. Gasoline so treated is marketed under the name Ethyl Gasoline, and the general introduction of this type of fuel bids fair to revolutionize the manufacture of internal combustion engines. Just as organic chemistry has made it possible to produce less expensive and better tires for the automobile by the use of accelerators, so also has organic chemistry developed a way to obtain more efficient utilization of the gasoline supply.



An aerial view of the du Pont dye works at Deepwater Point, New Jersey, across the Delaware river from Wilmington.

DU PONT'S CONTRIBUTION TO THE TEXTILE INDUSTRY

Improvements made in rayon have opened the way for the manufacture of many products of unusual appeal to the public

WHEN Chardonnet first produced a silk-like fiber by chemical means in 1884 and organized a company for its manufacture in France, he founded an industry that was destined to grow to astounding proportions. For years its manufacture was confined almost entirely to Europe. Even as late as 1910 there was practically no production and little consumption of this yarn in America. Two years later, however, domestic production had passed the million pound mark, and recent statistics show that in 1926 the United States led all other countries in the manufacture of rayon with an output of nearly sixty-two million pounds.

The entrance of the du Pont Company into the rayon field was a most natural step in its expansion program. Years of development work in cellulose chemistry had provided a splendid foundation for the manufacture of this newest of textile fibers — another cellulose product.

In 1920 the first plant of the Du Pont Fibersilk Company was erected at Buffalo, New York, and soon millions of pounds of wood pulp were being transformed into millions of skeins of beautiful fibersilk, as it was first called, or rayon as it is now designated. The company name was later changed to the Du Pont Rayon Company, and another large plant was built at Old Hickory, Tennessee, to take care of the increased demand.

The du Pont Company has contributed heartily to the marvelous development of the rayon industry. The resources of its chemical organization have been brought into play to give added beauty, increased durability and extra softness to this great man-made textile that stands shoulder to shoulder with nature's age-old fibers—silk, wool and cotton. In the limited space allowed for this article there is little room for more than a brief mention of two

By L. A. YERKES
President
Du Pont Rayon Company, Inc.

important developments. One of them is Du Pont Super-Extra, a multi-filament yarn of much greater softness than the regular grades. This is now standard in the field of fine underwear, hosiery, velvet and other high-grade products. And another important step is the marketing of yarn wound on cones instead of skeins, thus permitting greater speed and economy in its use by the textile manufacturer.

From the consumer point of view, rayon has brought the luxury of beautiful, colorful fabrics of delightful texture within the buying scope of millions of people who heretofore could not afford it.

Rayon has given to wool and cotton unusual decorative possibilities that have greatly increased their appeal, while to silk it has also contributed added wearing qualities and permitted prices lower than ever before.

Today rayon serves mankind in a wide variety of ways. One fifth of all the hosiery produced contains rayon. Every man, woman and child in this country consumes annually, on the average, about two pairs of hosiery made with rayon. From the dollar standpoint, one third of all women's underwear sold is rayon. Millions of yards of cloth are made wholly or in part of this yarn, and these fabrics are used extensively for dresses, draperies, bedspreads and hundreds of other articles. Rayon is not only serviceable but is also well suited for various modes. The highest style authorities in this



Courtesy of Franklin Simon & Co.

This girl is dressed in rayon from head to foot

country and in Europe are continually using it in their creations. The accompanying picture, secured from one of the most fashionable New York stores, shows a girl whose entire wearing apparel is made of rayon, thus indicating its remarkable adaptability. What the production will be or to what further uses it will be put during the next generation, one can only imagine.

MOTION PICTURE FILM

The du Pont Company sought another outlet for cellulose products, and that is why, today, Du Pont-Pathé film is contributing pleasure to millions

ABOUT fifteen years ago the du Pont Company, in accordance with its established policy of developing the field of industrial products made from cellulose, began to study the possibilities of the motion picture film, which was then a comparatively new invention. The large field for use of motion picture film in the theater, the home, the school, and in industry was easily appreciated, and the industry of producing the film itself appeared to be one worthy of consideration as a permanent investment. It was not, however, until 1914 that the company undertook actively the first experimental work on photographic emulsions and the celluloid base upon which these are coated.

This experimental work, like all other development work under way at that time, was temporarily suspended on the outbreak of the war and was not resumed until the close of the war. From then on, experimental work made rapid progress through laboratory and semi-works stages until the present factory for the manufacture of film was designed and constructed in 1921 and 1922. Active production began in 1923, and in 1924 the du Pont Company and Pathé Exchange organized jointly a new company which acquired the film manufacturing facilities and which has since administered this branch of the du Pont Company's activities.

Although the film industry is one of the youngest of the du Pont Company's ventures, its development has been remarkable because, contrary to the usual policy in

recent years, the industry was not started by the purchase of a plant already in production or by the acquisition of complete details of plant and process from another manufacturer. The processes and machinery were developed entirely by the company's own technical staff. It was also remarkable because of the rapidity with which difficulties

By GEORGE ROCKER

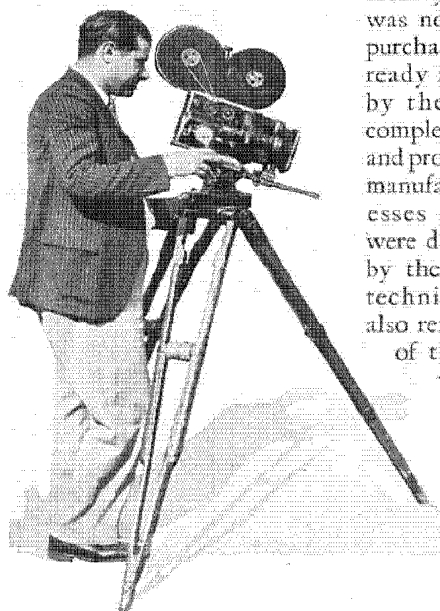
*Assistant to the President
Du Pont-Pathé Film Manufacturing Corporation*

that had to be surmounted were overcome, all of which required infinite patience and attention to detail before success was achieved. This can be real-

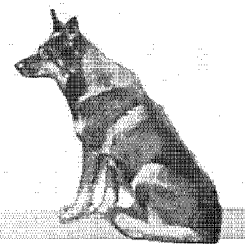
ized only when one considers the extreme sensitivity of photographic emulsions to light and to the minutest traces of impurities, or considers the requirements for proper speed and contrast upon which depend not only the registration of the image, but also the proper values of high lights and shadows.

In the manufacture of motion picture film the celluloid base or carrier for the emulsion is produced by casting solutions of nitrocellulose and camphor continuously upon a rotating drum. As the drum turns, the solvent used in making the solution is evaporated and a sheet of celluloid remains on the wheel. This sheet, before the drum makes a complete revolution, is sufficiently dry and tough to permit of stripping and is removed from the drum as a continuous endless sheet. After further drying, this sheet is wound up in large rolls which then go to a coating machine. On this machine the roll is unwound and the sheet is coated with a continuous layer of a silver halide gelatin emulsion. From the coating machine, the film passes into drying chambers, where it is dried and rewound. This coated roll is then slit into narrow widths, one and three-eighth inches wide, the standard width of professional motion picture film. The narrow rolls then pass to machines which punch small perforations on each edge of the film to fit the sprockets of motion picture cameras and projectors. The film in narrow roll form is then inspected and packed in light-proof containers. Operations from emulsion coating on are conducted in "dark rooms," where only a faint red light is permitted; also, all operations including the casting of film are conducted in rooms kept scrupulously clean, for even the smallest particle of dust on the film may injure the emulsion or may be magnified to a large spot on the projection screen.

At the present time the company is producing three types of film: positive, orthochromatic negative and panchromatic negative. The actual picture, in the studio or outdoors, is, of course, registered on negative film exposed in the motion picture cameras. The exposed negative is sent to the



The motion picture has today become almost indispensable to the progress of science, education and the dramatic arts



laboratory where it is developed in continuous developing machines or by so-called rack development. The various scenes desired in sequence are then composited by splicing into one thousand foot rolls, titles being added. From these a positive is printed in a continuous printing machine, is developed and, after inspection for defects, is ready for projection.

There is probably no product of the chemical industry which today touches the minds and activities of mankind in so many and varied ways as the motion picture film. In the theater it has become a medium for dramatic expression with possibilities beyond those of the ordinary stage, because of the wide scope of its settings. It interprets and vitalizes events and characters of drama, fiction and history. As a medium for portraying visually all that is best in literature it is unsurpassed. It appeals to the illiterate as well as to the educated. In another field, the recording of current events, it supplements the daily newspaper by bringing to every community living pictures of occurrences from all over the world. In the form of news reel it has been perhaps the most powerful educational force in recent years. Travel has always been considered educational, and travel with the news reel, which is not limited to the traveler's purse, and which millions of people enjoy daily, certainly has its broadening effect.

As an educational medium motion picture film is also playing an increasingly important part in schools and colleges, and some of the larger cities now have so-called departments of visual education. In many branches of biology, chemistry, physics, astronomy, ethnology and psychology, motion picture film is used extensively to record phenomena. In engineering, architecture, manufacturing industries and in other applied sciences, records are made of machine motion, of progress in construction or of unique processes, and such records are kept for study. As a medium for recording vanishing wild life, the habits and customs of fast-disappearing primitive races, or the rapidly-changing aspects of our present civilization, the film is of great value. In the practice of medicine its use for recording special phenomena or the progress of disease is becoming daily more important.

Motion picture film is finding large fields of usefulness in advertising, in safety campaigns, in office work, and finally, in the every-day life of the home, in recording events in the lives of children, or in anniversaries, weddings, fishing trips, vacation days, school or college sports. In undertaking its manufacture the du Pont Company has therefore entered a field which should not only afford a permanent outlet for cellulose products, but one which touches practically every side of human life.

CELLOPHANE—A SALES HELP

BECAUSE of the du Pont Company's activities in rayon manufacture, its interest in the development of Cellophane was a natural one, since the latter is made from the same wood pulp base as rayon, but in sheet form instead of in threads.

Cellophane is the sparkling, transparent material so often seen as the wrap on candy boxes and on many other articles. It is made from wood pulp by a series of interesting chemical operations, which have been described in previous numbers of this magazine.

Cellophane was first made in France in 1908 and was exported to this country until 1923, when the du Pont organization secured the American rights to its manufacture and built a plant at Buffalo, New York.

This wrapping material, originally used on candy boxes, has since been adopted for use in a score of other important industries, and today Cellophane may be found as the wrap on dried and smoked meats, baked goods, dried fruit, drugs, soaps, perfumes, textiles and notions.

Cellophane has given to these products many important advantages. To foodstuffs, it has brought one hundred per cent transparency combined with complete protection. It permits the housewife to really see what she buys, and

enables merchants to display food on open counters without fear of contamination from dust or germs.

To products other than foodstuffs, Cellophane has added like virtues. Articles wrapped in it are protected from dust and handling and reach the consumer as clean as when they left the makers' hands. Shopwear, which is one of the retailer's greatest problems, is eliminated, and thousands of dollars represented in merchandise soilage losses are saved each week.

Because of the nature of the raw materials used in its manufacture, Cellophane is absolutely odorless, as well as proof against odors. Furthermore, it is grease-proof, oil-proof, gas-tight and has many other interesting characteristics. In addition to the advantages of the original product, the Du Pont Cellophane Company's chemical research division has evolved a process for making Cellophane absolutely moisture-proof. This desirable property enables manufacturers of pastries and other foods requiring protection from moisture to market them in packages and yet keep them fresh indefinitely.

The quality note which this clear, sparkling material lends to a product has been instrumental in the adoption of Cellophane on hundreds of important articles—the leaders in their fields. To the buying public, it has also become a fitting symbol of quality in the product it protects.



THE HIGH PRESSURE INDUSTRY

Ammonia production by the synthetic method is relatively new in this country. Here are some facts about the process and the uses of the finished product

NOT so many years ago a pressure of 150 pounds per square inch was considered high; in fact, the schedule of dimensions for "extra heavy" pipe fittings was for working pressures of steam up to 250 pounds. Probably the first work on gases at high pressure was the compression of air to approximately 1000 pounds per square inch for air locomotives, although pressures considerably higher than this were in use for so-called hydraulic work where presses were operated by water or oil under high pressure. Pressures of 1000 pounds are now occasionally encountered in steam work, especially in large central stations.

The first extended use of gas compressed to what can now be considered an approach to high pressures was the manufacture in Germany of synthetic ammonia by the Haber process, which operates at a pressure of 3000 pounds per square inch. The research work of Georges Claude, the French inventor, and its reduction to practice in the Claude synthetic ammonia process, advanced the working pressure to 15,000 pounds, probably the highest pressure at which gas is handled in commercial use at the present time. Experiments on very high pressures for water have been carried to over 100,000 pounds per square inch, but such pressures are far more easily obtainable with liquids than with gases.

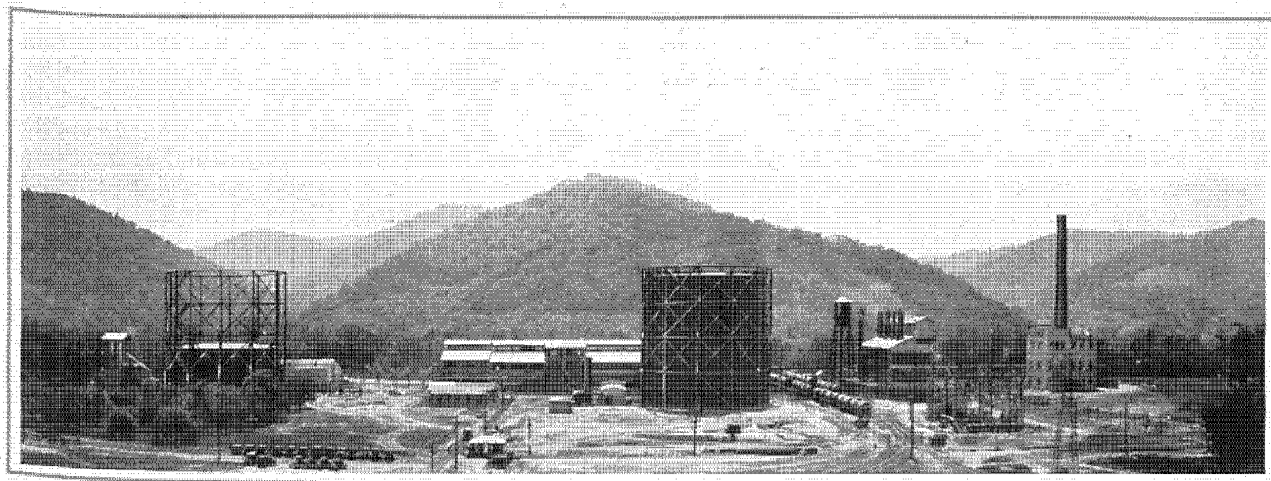
Considering now the use of extremely high pressures for gases in the chemical industry, it is apparent at once that the higher the pressure, the greater the mechanical difficulties, as the construction materials are naturally strained to a very much higher point. However, decided benefits are derived from working with gases at high pressures,

By F. A. WARDENBURG
President, Lazote, Incorporated

due to the fact that they take on, to a certain extent, the characteristics of liquids. For example, the nitrogen-hydrogen mixture used in ammonia synthesis is, at a pressure of 15,000 pounds per square inch, one-third as dense as water. Under such conditions it is much easier to transfer heat from one portion of a gas stream to another, as is required at almost every step in a chemical operation. Gases also react more easily with each other when the various molecules are forced by high pressure into closer contact. As a further advantage, the apparatus required to conduct a given reaction is smaller, the higher the pressure. For example, a certain flow of gas at atmospheric pressure requires a pipe ten inches in diameter, whereas at 15,000 pounds per square inch a pipe with an internal diameter of three-eighths of an inch is quite sufficient.

All of these advantages are particularly applicable to synthesis reactions, through which a compound is built up from its constituents. There is thus placed in the hands of the chemical industry a new tool, the development of which promises to be of far-reaching importance to industry and to mankind. In the future this work will undoubtedly call for pressures far beyond those considered extremely high today. Such pressures, however, will require a great deal of development work to overcome the many mechanical difficulties involved.

The du Pont Company has been quite alive to the possibilities of high-pressure synthesis, and through its participation in Lazote, Incorporated, is making ammonia and methanol, and is developing high-pressure technique which may be applied to many processes in the future.



Part of the new Lazote plant near Belle, West Virginia. Synthetic ammonia is made here from the cheapest of all raw materials—water and air

In the manufacture of ammonia, water-gas is produced, in which coal or coke is used to break down steam, composed of hydrogen and oxygen. The oxygen combines with the carbon of the fuel to produce carbon dioxide and carbon monoxide, leaving hydrogen as the principal constituent of the water-gas. This hydrogen is next separated from the water-gas by reducing the temperature of the gas to approximately 300 degrees below zero, Fahrenheit, liquefying practically all its constituents except the hydrogen, which is drawn off as a gas. A portion of the hydrogen is then burned in air, removing from it its oxygen, and producing a mixture of hydrogen and the nitrogen from the air, which is then available for the production of ammonia.

It is of interest, then, to note that ammonia, composed of nitrogen and hydrogen, can be made from raw materials which are inexhaustible. In the manufacture of ammonia at the Lazote plant, near Belle, West Virginia, hydrogen is, in the last analysis, obtained from water in the Kanawha River, and only a fraction of one per cent of the water flowing in the river is used. Nitrogen is obtained from the air. The plant operating at its present capacity of 25 tons a day could be supplied with its nitrogen from the air over the plant site only for a period of approximately 75 years before it would be necessary to call upon the air over neighboring property. It must not be construed, however, that all that is required to make ammonia is a little water and some of the surrounding air. A large amount of equipment is required for carrying on the intricate processes involved; as well as labor, power,

and the employment of a special catalyst, which is necessary to cause the reaction between the nitrogen and hydrogen to form ammonia.

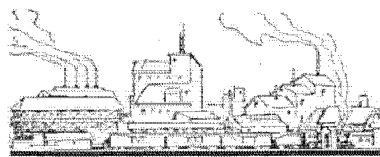
The ammonia produced by Lazote, Inc., is one of the principal raw materials used in plants of the du Pont Company. It is essential in the manufacture of nitrate of ammonia for explosives, and a large use is now developing in the manufacture of nitric acid, where it is rapidly replacing nitrate of soda, which has been the principal raw material for manufacture of nitric acid in the past. There is also a very large demand for ammonia in the general chemical field, in addition to its common use in refrigerating machines, distribution for which is handled by an associated company, the National Ammonia Company.

The largest use of ammonia, of course, is in fertilizers, to supply the necessary nitrogen to the soil. In European countries, particularly Germany, large amounts of synthetic ammonia find their way into fertilizer manufacture, but this use has not started, to any appreciable extent, in this country, as American requirements are quite well taken care of by ammonia secured from by-product coke ovens. The development of sales of fertilizer on a large scale in this country, however, will undoubtedly call upon the synthetic ammonia manufacturer for large amounts of ammonia in the future.

It will be seen, therefore, that the du Pont Company is not only engaged in the commercial high pressure synthetic field, but is also carrying on at least its share of the research work which is being done all over the world on this important advance in the chemical field.

OTHER DU PONT INTERESTS

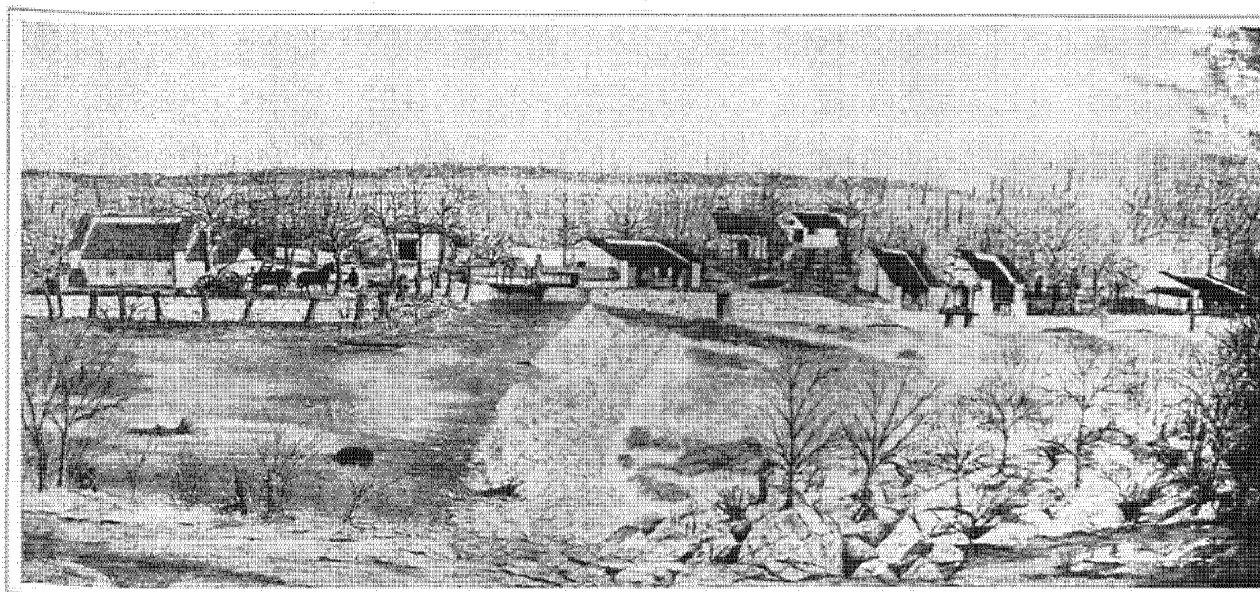
SPACE limitations in this number preclude the possibility of a detailed description of all the industries and interests of the du Pont Company. The principal activities of its departments, as well as those of some of its subsidiary and affiliated companies, are touched upon briefly in the preceding pages. The thought has been to give the reader at least a representative picture of the various branches of the business, and their intimate relationship one to the other—particularly those manufacturing products in which the reader may be especially interested as a consumer or prospective consumer. But the picture of the organization as a whole would be incomplete were no mention made of several other organizations with which the du Pont Company is identified in one way or another. Some of these companies produce raw materials which are used in du Pont industries, and to some extent in others. Again there are subsidiary and affiliated companies that operate in special fields and in local sections of this country and elsewhere. Still others are sales, operating and holding companies. Their names are in



most cases descriptive of the lines of business or functions served. Among these may be enumerated the following:

E. I. du Pont de Nemours & Company of Pennsylvania (manufactures black powder for use in the anthracite field); American Nitrogen Company, Ltd.; Pacific Nitrogen Corporation; Pacific Ammonia and Chemical Company; Du Pont National Ammonia Company; National Ammonia Company, Inc.; The Celastic Corporation (manufactures pyroxilin products used in the manufacture of shoes and shoe linings); Eastern Alcohol Corporation; Du Pont Nitrate Company; Compania Mexicana de Explosivos, S. A., and the Compania Sud-Americana de Explosivos.

Aside from these companies which are mainly associated with the du Pont Company's chemical manufacturing organization, there are others in which the company is interested as a stockholder, notably the General Motors Corporation. The du Pont Company has been a shareholder in that corporation continuously since early in 1918, and today owns the equivalent of 3,992,488 shares of its common stock.



The Lower Yard of the Brandywine Mills, from a painting made in 1878 by Pierre Gentieu, one of the old powder-workers. Some of the buildings are still standing and in use as a part of the facilities of the du Pont Experimental Station.

RÉSUMÉ OF BLACK POWDER HISTORY

(Continued from page 9)

then nearly all the black powder used for blasting in this country has been made from "Chile saltpetre," as sodium nitrate is called. This was undoubtedly the greatest advance in the economic development of the industry, because the supply of this substitute as compared with the greatest demand for it has always maintained a cost of, at least, one-half that of potassium nitrate or saltpetre.

When one thinks of the railroads built, with their attendant tunnels, of the coal mines developed and operated, of the land cleared and the highways constructed even prior to the advent of high explosives, one certainly will not belittle the important part good old black powder has played in the nation's development, apart from its military enterprises. It has been estimated that from 85 to 90 per cent of all the nation's production of black powder has gone to commercial fields for constructive development.

The tremendous advance in the use of high explosives, especially the permissibles, which have been devised to promote safety in gaseous coal mines, has done much to diminish the use of black powder in the peaceful arts. But it is universally admitted that no high explosive will "pull" coal so economically or in so satisfactory a manner as will black blasting powder. Because of its deflagrating nature and its comparatively slow and progressive combustion, it does not shatter the coal. While its use in this industry alone has greatly diminished during the past twenty years, about 6,000,000 kegs or 150,000,000 pounds a year are still employed.

Within the past two years, the du Pont Company has

introduced its use in "stick" or "cartridge" form. This is called pellet powder and the cartridges, conforming to the varying diameters of dynamite, are built up of four pellets, each two inches long. Similar pellets have been in use in Europe for many years but the du Pont Company was the first to introduce them in America. The European pellets are individually wrapped and are made from saltpetre powder, while those manufactured by the du Pont Company are made from sodium nitrate black blasting powder. The acceptance of this improvement by the trade has been beyond our original conception. It has many points of advantage over the old granular form, such as increased safety in handling, greater economy to the operator because of increased production of merchantable coal and decreased cost to the miner. The company has two manufacturing units each of 20,000 pounds daily production already in operation, and is now building several additional units to meet the increasing demand.

Whatever may be the reader's attitude of mind as to the importance of black powder among the many diversified products of the du Pont Company, he must always remember that it was upon the firm foundation of black powder that this great industrial structure was reared.

Admitting its decreased importance as a factor in the development of the peaceful arts by reason of its displacement by high explosives, may we not hope that this new development—pellet powder—will, at least stabilize black blasting powder's present position and that we shall not yet have to sing its "swan-song" in this realm of its usefulness.

OLD BLACK POWDER DAYS

(Continued from page 11.)

used for hauling raw materials and supplies from our storehouses in Wilmington, from the du Pont station on the Wilmington and Northern Railroad and from our Middlesboro wharf on the Christiana Creek just below Wilmington.

These covered wagons also hauled the finished product to the railroad station at Montchanin, to the Delaware River pier, commonly known as Shellpot, or back to the Middlesboro wharf for forwarding. The powder used at nearby points was delivered direct, the wagons going as far as Lancaster, Columbia, Norristown and Reading, all in Pennsylvania. Blasting powder at one time was teamed from the Brandywine Mills to Safe Harbor, Pennsylvania, along the Susquehanna River, where the railroad between Harrisburg and Perryville, Maryland, was being constructed.

Most all of our powder for the West Coast trade was moved in the old days from the Delaware River. Sometimes it was lightered to New York, sent around Cape Horn and, if all went well, it would arrive in San Francisco Bay about three months after leaving Wilmington. Powder for our Lake Superior mining district trade was also manufactured on the Brandywine. I remember the brand well—"Starr F. C."—a saltpetre grade of blasting powder. It was boated to New York, thence by canal and the Great Lakes to Eagle River, Houghton, or some other point on Lake Superior. We also shipped regularly to our two agencies in Valparaiso, Chile, one of them being Graham Rowe and the other Hazan and Compton. These houses sold considerable powder for us and bought and shipped to us cargoes of nitrate of soda.

During the years I have been associated with the du Pont Company, numerous incidents have been indelibly impressed on my memory. Many of them serve to recall examples of whole-hearted cooperation on the part of the executives of the company. In the old days, when the Brandywine Mills made practically all the du Pont

powder, company executives worked right with the men, a personal relationship that today is, of course, impossible, with the tremendous organization now represented by the du Pont oval and the ever-increasing demands made upon executives by other duties.

I remember Henry du Pont coming into the office one morning in the spring of 1883 or 1884, with a jovial smile on his face, and describing to me an event of the evening before, which probably resulted in preserving for future generations the first du Pont powder mill.

It appears that about nine o'clock in the evening, Mr. du Pont heard a continuous ringing or whistling sound coming from the works, indicating to him that all was not right along the powder line. The only mills in operation in the Upper Yard that night were the glazing mills. It did not take the General more than a moment to make up his mind to investigate. He procured his little square lantern with its tallow dip and quickly made his way from his home overlooking the mills to the Upper Banks, a village nearby.

In a few minutes he found Thomas Kane, foreman of the Upper Yard. With the aid of the lantern they began their search, the sound directing them to the Eagle glazing mill, near the dam breast. There they found that the main shaft, where it entered the mill, had become overheated and that an explosion might be expected at any moment.

The mill was immediately stopped. The shaft, to use Mr. du Pont's expression, was "red hot and sparks were coming from it." However, Mr. du Pont, always resourceful, quickly brought into use his high silk hat. After carrying several hatfuls of water from the nearby creek and pouring them over the hot shaft, the danger of an explosion was averted, everything was again serene, and the two men, president and yard foreman, turned away together and went to their respective homes.

(EDITOR'S NOTE—This is the first of two articles by Mr. Macklem on the old days of du Pont black powder manufacture. The second article will appear in a subsequent number.)



One of the old du Pont powder teams that used to make regular trips between the Brandywine Mills and nearby shipping and supply centers. Astride the wheel mule is Mr. Macklem's father, the company's crack driver in those days

EMPLOYEE-EMPLOYER RELATIONS

A survey of company policies for carrying on the same cordial relations between men and management that existed over a century ago

THE establishment and maintenance of a sincere mutual interest on the part of employee and employer is a fundamental requirement of progress in any industrial organization. This principle has been recognized in outstanding industries for many years. In the du Pont Company it has been applied practically from the inception of the business. That the employees have been faithful to their trust is reflected by the eminently successful progress of the company.

It is not so easy to determine how the company, the employer, has maintained its bargain because of the various and scattered character of its influences. So it seems in order to ascertain what accomplishments have been made, and to acquire a better understanding of the motives and purposes underlying the so-called Industrial Relations Plans.

Approximately the first century of the company's existence was marked by slow but sound development of the business. The character of its operations and the demand for its products called for a relatively small investment and a proportionately small operating force. Under these conditions, ownership and management were centered in a few individuals who could and did maintain intimate personal contacts with the workers. In fact, they lived in homes provided by the company at nominal rentals and in close proximity to each other.

In the daily operations of the mills, safety was a prime consideration. Owners and operators shared equally the hazards of powder-making. Indeed, it was an early rule that any new building or operation should be put into service by the owners themselves to insure, so far as possible, that no error in construction or other oversight would needlessly expose employees to extra hazard. When an occasional accident involved injury or death to employees, it was standard practice to supply the best available medical and surgical aid in the case of injuries; suitable care of the dead, and sympathetic personal and material assistance to dependents.

Social activities of those times were frequently enjoyed by employees and employers alike. These occasionally took the form of anniversary picnics, notable among these being the celebration of the hundredth anniversary of the

By WILLIAM B. FOSTER

Director, Service Department,
E. I. du Pont de Nemours & Co., Inc.

substantial tokens befitting the season. Employment and general personnel problems were not difficult to solve when the industry was relatively small. When employees became old or physically incapacitated, a personal knowl-

edge of material conditions provided the medium for adjustment either in the line of modified duties or in such aid as later came to be provided for in pension plans.

The past quarter-century has witnessed a change in the methods of furthering industrial relations in the du Pont Company. This change was brought about primarily by the fact that a number of small industries developed into a relatively large corporation with many varied interests. The attendant need for enlarged capital investment and increased supervision brought about a condition where now the term "employer" really represents a composite of a large number of stockholder-owners and an involved managing organization, while the term "employee" represents many thousands of skilled and unskilled producers in plants from coast to coast. Intimate personal contacts are no longer feasible or even possible, yet

it is perhaps more than ever essential to maintain employee-employer relations at least in character with those which previously existed. With this purpose in mind, plans and policies have been adopted by the corporation from time to time as normal developments indicated their justification. A brief outline of some of them will indicate the resemblance to former policies, with the addition of new ideas intended to contribute to the general aims.

For the well-being of employees, facilities have been provided for medical examinations and treatments, and recommendations are made to insure the assignment of individuals to tasks for which they are physically fitted.

Safety is a constant objective. Individual operators are instructed in the hazards of their work, and engineering ingenuity is taxed to devise proper and safe apparatus and appliances. One unit of the organization concentrates its efforts continually on accident prevention and on the mechanical means for safeguarding employees. Responsi-



Symbols of Service

Every du Pont employe may earn the right to wear a service pin. It is a badge of distinction.

A plain green gold pin bearing the du Pont oval is awarded for five years' service; for ten years' service the award is a pin with one gold star; for fifteen years' service, a pin with two gold stars, and for twenty years' service, a pin with three gold stars.

The coveted twenty-five year pin shown here is of white gold, set with four diamonds. It becomes the employee's property.

bility for the proper care of injured workers is fairly well defined by law in the several states. The company has always been glad to conform to reasonable legislation of this character and, indeed, to exceed the strict legal requirements by the provision of resident medical staffs, first-aid hospitals and liberal financial aid.

The community life of a large percentage of employees is now determined, to considerable extent, by the increased facilities which the normal growth of the country provides. A number of the company's activities, however, require more or less isolated locations. In these cases it is customary to provide for the comfortable housing of employees and their families in suitable dwellings. Frequently entire villages are established either at the beginning of a new operation or during the normal course of its development. In such villages will be found also boarding-houses for unmarried employees, community stores, club houses, athletic grounds and other facilities. Dwelling rentals are about sufficient to provide for their proper upkeep. Stores and boarding-houses are operated substantially at cost. The company does not aim to profit from these activities. In connection with the day-to-day problems arising in works operations, there has been maintained a policy of free intercourse between the men and the management. At some of the larger plants has been established a system of works councils. These provide for the regular periodic consideration of such problems by chosen representatives of the works employees, on the one hand, and selected representatives of the company on the other.

To encourage the constant betterment of the financial standing of employees—aside from the maintenance of equitable wage rates—the company has adopted the following Industrial Relations Plans:

Pensions. These are designed to aid employees who, after a reasonable period of satisfactory service, become physically or mentally incapacitated for normal duties. This plan provides for a monthly pension, the amount of which is determined by length of service and rate of pay at the time of retirement.

During approximately twenty-three years since this plan has been in effect, a total of 831 employees have been pensioned; 390 are living at the present time. Payments are made from a reserve fund which at present contains a total of \$8,250,000, and is being augmented monthly.

Group Insurance. This plan provides for a quickly available income to employees' families in the event of death of an employee or permanent disability before the age of sixty. The policy represents a value of \$1000 after six months' service, and increases by \$100 each year until a total of \$1500 is reached at the end of five years' employment. This insurance is provided without cost to employees.

The plan has been in effect about eight years, during which there have been paid 709 claims amounting to \$973,980.

Salary Allotment Insurance. To supplement the group insurance plan, this one comprises an arrangement whereby employees may apply for additional insurance at standard rates, regardless of occupation and usually with only a simple form of medical examination. Premium payments are arranged for by monthly deduction from wages or salary. This plan has been in effect slightly more than one and a half years. Approximately 17 per cent of the total number of employees carry \$5,078,916 in insurance.

Stock Investment. An opportunity is offered under this plan for employees to become shareholders in the du Pont Company. Debenture stock has been offered annually at approximately market value with the privilege of payment by means of a monthly deduction from wages or salary, if desired. Approximately 77,000 shares of stock have been acquired by employees in this way.

Savings. This plan is designed for employees who can save only a small amount at a time and who may need to draw on such savings for emergencies;

also to assist employees in starting a fund for permanent investment. Deposits may be made through deductions from wages or salary in amounts as small as \$1.00 a month. Interest at six per cent is paid semi-annually.

Benefits. Under this plan provision is made for needed relief in the form of financial assistance to the following classes: (A) Employees who, through sickness or other non-occupational causes, become either physically or mentally incapable of performing their duties; (B) employees who are injured or disabled in the performance of their duties by accident or occupational disease arising out of their work; (C) actual dependents of deceased employees of the company who lose their lives in the performance of their duties.

Eligibility for Class A benefits is predicated on fifteen years or more of service, where incapacity results through no fault of the employee. Class B and Class C benefits operate in conjunction with compensation laws but make further assistance possible.

The sentimental attachment which results from continued association in a mutual interest finds expression in the award of du Pont service pins, which are described more fully on the preceding page.

In short, the Industrial Relations Plans represent the efforts of the stockholder-owners to manifest their interest in the well-being and prosperity of a large and scattered group of employees. With close personal contacts between executives and other workers no longer possible, these plans indicate a sincere desire to maintain the same mutuality of interest that has contributed so largely to the success of the company during the past 125 years.



The first du Pont powder mill near Wilmington, where men and management came into personal contact every day



E. I. DU PONT DE NEMOURS & Co., INC.

General Executive Offices

WILMINGTON

DELAWARE

All Inquiries Regarding du Pont Products Should Be Addressed to the Company—the Nearest Office

ACIDS AND HEAVY CHEMICALS

*Acids, alums and miscellaneous
heavy chemical products.*

Philadelphia, Pa.

35th & Gray's Ferry Rd.

Newark, N. J., 256 Vanderpool St.

AMMONIA

Anhydrous and Aqua Ammonia.

Lazote, Incorporated

Du Pont Bldg., Wilmington, Del.

CELLOPHANE

Du Pont Cellophane Company, Inc.

New York, N. Y., 40 W. 40th St.

Chicago, Ill., Railway Exchange Bldg.

Michigan Ave. and Jackson Blvd.

San Francisco, Calif.

Ballfour Bldg., 351 California St.

CHEMICAL PRODUCTS

*Bronze powders, collodion, household
cement, leather belting cements, Duco,
No. 7 Duco Polish, No. 7 Auto Top
Finish, No. 7 Nickel Polish, pyroxylin
lacquers and enamels, split and patent
leather solutions and other pyroxylin
preparations and solvents.*

Boston, Mass., Everett Station 49

Chicago, Ill., 2100 Elston Ave.

Detroit, Mich., General Motors Bldg.

Flint, Mich.

Parlin, N. J.

San Francisco, Calif., 569 Mission St.

DYESTUFFS

*Dyestuffs and dyestuff intermediates.
Rubber chemicals and seed disinfectants.*

Boston, Mass., 274 Franklin St.

Charlotte, N. C., 232 W. First St.

Chicago, Ill., 1114 Union Trust Bldg.

New York, N. Y., 8 Thomas St.

Philadelphia, Pa., 126 S. Front St.

Providence, R. I.

709 Hospital Trust Bldg.

San Francisco, Calif., 569 Mission St.

Bombay, India, Jacob Sassoon Bldg.

Rampart Row, P. O. Box No. 1010

Kobe, Japan

No. 88 Nakamachi-Dori

P. O. Box No. 384

Hankow, China

No. 23 Tung Ting Road

Shanghai, China

Robert Dollar Bldg.

3 Canton Rd., P. O. Box No. 393

Tientsin, China, 52 Taku Road

MOTION PICTURE FILM

Positive and Negative.

Du Pont-Pathé Film

Manufacturing Corp.

New York City, 35 West 45th St.

EXPLOSIVES

*Explosives for all industrial, agricultural,
military and sporting uses.*

Birmingham, Ala.

601 Brown-Marx Bldg.

Boston, Mass., Harvey Building,

Chauncey & Bedford Sts.

Chicago, Ill., 1814 McCormick Bldg.

Denver, Colo., 406 Ideal Bldg.

Duluth, Minn., Hartley Bldg.

742 E. Superior St.

Huntington, W. Va.

Suite 1004 Union Bank Bldg.

Joplin, Mo., 816 Joplin Nat'l Bank

Bldg.

Juneau, Alaska, P. O. Box No. 231

Kansas City, Mo., 225 Scarritt Bldg.

Miami, Florida, 305 Clark Bldg.

343 S. W. North River Drive

New York, N. Y., Graybar Bldg.

420 Lexington Ave.

Pittsburgh, Pa., Fulton Bldg.

Portland, Ore.

Northwestern National Bank Bldg.

St. Louis, Mo.

17th Floor, Arcade Bldg.

San Francisco, Calif.

Suite 403 Balfour Bldg.

351 California St.

Seattle, Wash.

Hoge Bldg., 2d Ave. & Cherry St.

Scranton, Pa., 710 Traders Bank Bldg.

Spokane, Wash.

721-22 Old National Bank Bldg.

Riverside Ave. & Stevens St.

Springfield, Ill., 716 Reich Bldg.

Wilkes-Barre, Pa.

728 Second National Bank Bldg.

FABRIKOID

*Fabrikoid for auto and furniture uphol-
stery; auto topping, bookbinding, luggage,
novelties, etc. Tontine Washable Window
Shade Cloth.*

Newburgh, N. Y.

San Francisco, Calif., 569 Mission St.

RUBBER PRODUCTS

*Pontop for auto tops and curtains. Rain-
coat fabrics, gum rubber, Rug Anchor,
Ventube for mine ventilation. All kinds
of rubberproofing.*

Fairfield, Conn.

San Francisco, Calif., 569 Mission St.

RAYON

Du Pont Rayon Company, Inc.

P. O. Station B, Buffalo, N. Y.

Greensboro, N. C.

708 Jefferson-Standard Bldg.

Greenville, S. C., 408 Woodside Bldg.

New York, N. Y., 132 Madison Ave.

Old Hickory, Davidson Co., Tenn.

Philadelphia, Pa.

1209 Land Title Bldg.

Providence, R. I., 937 Rhode Island

Hospital Trust Building

Reading, Pa., 31 N. 6th St.

San Francisco, Calif., 569 Mission St.

LITHOPONE, DRY COLORS & PIGMENTS

*Products for paint, ink, oilcloth, linoleum,
rubber and other industries.*

Boston, Mass., Everett Station 49

Chicago, Ill., 2100 Elston Ave.

Cleveland, Ohio

876 Union Trust Bldg.

Los Angeles, Calif.

Citizens' Warehouse

1904 Atlantic St.

Newark, N. J., 256 Vanderpool St.

Philadelphia, Pa.

3500 Gray's Ferry Rd.

PAINTS, VARNISHES, DUCO (FOR HOME USE)

*A complete line of paint and varnish prod-
ucts for all home and industrial uses.*

Boston, Mass., Everett Station 49

Chicago, Ill., 2100 Elston Ave.

Newark, N. J., 256 Vanderpool St.

New York, N. Y., 21 E. 40th St.

Philadelphia, Pa.

Public Ledger Bldg.

Independence Square

San Francisco, Calif., 569 Mission St.

PYRALIN AND VISCOLOID

Pyralin—Arlington, N. J.

Viscoloid—Leominster, Mass.

Pyralin toiletware of Amber, Pearl, Shell

and ivory and combinations of these colors.

Novelty and transparent sheeting, rods,

tubes and beading. Also Cleanable Collars.

Boston, Mass., Harvey Bldg.

52 Chauncey St.

Chicago, Ill., North American Bldg.

New York, N. Y., 330 5th Ave.

San Francisco, Calif., 569 Mission St.

PACIFIC NOVELTY DIVISION

Toys, rattles, infant sets, hair ornaments.

New York, N. Y., 330 5th Ave.

When you are in Atlantic City, New Jersey,
Visit the Du Pont Products Exhibit, at 1121 Boardwalk

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WILMINGTON
DELAWARE

DU PONT'S GUNPOWDER

SUPERFINE SPORTING
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Fine grain, for Sporting, in Canisters, pound papers, and 6 1/2 pound kegs; Coarser grain, expressly for Water Fowl Shooting, in Canisters, 6 1/2 and 12 1/2 lb kegs.

GUNPOWDER OF SUPERIOR QUALITY

F. F. and H. F. glazed and rough, in 25, 12 1/2 and 6 1/2 lb kegs.

GUNPOWDER FOR ORDNANCE

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F and FF; C, F, FF and FFF in 25 pound kegs.

All kinds of GUNPOWDER of superior qualities.

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E. I. DU PONT DE NEMOURS & CO

Wilmington, Delaware.

Time was when du Pont advertisements were neatly framed and sent to dealers for display on the walls of their stores. The one illustrated here is a reproduction from a steel engraving made about seventy-five years ago

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