THE HISTORY OF THE
E. I. DU PONT DE NEMOURS POWDER COMPANY

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A CENTURY OF SUCCESS

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A Century of Success

I

GUNPOWDER—ARMS—AMMUNITION—EXPLOSIVES

NO one really knows when the making of gunpowder began. It may have been in China. It may have been in Arabia. It may have been in India. It may have been in Germany or England. Evidences of something like it are found in the oldest records of ancient Egypt. The mysteries of "Greek fire" are presumed to have been based upon it, and many of the spectacles of Imperial Rome are said to have owed much of their brilliant splendor to the flashes of pyrotechnics and the bursting of bombs which alone could have been created by substances analogous to powder.

So, in the first place, the manufacture of gunpowder has behind it the venerableness of age, together with all its romance. Instead of having first come into use for the deadly purposes of the Battle of Crécy, as is so often stated, it dates as far back as the time of far-away religious and imperial ceremonials and appears to have been used to impress both the susceptible and the ignorant with the mysteries of the

heavens and to stimulate their instincts of reverence and worship. The details of the earliest uses and forms are lost, but it is significant that with the knowledge of many things Oriental which the Crusaders brought back with them from the East was the familiarity with gunpowder, not as an instrument of warfare, but as an aid to churchly service. And long before the formal introduction of powder guns at Crécy by the English, tales are told of the customs at Florence and Siena where fables or stories were told in symbols and pantomimes at the Feast of St. John, or at the Assumption.

On these latter occasions, stage properties, including effigies made of wood with limbs of plaster, were grouped upon pedestals rising high in the air, and these figures gave forth flames, says the historian, whilst round about, tubes or pipes were erected for projecting fireballs into the air. So imposing were these affairs and so far were they from indicating the use of powder for destructive purposes that presently the spectacles came to be held only at Rome when an Emperor was to be crowned, or a Pope to be installed.

After a time spectacles of this sort spread to England and there, under Henry VII and Elizabeth of York, the most gorgeous and indescribable displays of the effects of gunpowder were made. At the marriage of Henry, the famous "Bachelor's Barge" carried a dragon spouting flames from his mouth, while at the marriage of Anne Boleyn "there went before the lord mayor's carriage a foyster or wafter full of ordnance, which foyster also carried a great red dragon that spouted out wild fire and round about were terrible monstrous and wild men casting fire and making a most hideous noise."

Later, as Europe drifted into the maelstrom of in-

PIERRE SAMUEL DU PONT.

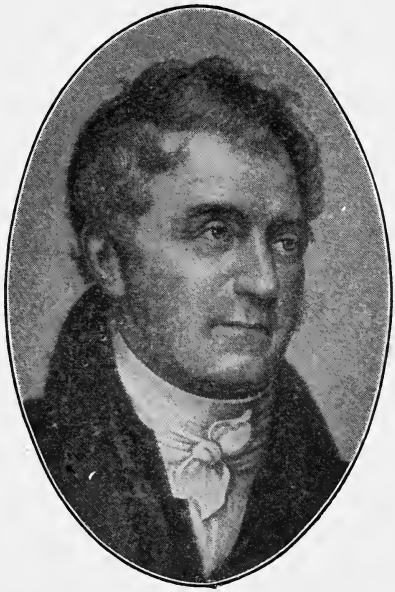
ternational conflict which culminated in the ascension of Charles the Fifth and the reaction represented by the Reformation, the ceremonial aspect of gunpowder was lost, and the destructive aspect of it came to the front. But even here it is recorded that powder was quite as much used for ceremonial and display as for battle. Returning warriors, for instance, were greeted with *ignes triumphales,* or fireworks columns. Poles were erected with trophies at their tops, while clustered around their base were casks filled with combustibles, which when set afire, made the poles look like flaming trees, while forms of dragons and beasts were made to appear afire at the tree roots.

Still later, there developed a fad of what were called "fire combats." These consisted of military lists in which the participants wore helmets from which fire would shoot, and used swords and clubs from which sparks gave out at every stroke, "lances with fiery points, and bucklers, which when struck, gave forth a detonation and a flame."

Of course, in time it became impossible to withhold such a remarkable possession as gunpowder for the exclusive use of the church or the rulers; and it also became impossible to make a mystic or religious impression by gunpowder spectacles, however gorgeous and imposing they might be. The increasing intelligence of the public, the universal spread of science, and other developments of civilization led to a quite common understanding of the nature of the material used for these rites and spectacles; and the spectacle diminished accordingly in extent and in interest.

With that change came the great step which lifted gunpowder out of the realm of mysticism and placed it in the greater realm of practical affairs. And

here begins the recognized history of gunpowder as such, and as it is known to-day, and here, of course, also begins the controversy as to who invented it. By some investigators the origin is traced to a German, Berthold Schwarz, who was, curiously enough, a monk. By others, it is traced to an Englishman,



FIRST PRESIDENT OF THE PRESENT E. I. DU PONT DE NEMOURS POWDER CO.

Roger Bacon, who also was a monk and known as Friar Roger Bacon. But Bacon lived and wrote in 1242, while Schwarz lived about a century later, and Bacon himself virtually said that he "didn't do it," remarking in his historic book *De mirabili potestate artis et naturæ* that an explosive mixture used before his time had been often employed for "diversion, producing a noise like thunder and flashes like lightning."

In those days, it is said, the projective power of powder was not known, the writers and experiment-

ers being familiar only with the explosive power; but however that may be, the knowledge of the projective power was abundantly demonstrated at the battle of Crécy, and from then till now there has

FIRST DU PONT POWDER MILL ERECTED ON THE BRANDYWINE IN 1802.

been a continuous and extraordinary evolution of gunpowder's use.

From the field of battle, it spread to the field of mining and engineering, and to-day its use in battle is its least, its most infrequent. Indeed, it is a singular thing that something seems always to have held this most potent of dynamic forces from being utilized for purposes of destruction. Something—perhaps the very peril of handling it—has surrounded

it with a sort of awe and reverence not un-akin to that which the ancients sought to impart to it when it was used solely for purposes of spectacle. It has served its function in war, deadly, cruelly, to its full power. It has been the deciding factor in the fates

SECOND DU PONT POWDER MILL ERECTED EARLY IN THE LAST CENTURY.

of nations ever since the days of Crécy. But always it has remained protected against misuse, always held back in the control of the government, always surrounded by precautions and secrets and legal proscriptions.

Indeed, the manufacture of it has been, as it were, a public trust. In the very first authentic record that exists in Europe, under date of 1326, it appears that the making of explosives was delegated to the supervision of a council of twelve appointed by the State, and the use of the product was limited to the defence of the republic (Florence). In 1346 Ed-

ward III of England ordered that all available saltpeter and sulphur (from which, together with charcoal, gunpowder is made) be bought up for royal use. Henry V ordered that no gunpowder should be taken out of the kingdom without special license. Elizabeth converted the manufacture of powder into a crown monopoly, and James I increased, rather than diminished, the proscriptive regulations.

And so it has continued to this day. In 1860 England revised all its laws bearing upon explosives with a view to making them still more minute and stringent, and in 1875 the same country enacted a statute on the subject so exacting and protective that it has been copied by practically all the leading nations of Europe.

Of what gunpowder consists there is no secret; it is only of the intricate steps in its manufacture and its evolution into the innumerable forms of explosive that are now in use. Roger Bacon's famous cipher, which it took so many years to interpret, gave a recipe for gunpowder which, in essence, is the same as that used to-day, namely: saltpeter, 41.2; charcoal, 29.4; sulphur, 29.4. Dr. John Arderne, a physician for Henry IV, modified this, as to the percentages, and further prescribed that it should be "thoroughly mixed on a marble and then sifted through a cloth"—which recipe was almost identical with that given in the manuscript of Marcus Græcus, which is supposed to have revealed the mysteries of the "Greek fire" of Greece.

In early times all gunpowder was a mere loose mixture of the three ingredients, but later a process of wet mixing or "incorporating" was developed, and from that came, through an infinite number of steps, the compact and regularly shaped bodies or "brains"

in which most powder is furnished at the present time. In early times, too, the mixing was all done by the simplest possible process, but the evolution of mechanics and the continued application of human cunning has reduced the whole process to a most elaborate method of manufacture by machinery.

Of course, throughout its progress, the manufacturing of gunpowder has sought increased potency with reduced space and reduced danger in handling. And now, as what appears to be an era of international peace and arbitration approaches, this process has reached such a limit that it becomes in turn an instrument in bringing about peace. For, so compact have such explosives become, so tremendously destructive is their power, that men are shrinking from their use altogether and seeking to reconstruct their relations with each other, as nations, in such a manner that there shall be no more war and that explosives shall be closely confined to the uses of engineering and mining.

From the very beginning there appear to have been efforts to make powder smokeless, but it was not until the Spanish-American War that the efforts were successful enough to make the smokeless product any considerable factor in battle. There has also been a constant expansion in the size of the guns used both in the armies and navies, and this has required constant modifications of the powder.

ARMS

The evolution of arms in warfare and in home protection goes hand in hand, of course, with the evolution of explosives. How long ago weapons capable of using gunpowder were invented is quite as impossible to determine as the age of gunpowder itself.

But there are records of hand firearms being used in England and among the Flemish as early as the fourteenth century, while it is quite generally known that the famous old arquebus, with its gaping mouth, was the forerunner of the hand gun of to-day.

Spain has the acknowledged honor of having been the first to make intelligent and effective use of this weapon, having employed it to tremendous advantage in its wars with Italy in the sixteenth century. By its action, the fire of infantry first became an important factor in military tactics.

Again in the days of the notorious Duke of Alva, Spain made another forward step in the use of firearms by introducing the musket. It was a clumsy old thing, this musket, with its touchhole on the side of the barrel, its flash pan and quick match, and with its weight so great that it had to rest on a stand extending from the barrel to the ground, but it was so effective that all Europe soon copied it and it remained the chief weapon of war for two centuries.

In the quaint German city of Nuremberg the flintlock gun was invented in 1515, but it was only a moderate improvement on the matchlock and never fully supplanted the latter (although it was used generally in the early days of the American Republic) until the percussion musket came into being in 1830–40. Curiously enough it was a Scotch clergyman who invented this method of ignition. The needle gun followed shortly afterward, and by 1854 European armies in general had advanced to the use of the muzzle loader. The magazine rifle came in in 1886.

Artillery using explosives for propellants dates back to the fifteenth and sixteenth centuries, when it is recorded that great stones weighing as high as 300 to 600 pounds were projected high enough and far

enough to split the masts of vessels and to accomplish other feats then considered miraculous. It was in the Thirty Years' War, however, that artillery was first used as a scientific part of warfare. Gustavus Adolphus was the pioneer. A few years later, Cromwell made good use of 12-inch shells; while in the period of Frederick the Great artillery service was developed to the systematic and highly organized military use to which it is put at the present time. Napoleon made "artillery preparation" the feature of his campaigns, and until the method of "combining the three arms" of the service was introduced at the time of Napoleon's death, the great Corsican represented the farthest point in the evolution of arms humanity had yet attained.

Breech-loading big guns came into service in the Franco-German war of 1870. The modern quick-firing field gun came into use in 1891. The world is now in the midst of a most advanced stage of heavy field, siege, and garrison artillery, the use of which has been rendered possible only by the enormous advances in the ingenuity and science of making explosives. It is also in the midst of an equally advanced stage in the evolution of naval arms. The latter include not only the huge 12-inch and 13-inch guns, but also the highly organized and extremely effective torpedoes and torpedo propellants.

It belongs to the history of explosives to narrate the correspondence between the gun evolution and the powder evolution, but it is to be noted here, that while one of the greatest features of gun evolution has been the invention of the disappearing carriage, such an invention would be without half its utility were it not that it has been accompanied by an equally important application of the smokeless powder. This

smokeless powder is now being succeeded by the noiseless gun, and by conjunction with the latter, it promises to effect as enormous a new forward step in the devices of national offense or defense as is reputed to have been taken when gunpowder was used at Crécy or when the Spaniards took the arquebus into their wars with Italy.

AMMUNITION

"Arms and the ammunition I sing," Virgil might have written and have had almost as interesting an epic to unfold as his "Æneid." For these two great essentials of human society have gone along the same pathway in a fairly seething competition of wit and invention. The maker of the gun has always seemed to be seeking to make a use of the latest invention in explosives such as would challenge the explosive-maker to an incredible effort to do something better; and vice versa. And the result has been that the whole progress of modern nations has been almost the direct fruit of this rivalry. Nations have won or lost their positions by the state of advancement in the invention of both arms and ammunition.

So far back as military history is recorded, there has been a steady concentration of the mind of strategists upon ammunition, and the question of how to keep the armies supplied and yet not reduce their mobility has been of the utmost gravity. Originally, the ammunition of one side in a battle became to a greater or less extent the ammunition of the other side. That is, the arrows shot by one side were utilized in return fire by the enemy. And, to a certain extent, this was possible when stones and such material were used in guns. But nowadays, of course, each army has to travel fully supplied; and the maintenance of this supply becomes an acute problem.

THE CHAIR WHICH ELEUTHERE IRÉNÉE DU PONT DE NEMOURS USED, AND WHICH SEVERAL PRESIDENTS OF THE COMPANY HAVE OCCUPIED. THIS CHAIR IS STILL IN USE IN THE PRESIDENT'S OFFICE.

Conscious of the urgency of the problem, powder manufacturers have given constant attention to increasing the compactness, the portability, and the safety of ammunition. In infantry ammunition, the manufacturer has progressed to a point where a soldier is obliged to carry only a little over ten pounds in weight to be provided with 100 rounds of ammunition, while each pack animal bringing up the rear of a regiment carries from 2,000 to 2,200 rounds, and each cart carries from 16,000 to 18,000 rounds.

Similarly, the weight and bulkiness of the ammunition for field guns, siege guns, and permanent fortifications have been reduced. In early times, solid stone or solid iron was used in the cannon; but as the cannon increased in size, or the military tactics increased in mobility, so-called case shot was introduced, then grape shot, then quilt shot. In 1579, red-hot shot was invented, and it was used with great effect by the English as late as in the siege of Gibraltar.

When armor plates came into existence, a new problem was put up to the ammunition maker, namely, the problem of vastly increasing the propelling power, without unduly enlarging the bulkiness of the projectile or the explosive. It took a number of years to arrive at success in this line, and the work of the ammunition maker had to be supplemented by the work of the projectile maker. The latter had to perfect the hardening of the steel, and the former had further to condense and intensify his powder.

One of the conspicuous features of this intensifying of the explosives was the alteration made in the explosive shells. The latter were in use long before armor plate came into being, even the old stone or iron balls being filled with gunpowder, but gradually

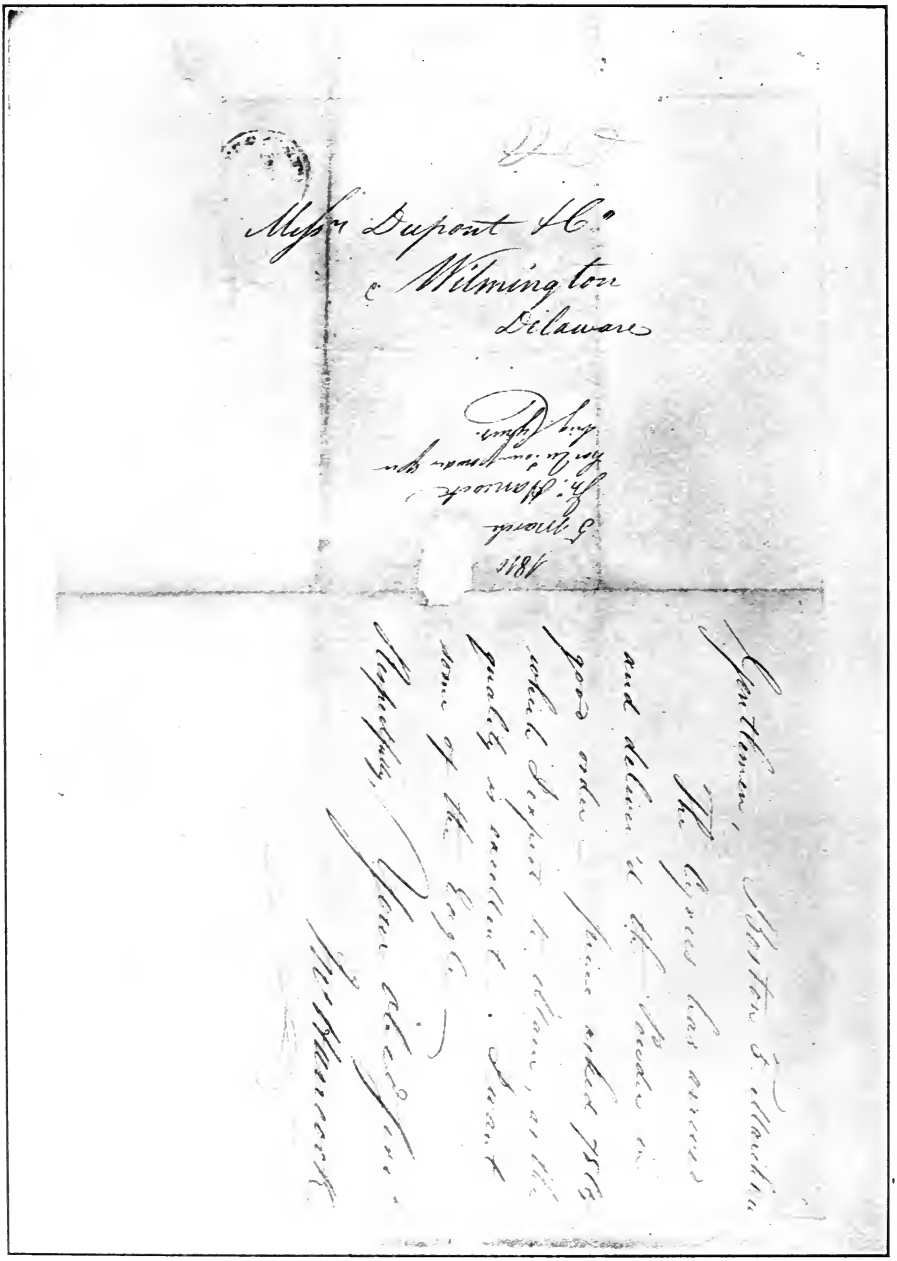
the shells came to be fitted with a hollow, forged iron or copper plug, and from that base many extraordinary things have evolved. One of these is what is technically known as the armor-piercing shell. It is extremely destructive to naval vessels, and yet the powder-maker's share in its construction has been reduced to so fine a point that only two per cent of the weight of the projectile is the powder contained in it.

Another problem that has had to be conquered, of course, has been the reduction of the danger of premature explosion of shells. This has required constant and progressive experiment, but the difficulties have been surmounted.

The explosives used in different countries differ materially as yet, but the United States appears to be well to the front in all respects. It promptly took up smokeless powder, and as quickly dropped melinite when the latter was found to be too apt to degenerate. It has not used lyddite to any extent, but it has used practically every form of compound shell, shrapnel, and the like that has been invented. It has used the most recent fuse inventions, the latest modifications of the rifle bullet, and all other devices for increased power and diminished weight and bulk. And in the development of all its steps of progress, the du Pont factories have led the way.

EXPLOSIVES

In times gone by the chief work of powder factories was the making of gunpowder and supplying the needs of armies and navies. But in modern days, warfare with the earth has become greater than warfare with men, and the powder factories' chief function becomes the making of material for blasting and



LETTER FROM JOHN HANCOCK TO MESSRS. DU PONT & CO., WILMINGTON, DELAWARE.

other mechanical and engineering work, connected with the laying of foundations, the digging of roadbeds, the operating of mines, and the like, and in farming.

The making of gunpowder was comparatively simple. The making of its successors in the explosive world has become a vast and intricate process. Gunpowder was only a combination, in certain proportions, of simple materials such as charcoal, sulphur, and niter; its successors involve the use of chlorates, perchlorates, permanganates, and chromates, and these in turn are mixed with all manner of compounds, such as sulphur and sulphides, phosphorus, charcoal, sugar, starch, cellulose, and coal.

One by one these various combinations, with their resultant explosives, have developed as chemistry has progressed and as public demand has increased. The tale of the evolution would be most absorbing, but it is almost impossible to narrate in detail, for the reason that the steps in the invention of each succeeding new explosive are so minute and the secrecy of the processes is so necessary for the discovery to maintain that a story could hardly be told in form for the general reader to grasp.

Suffice it to say that in the course of time, explosives have come to be divided into three or four different groups. The first, technically known as *explosive mixtures,* consist of more or less extensive modifications of the original principle on which gunpowder-making was based, viz., that of mixing, instead of compounding, the various substances used. The second consists of what are known technically as *explosive compounds,* and are chemical fusions or blends of different substances. The third are the *smokeless propellants,* which first became generally

known to the American public during the Spanish-American War.

There are infinite varieties both of the mixtures and of the compounds, each varying in power and serviceability, according to its composition. Take the mixtures of the chlorate of potassium and sodium with sulphur or charcoal or starch or sugar or other carbon, and the result is a mixture that is fired by very slight heat or percussion. The propellant power of the mixture is very great, but its easy ignition makes it dangerous both to store and to manufacture. Also, it has a tendency to explode with strong detonation, is not smokeless and leaves considerable residue to foul the gun.

Mixtures of chlorates with nitro-benzines or similar aromatic compounds make powerful blasting agents, the strength of the action being due largely to the first rapid evolving of oxygen in the chemical processes. So, too, do the potassium and sodium perchlorates and permanganates, although the latter are slightly less sensitive and slightly less powerful. Bichromates make rather feeble explosives, as a rule, but there are ways of using chromic acid with certain other compounds to make an extremely explosive as well as sensitive powder.

Among the explosive mixtures, nearly all explosives that are used for blasting or for propellants are nitrogen compounds, obtained from nitric acid by some process more or less direct. Gun cotton and nitrogen result from one kind of mixture, while nitrobenzine, rick-a-rock and other well-known substances result from other kinds of nitric acid mixtures. Among the latter are the "flameless" blasting powders which have developed in recent years and which correspond to the smokeless powder used in military and

naval circles. Even mercuric fulminate, one of the most useful of high explosives known at the present day, is the result of the action of a solution of mercurous nitrate, containing some nitrous acid, or alcohol.

The first real smokeless powder was gun cotton, but the original gun cotton had a fibrous, porous mass in its make-up which burned too quickly or was likely to create too great a detonation, and it did not take the place now occupied by the so-called smokeless powder until certain processes were discovered for gelatinizing it by the use of such substances as ethyl acetate or benzoate acetene, or other benzene compounds.

As early as 1887, France adopted a gelatinized gun cotton for its magazine rifle, and thus became practically the pioneer in the use of smokeless powder. In 1890, Italy adopted another form of smokeless powder called ballistite, which was the result, indirectly, of a discovery by A. Nobel that nitroglycerin could be incorporated with collodion cotton to form a blasting gelatin, or dynamite. Thus nitroglycerin was added to gun cotton as one of the substances to be used as bases in making the smokeless powder, and ever since that time, either one or the other of these two materials has been the chief ingredient.

Originally, when the du Pont factories first came into existence, the great danger in the manufacture of its products lay in the incorporating of the ingredients one with the other. But now the danger lies in the chemical processes of preparing the nitroglycerin, the drying of the gun cotton, and similar operations. After the gelatinizing has once been accomplished, the balance of the manufacturing is practically without risk.

As probably everybody knows, gunpowder was generally made loose, as it is to-day, but the other explosives which have developed from it have come to be made in various compact shapes such as cubes, flakes, cords, and cylinders. All of these are designed to regulate the rate of burning of the explosives, and the calculation of that speed is but one more of the many fine arts which it has become necessary for the powder manufacturer to acquire.

II

NEMOURS—PIERRE SAMUEL DU PONT—ELEUTHERE IRENEE DU PONT DE NEMOURS

THERE is a little town in France, not far from Paris, on a river and a canal and with a long, long history behind it. It is known as Nemours. Centuries ago, it was a Roman lumber camp, and from the woods (*nemora*) which surrounded it it derived the peculiar and musical name which it still retains. Then, as the aristocracy of France grew up and the peasantry grew down, Nemours passed into a center of feudalism, erecting one of those memorable castles and strongholds which a thousand or more years have not sufficed to destroy.

But feudalism palled upon Nemours, as it palled upon all of Europe, and presently the place emerged into the liberties and hopes of free thought and economic independence. It became a center of intellectualism, as it had once been of feudalism. In its quiet streets and away from the seething strifes of the capital, beside its beautiful waters, yet near enough to the capital to be in touch with the process of learning, the arts, and the government, men of unusual culture found refuge. Writers, philosophers, scientists, and the like were glad to make it their home. Its fame became widespread and good. Even at this time so extraordinary a relic of those days remains that one of the most conspicuous features to confront the traveler is a monument to Bezout. What other town so poetic and appreciative as to erect a memorial to a mere mathematician?

PIERRE SAMUEL DU PONT

So when, in the strenuous times preceding the great Revolution, Turgot, the political adviser of Louis XVI, who alone among the countless reformers of the hour had a plan which if adopted and adhered to might have forfended all the turbulence and destruction which afterwards ensued, was compelled to relinquish his fight because there was little of the spirit of conciliation in any hearts save his own and those of some of his immediate followers, one of the chief of these—a du Pont—gravitated to Nemours for refuge, repose, and reflection.

He was a strong du Pont, this du Pont de Nemours (born December 14, 1739, died August 7, 1817), as he afterwards became known, and his life was one of public thought and service. Born in the national capital and educated for the practice of medicine, but too ardent a civilian to listen to any inner calling save the dominant one of the hour, viz., what to do to rescue a nation from its threatened economic and social overthrow, he early abandoned Æsculapius for Aristotle, and, together with the famous Turgot and François Quesnay, founded and promoted the school known to the world as the Economists.

This notable organization was the direct fruit of France's ever increasing internal difficulties, which began in the autocratic period of the great Cardinal Richelieu, grew worse under Mazarin and his financially brilliant but unimaginative and short-sighted successor Colbert, and finally culminated in the excesses and follies of the court of Louis XVI. Little by little through all the intervening years the position of the peasantry or working classes, and even of the middle business class, had grown worse, until some

manner of violent resistance to the conditions had become inevitable. Far-sighted thinkers foresaw what must happen, and they divided into schools and groups, each of which had its remedy. The Economists were one of these groups, led by Quesnay in the first instance and reënforced by Turgot, who was Quesnay's pupil. They were for rectifying the economic ills by destroying certain special privileges, dissolving big trade corporations which had monopolistic powers, reducing taxation, retrenching in government expenses and terminating government borrowing.

Pierre Samuel du Pont was one of the school. His mind was broad and keen, his pen was able and convincing, and he soon became a close friend and intimate both of Turgot and of Quesnay. Abandoning the practice of medicine, he turned to letters and became editor of the *Journal of Agriculture, Commerce and Finance,* and later of the *Ephemerides of the Citizen.* In this capacity his writings had great force and influence and made him so much of a factor in the critical affairs of the hour that he was sent for in 1772 by the King of Poland, Stanislas Poniatowski, to become secretary of the council of public instruction. He filled the post for two years with energy and acumen. In the meanwhile, however, the vacillating Louis, driven between the fires of his covetous love of power and elegance and the increasing unrest and passion among the people, resorted to the Economists for help and summoned Turgot to power. Turgot at once sent to Poland for du Pont, and du Pont returned to become one of the most active participants in the brief but fruitless struggle of the great French statesman to restore harmony.

Turgot fell, as all students of French history well know, and with him fell du Pont and all of the Economist School. But the fall was to du Pont really only a beginning. It took him to the quiet of Nemours, or rather, at first, to the near-by Gatinais, and there, in the undisturbing pursuits of agriculture, he not only wrote the now widely known *Memoirs of the Life of Turgot,* but so continued his manifestations of public spirit that he was sent for by the minister of foreign affairs in 1782 to help in negotiating for the recognition of the independence of the United States and in preparing a treaty of commerce with Great Britain.

Doubtless he would have been glad to remain upon his farm, contented with his books and his pen; but as the Revolution grew, as the forces of discontent and disorder threatened to overthrow the very government itself, his sense of public preservation rose to its urgency, and he returned to political life as deputy from the *bailliage* of Nemours. He became president of the Constituent Assembly, and wisely or unwisely, but certainly, sincerely, and fearlessly, he championed the cause of the monarchy. His attitude proved his undoing. It drove him into hiding, then into prison, and finally into exile with a price upon his head. But nothing could curb his spirit, his energy, or his mental activity.

While in hiding, he wrote a yet well-known work on *The Philosophy of the Universe,* and when liberated by the general amnesty of Robespierre, he became a member of the Council of Five Hundred and actively and persistently fought along his previous lines, directing his forces chiefly against the Jacobins. To what end this determined and changeless adherence to his convictions might have brought him is to

Dear Sir

Monticello Apr. 24. 11.

We are, four of us, sportsmen, in my family, amusing ourselves much with our guns. but the powder sold here is wretched, carrying the index of the French eprouvette (such as you furnished Gen[l] Dearborne) to 9. 10. or 11. only, while the cannister of your powder, recieved from you 2. or 3. years ago, carried it to considerably upwards of 20. I have persuaded a merchant in this neighborhood to get his supply from you which he has promised to do, and I am in hopes the difference which will be found between that & what has been usually bought will induce our other merchants to do the same. I promised mr Lietch, the merchant alluded to, a letter to you when he should go on. this will serve instead of it. but he does not go on till autumn. in the mean time I am engaged in works which require a good deal of rock to be removed with gunpowder, in doing which with the miserable stuff we have here, we make little way. will you be so good as to send me a quarter of a hundred of yours, addressed to Mess[rs] Gibson & Jefferson of Richmond, who will forward it to me. the cost shall be remitted you as soon as made known. vessels pass from Philadelphia to Richmond almost daily, & the sooner I recieve it, the sooner I shall make effectual progress in my works. Accept the assurances of my great esteem & respect.

Th: Jefferson

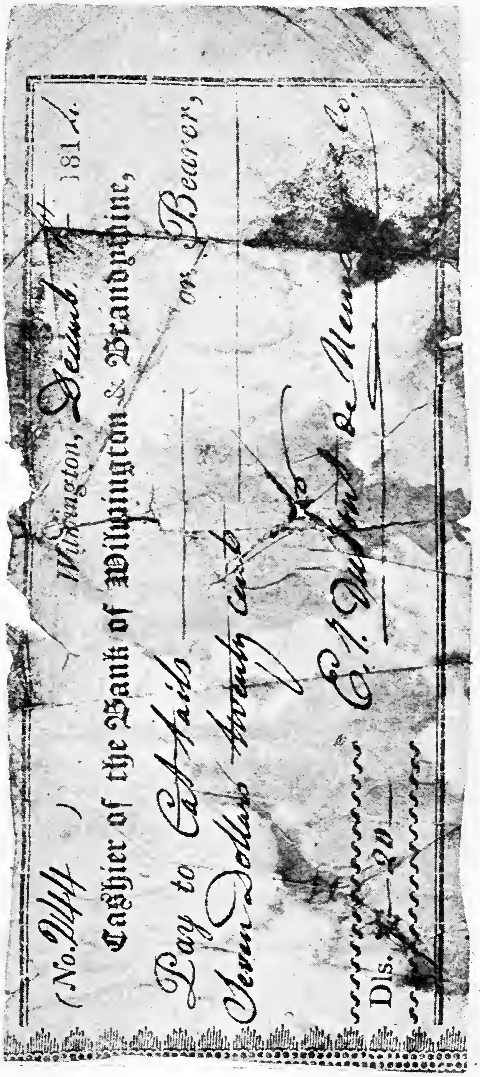
Mr. E. Dupont de Nemours

A LETTER FROM THOMAS JEFFERSON, DATED APRIL 24TH, 1811, ADDRESSED TO MR. E. DU PONT DE NEMOURS.

be judged from the fact that when, in 1797, the Republicans finally triumphed, his home was sacked by the mob and he only escaped transportation to the deadly penal colonies of Cayenne through the interposition of a friend and his subsequent departure for the United States.

The arrival in America in those strenuous days of this refugee from France was not an event in itself to amount to much, for there were thousands of other political outcasts. But the arrival of Samuel Pierre du Pont proved to be more than notable. It was in 1799 that du Pont first reached the new republic, but within a year Jefferson, recognizing his merits and abilities, had called upon him to prepare a scheme of national education, and two years later used him to convey unofficially to Napoleon Bonaparte a threat against the French occupation of Louisiana. His scheme for education was never adopted, but his brochure entitled *Sur l'education nationale dans les États-Unis d'Amerique* is one of the early American classics and is found in every American library which makes any pretense to historical efficiency. Several of the most important features advocated by him have since been adopted in the school system of France.

For a time, when affairs had quieted in France, love of home and country carried du Pont again across the sea, but he declined to accept any office under Napoleon, contented himself with his pursuit of letters, and became one of the early presidents of the famous Institute. Then, when Napoleon fell in 1814, du Pont's political instincts were unable to suppress themselves and he became secretary of the provincial government and afterward Councilor of State. He hoped that the turbulent affairs of his country were at an end and he was willing to sacrifice his own



(No. 444) Wilmington, Decemb. 19 1814.
Cashier of the Bank of Wilmington & Brandywine,
Pay to Cat tails or Bearer,
Seven Dollars twenty cents
E. I. Dupont de Nemours & Co.
Dis. $ 7 — 20

A CHECK DATED DECEMBER 19, 1814, MADE BY E. I. DU PONT DE NEMOURS CO. IN PAYMENT FOR $7.20 FOR CAT TAILS.

personal comfort for the people's good. But his hope proved vain. The redoubtable Napoleon returned to upset the equilibrium of the nation once more, and du Pont's patriotic courage and optimism gave way. He was seventy-five years of age by this time. His family had grown up and scattered. There was no mission left for him but the honored mission that falls to the Elder Statesman—the mission of repose and counsel, the mission of watching the sons and children as the latter build their way into the careers for which their parents may have fitted them or for which their own caprices may have destined them.

Curiously enough, this mission called Pierre Samuel du Pont back to the United States. It called him back to watch his youngest son, Eleuthere Irénée, whom he had long since caused to be as profoundly grounded in science, particularly in chemistry, as the father had been in civics, lay the foundation of a career which should make a place in history even greater than that of his father's, for the entire du Pont family and name. It called him back to watch the establishment of America's first powder works and the creation of an institution which has already lasted for more than a century.

Curious that the son of a man of letters should be the creator of a manufactory of explosives? Curious also that a man whose weapon was the pen should be followed by a son whose work was to be for those whose weapons were the gun and the cannon.

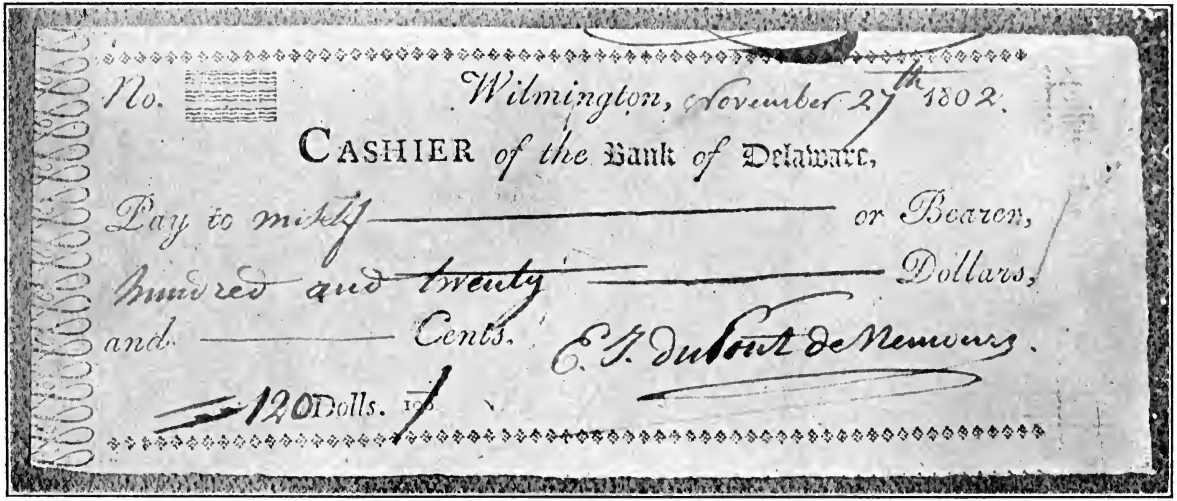
ELEUTHERE IRÉNÉE DU PONT DE NEMOURS

Thoroughly practicing what he preached, Pierre Samuel du Pont had established a large printing plant at Nemours, from whose presses were sent forth books, pamphlets, and other literature on their far-reaching errands of reformation.

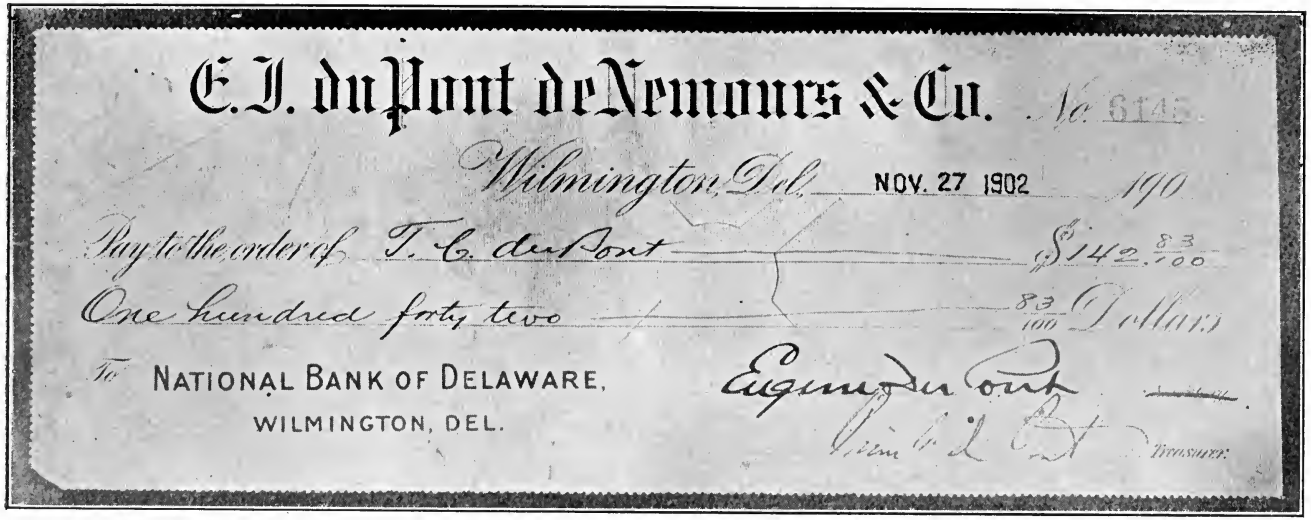
The masses, however, in those years of unrest apparently desiring neither education nor an understanding nor an advocacy of their rights, nor reform, and having shown their mal-appreciation of his desires and activities by wrecking the plant and totally destroying the family estate at Nemours—a not altogether unexpected or unusually ungrateful reward for such unselfish services so unconditionally rendered—another country had to be sought.

Eleuthere (born June 24, 1772, died October 31, 1834) had, meanwhile, been placed by his father in charge of the printing plant. On the wrecking of the works and their home, they both fled from Nemours. Eleuthere escaped to Ensonne, remaining for some time in seclusion there. Ensonne was the locale of the Government's Powder Plant. Eleuthere was a scientist by instinct and nature. His father's philosophical inspiration and training only served to increase his desire for a complete knowledge of chemistry. He became a pupil of the great Lavoisier, who was recognized as the foremost expert of the day. Lavoisier had recommended Eleuthere for the vacant superintendentship of the Government Works, and the new head threw himself with traditional energy into the study of the mystery and manufacture of explosives.

Like his descendants and representatives of to-day, there was nothing that escaped his observant and open mind. He studied and experimented unceasingly. He learned every possible detail theoretically, as well as practically, from the use of the raw material to the finally tested product. He furnished many new ideas and introduced numerous improvements. In a word, he raised the hitherto rough methods of manufacture to the higher level of a recognized science,



ONE OF THE COMPANY'S CHECKS DRAWN NOVEMBER 27, 1802.


E. I. du Pont de Nemours & Co. No. 8145

Wilmington, Del. NOV. 27 1902 190

Pay to the order of T. C. du Pont $142.83/100

One hundred forty two 83/100 Dollars

To NATIONAL BANK OF DELAWARE, WILMINGTON, DEL.

Eugene du Pont

Wm. du P. Jr. Treasurer.

ONE OF THE COMPANY'S CHECKS DRAWN NOVEMBER 27, 1902, EXACTLY ONE HUNDRED YEARS LATER.

and as a distinguished pupil of a most distinguished tutor rivaled the master himself in his thorough grasp and knowledge of the products, that have meant so much for the world and without which it would be impossible to carry on its work.

Eleuthere Irénée du Pont de Nemours, founder of the great industry which, as a tribute to his memory and enterprise, was in 1903—one hundred and three years afterwards—renamed after him, having made good his escape from France, reached this country in the year 1800, then occupied in its own remaking. He landed at Bergen Point, New Jersey. Pierre Samuel du Pont de Nemours, the father, Victor, his elder brother, and the respective families of each accompanied him.

At the time of their advent here, Thomas Jefferson was President of the United States. The country was practically without means within itself of supplying gunpowder and explosives. It had no mills or manufactories organized for the purpose of making them, and the little that was made was on a hand-to-mouth principle, just in the same way that people used to make their own leaden bullets in their own homes.

On looking around, the du Ponts saw the magnificent opportunity afforded to them of manufacturing explosives of a character and quality entirely unknown to the people here, far ahead of anything of the kind that had been produced. Though greatly lessened in fortunes, strangers in a strange land, the possibilities of this great and somewhat crude and untutored country were apparent to them all, and their indomitable courage and enterprise came to their aid. Without loss of time, the du Ponts opened negotiations with Thomas Jefferson, General John

Mason and John Hancock, for the purpose of establishing a plant in this country which would standardize the products and supply them in sufficient quantities, and of a grade that would make them the leading ones of their kind.

The project was received with acclamation and many prominent people of the country expressed their willingness and desire to coöperate and be associated with it. The broken fortunes were forgotten. The unbroken spirit remained. The inherited strain and pedigree of centuries they each possessed told, and the knot of men set to work, in face of almost unsurmountable difficulties, to the task of erecting a plant that should be worthy of their experience, of their enterprise, and of the country which had welcomed them.

Seven chief factors presented themselves, with which they had to contend—isolation, water-power, labor, the means of securing raw materials, facilities for transportation, and lastly money and machinery. To decide upon the right locality where the elements and conditions were favorable was no slight matter, and many parts of the country were visited; and at that time traveling was a very tedious and slow process. Virginia was considered, Maryland and other parts of the States offered sites, but nothing appealed to the du Ponts more than Wilmington, Delaware, for there it appeared as though nature itself had prepared the way for these talented *émigrés*. There, the beautiful banks of the Brandywine, the scene itself of vital and important occurrences in the history of America, offered the ideal situation. Jefferson, Mason, and Hancock saw the immense benefit that such an enterprise would be to the country, and in the bigness of their big hearts offered their moral support in

the founding of an industry which is now the fourth largest in the United States, manufacturing 2,000,000 pounds of explosives a day, having on its payroll 15,000 people, a monument of perseverance, intelligence, broad-mindedness, and sterling integrity.

III

FIRST POWDER MILL IN AMERICA—ANOTHER COUNTRY THAN FRANCE—ANOTHER WAR

IN 1802, two years after the arrival of the du Ponts, the first powder mill in America was erected. The grounds around it covered sixty acres. It was situated close to the Brandywine. The money and machinery had been secured in the country they were driven from, for they had in the meantime, both father and son, revisited the land of their expatriation and obtained them. The mill still exists. It is still working and producing. It is preserved and regarded with a respect amounting almost to reverence. It was the stepping stone to great things. It was the beginning of still greater things. It was a help to the country, and a reward to those indefatigable men whose tenacity and far-sightedness were the means of its foundation.

The du Ponts, during their more than a century of business existence, have always worked shoulder to shoulder with their men, have passed through the same experiences and faced the same dangers. They have been no less soldiers of industry than soldiers of the country, and Eleuthere Irénée du Pont de Nemours was always willing to share the common dangers surrounding his work-people. This spirit and example brought out the best that was in their help, and to-day loyal descendants of these first early employés are proud of being on the company's payrolls. The first year of its existence, the du Pont enterprise

netted the handsome sum of $50,000, which was accounted an unusual achievement in those days. To-day, that sum and more is netted by the company every seventy-two hours.

During the first decade ten more acres were added to the property and other mills established on the Brandywine.

A supreme test of Eleuthere Irénée du Pont de Nemours' patriotism came in the year 1812, during the awful and uncertain war America had with its mother country. It was the first time a navy had been equipped here and a sea war experienced.

Without a moment's hesitation, he placed the whole of his services and his equipment at the disposal of the country which now claimed him. Recompense or reward was not thought of or considered. His single-minded idea was to do all that lay in his power to serve the country that had welcomed him, and give the best of his brains and services in the accomplishment of its liberty. Through those wars, which were the means of its freedom, in fact through the whole of them, were used the products of his mills.

He bequeathed to his descendants a firmly united family and his life's work, the largest and most perfectly equipped enterprise of any kind that the country at that time possessed.

He was personally the soul of honor, the gentlest and kindest of men, far-seeing and liberal to a degree, having attracted to him by a sheer personal influence and character men of all classes from all parts of the nation. From one of his letters is culled the following:

"Soutiens ton courage. Les du Ponts ne s'abandonnent pas!"

PIERRE SAMUEL DU PONT.

ANOTHER COUNTRY THAN FRANCE

That Eleuthere Irénée du Pont grasped in any way the great part that his study of powder-making under Lavoisier was to play in the future of another nation than France is doubtful. Men seldom, if ever, are gifted with such eyes of prophecy. But, as stated previously, the visit in exile of Eleuthere's distinguished and scholarly father to the United States was not for nothing. It planted in the family mind the knowledge that there was another country than France that could be served, another land where patriotism was not likely to be rewarded by banishment, and where enterprise and ingenuity were more certain to be in demand than in opprobrium. And when, the hopes of a republic temporarily vanishing, France went into the eclipse of Napoleonic imperialism, young Eleuthere reached out for the New World with his skill and his ambition and found there his future home.

His elder brother, Victor, had already been secretary of the French legation at Washington and consul of France at Charleston, and through this and other connections the proposition was put up to such leaders of American thought as General John Mason, John Hancock, and others to establish a powder plant in the new republic. The battles of 1775 to 1781 had been a sad commentary on the powder-making skill of the country, and many an advantage in the several years' struggle had been lost through the miserably poor quality of the explosives that had been used. So that when a qualified student of so expert a maker as the great Lavoisier offered to transfer his faculties to the United States, the United States was only too glad to offer them a welcome.

The Revolution by this time—for it was between 1800 and 1802 that Eleuthere brought forth his proposition—was past and gone, and the young nation looked forward eagerly to an era of peace. But westward of the seat of government and of the centers of business was as yet a vast wilderness, peopled with Indians and beset with wild beasts and game. Into this the march of the country's growth was gradually penetrating, and at every step came the call for the thing that Eleuthere had to offer. Farmers made their living not more from the soil than from the animals of the forests. They shot and trapped and cured pelts and furs. They slaughtered for food and killed for protection. And nothing was more necessary to their success than a good, reliable quality of powder, made in their own country and sold to them at a reasonable figure.

Besides, there was the specter of the Indians, of their sudden attacks, of their unexpected treacheries, of their merciless retaliations for injuries or encroachments. And it was but one of the many duties of the government to maintain troops and to furnish ammunition for the settlers' defense. Also, though the Revolution was over and though the nation presumably was at peace with all the world, only three or four years had elapsed since intrigue of one kind or another had almost landed the country in war with its benefactor, France, and even at that very moment other intriguers were causing hostilities with the so-called pirates of Teneriffe. So wise statesmen knew enough to provide against emergencies and to encourage industries which might aid in making that provision.

Thus, between the simple necessities of domesticity and the potential necessities of national exigency there

opened for Eleuthere Irénée du Pont a splendid chance, and he took advantage of it. Location after location was tendered to him up and down the coast for his proposed powder works, but he was essentially a child of little, old, picturesque Nemours in the motherland—of Nemours, with its woods and its flowing streams—and he selected the beautiful shores of the Brandywine in Delaware, near the present site of the city of Wilmington. There, with the force of the river's current to turn the wheels, the timber to furnish the buildings and the charcoal, and the landscape to minister to his inspiration, Eleuthere placed his first powder factory. And there, from that remote day, one hundred and ten years ago, until now, the first E. I. du Pont de Nemours factory has remained.

America in its marvelous growth has gone on westward, southward, and northward. There were but four million people in all its vast domain in those days; there are nearly twenty-five times that number now. The Mississippi and the Ohio were its utmost western limits then; the Philippines on the Asiatic coast mark its termini to-day. Where the Brandywine was once in the heart of a seemingly primeval wilderness as Eleuthere Irénée du Pont cleared out its timber for the first mill, it is to-day in the heart of a vast and complex civilization. Cities have come and cities have grown great in the meanwhile. Generations have lived and generations have passed away; all those things and those people among whom and for which Eleuthere himself lived and worked have vanished. The making of war by the use of a powder composed of a combination of saltpeter, charcoal, and sulphur fed into flintlock guns or rammed into muzzle-loading cannon, has long since given way

FIRST OFFICE OF E. I. DU PONT DE NEMOURS AND CO.

to the disappearing carriage, the smokeless powder, and aiming by machinery. American settlers have not made their living by trapping and hunting for two generations. Yet the Eleuthere Irénée du Pont plant still stands on the Brandywine, vast, enlarged, an industry modern in magnitude, wealth, and power. The one little old building with which it began has become a hundred. The few acres which were originally required for the entire purposes of the business are now expanded into many times the original number. And where once the wood for charcoal was burned within a stone's throw of the mills, now whole freight trains come and go with charcoal burned many miles away and with infinite quantities both of raw material for the plant's consumption and of the plant's products for the world's consumption.

Instead of passing away with the passing of the early conditions, the powder plant has remained and changed with the changing circumstances. It has weathered the succeeding conflicts of the nation for whose benefit it was created. It has watched, witnessed, and played its part in the hundred years of wars with the red man. It has sent its products ever westward in the winning of the wilderness and the opening of the mines. And it has been ready as the pioneer in every forward turn of civilization's wheel when a new use has been found for explosives or a new service for the fruit of the du Pont family ingenuity.

And not once in all the lapsing hundred and ten years has the plant passed out of the hands of the family which founded it—a rare achievement, indeed, in the United States of America, or, for the matter of that, in any new country in the history of the world.

ANOTHER WAR

Only ten years had gone by from the time of the founding of the first powder mills on the Brandywine by Eleuthere Irénée du Pont when the young American nation was again in war, and with the same country from which it had previously wrested its independence. The war, happily, was not a long one, and, still more happily, the young nation was victorious; but it was long enough to prove to Eleuthere Irénée du Pont and his sons what had long since been learned in the older world across the sea, viz., that the making of powder for wars is nearly as much of a curse to a powder factory as it is to the country which requires a powder factory's products. For it suddenly brings upon an institution equipped solely for the needs of peaceful industry, the extraordinary demands of an extraordinary situation. It suddenly displaces all the routine and system of labor, all the established facilities for obtaining raw material and producing manufactures, and puts the entire concern under the dread spell of imperative emergency. The making of powder for business purposes is rendered secondary to the making of it for patriotism. And, above all, there rests over the entire concern, from proprietor to chore boy, the nerve-straining sense of how much depends upon the thoroughness, the efficiency, the promptitude with which the requirements of patriotism are met. Not a soul in the plant from top to bottom but knows in his heart the responsibility that hangs upon meeting the nation's need, and not one but feels the resultant strain and test even in the hours when he is off duty and at rest.

Albeit exigency piles upon exigency in war time with a speed beyond human calculation, the making

of gunpowder is a thing which cannot be hurried. Too quick a turn of the accustomed wheel, too hasty a fall of a compressed hammer, the careless packing of a finished product—and, lo, the entire plant may be blown to destruction! Or, worse still, a hastened output, an unfinished workmanship, an unconscientious delivery— and, lo, the men who handle the guns in the field may be the ones to meet destruction!

Furthermore, the suddenly expanded requirements cause a correspondingly sudden expansion of manufacturing capacity, of mills, of raw materials, of employés. And with the termination of the war comes an equally sudden reaction, when mills become useless and employés are no longer required.

Eleuthere Irénée du Pont knew of these things from his experience in France. But he had entered the business with his eyes fully open to what might follow; and the war of 1812, wherein his plant furnished the government with its entire supply of explosives, served but to impress upon him that, from a selfish point of view, if from no other, wars were rather to be avoided than courted, and that the goals of personal and professional prosperity were to be hunted for in the realms and circumstances of industrial amity. Together with those who followed him—his own sons and their sons' sons—Eleuthere from the outset bound himself tightly to the interests of his fellow-Americans and sought to evolve business along the lines consistent with, rather than injurious to, the latter's interests and welfare. He and his successors made patriotism and public service their watchwords and stuck to these watchwords from beginning to end.

For this reason the du Ponts became, in hours of national crisis, national counselors; and in their fam-

FIRST OFFICE OF E. I. DU PONT DE NEMOURS AND CO.—ANOTHER VIEW.

ily archives are preserved to the present day letters, correspondence, and documents of statesmen, warriors, and distinguished civilians of every period, attesting the intimacy with which the du Ponts participated in framing public policies, preparing for possible contingencies, and meeting great exigencies when they occurred. Eleuthere impressed upon his sons, who first worked with him, that they must regard their relations to the nation in time of war as a trust and must neither prey upon the necessities of the hour nor neglect its duties. And no successors of Eleuthere have ever been allowed to forget those precepts.

It is but necessary to run through the volumes of official United States documents, the War and Navy Department records, the Congressional committee investigations and the like to verify the fact that the du Ponts have never overcharged their country for its powder. However great and sudden the war's demands, like those of 1898, which followed so sharply upon the unexpected blowing up of the *Maine;* or however prolonged and seemingly exhaustless, like those of 1861 to 1865, the du Ponts have accepted their responsibility, met it in a spirit of self-sacrifice, and emerged at the end of the struggle without a successful or sustainable complaint of extortion, or even of the remotest undue expanding of prices, being lodged against them. In fact, the story of their relations with the government in time of war is one of reduced rather than increased prices, of concession rather than demand. The successive leaders of the works have been called into the private and confidential conferences of the nation at every critical period and have been looked to, not in vain, to make it rather more than less possible for the country to meet its difficulties.

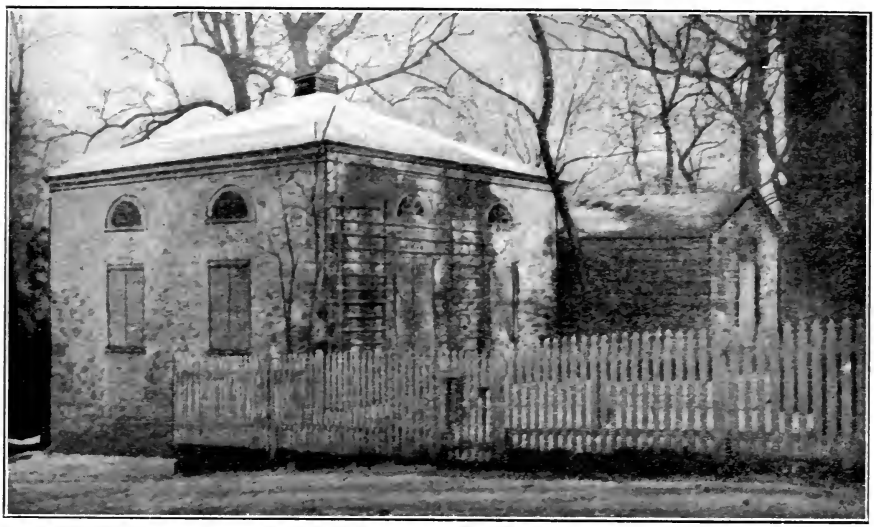
IV

LEGITIMATE COMMERCIAL EVOLUTION—EXPLOSIONS

THE du Ponts have always looked to legitimate commercial growth and not to military exigency for their profit; and it is because they have done this that their plant stands stronger, more stable and enduring to-day as the world at large turns its face toward universal peace than did the wonderful factory at Ensonne in France, where Eleuthere first learned his trade and where the great Lavoisier presided, in the tempestuous days of Napoleon. The du Ponts have sought to camp on the trail of industrial evolution, as it were, rather than on that of martial tactics and international contention. They have kept the eyes of their scientific vigilance upon the ever expanding utilities of powder and its successors in the arts of engineering and mining and building construction. Whenever some chemical ingenuity has rendered it possible to increase the effectiveness of explosives in boring tunnels for gold, copper, zinc, lead or silver in the great regions of the mineral West, the du Ponts have made it their business to be to the fore with the improved products. Whenever some other combination of the ingredients of explosives has rendered it more easy by the use of the new combination to carve out the paths of railroads through the rocks and precipices of the mountains, or to sink the caissons for the monster buildings of the past quarter of a century, the du Ponts have altered

their factories, or changed their formulæ, or risked their capital, not only to meet the new need but also to get into advance of it.

Since 1802, when the du Pont plant was first established on the Brandywine, there have been less



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than eight years of war altogether and a full hundred years of peace. In that period over a quarter of a million miles of railroad have been built, and it is safe to say that a big percentage of the track could never have been laid without the use of the product of the du Pont mills. Certainly hardly a mile of the difficult and precipitous tracks of the Rocky Mountains and the Sierras and the Cascades could have been enabled to worm their way through the passes and defiles and tunnels to tap the great Pacific at San Francisco, Los Angeles, and Seattle. More than two million miles of highways have been constructed by

farmers, the counties, the States, and the nation, and it is impossible even to approximate how large a proportion of this work has required explosives to clear away obstructions, to make passages through rocks, to root out tree stumps, to establish grades.

FIRST OFFICE OF E. I. DU PONT DE NEMOURS AND CO.—ANOTHER VIEW.

Over four hundred million acres of land have been cleared and improved in that same interval of one hundred years, and certainly on more than half of this there has been stumpage to blast out with one kind or another of powder or dynamite; while of mineral product requiring the use of explosives for tunneling, drifting, stopping, prospecting, there is almost no available means of calculating the amount. In the year 1909 alone the coal output was over four hundred and seventy million tons, practically every ton of which had to be loosened either directly or indirectly, by blasts of powder, gelatin or dynamite.

In the same year the copper output was nearly a million tons, and far more than coal does copper require to be freed from its fast home in nature's walls by the use of the drill and the stick of powder.

Fifty-four million ounces of silver, a third of a million tons of lead, and nearly half a million pounds of pure gold had to find their way into men's service in that same year by the application of the agencies which it was the place of the du Pont mills to supply.

And when to all this is added the use in blasting for excavation, in driving tunnels under rivers, as at New York, at Detroit and at Chicago, and in running subways under the streets of metropolises, some slight conception may be derived of the commercial as well as the military responsibility which rests upon the du Ponts. The registered cost of buildings alone for 1910 in fifty-two of the principal cities of the United States was seven hundred and fifty million dollars, or three quarters of a billion—and certainly a vast percentage of that huge construction would have been impossible without explosives.

There is no multiple by which these annual figures can be amplified to give a comprehensive sense of the developments of the 110 years since the du Pont plant was first built, because the ratio of growth for each particular sphere in which explosives have been used varies with the sphere itself and with the nature of the explosives. But certain it is that to advance apace with such enormous progress, to keep in front of the growing needs, to furnish men with an explosive product that would fully meet the restless spirit of modern invention in general as fast as it evolved, and to do this without interruption for a century and a tenth is a task that may well have taxed the power

of more than one great institution and of more than one set of men. Compared volume for volume, these activities of a hundred years of peace make the requirements of eight years of war look but small indeed. Eight years of war never would have made the du Pont plant the great industry which it is today. One hundred years of peace have done it.

And the record of evolution within the plant itself is correspondingly diverse and commanding. From the very first days Eleuthere must have had at least some glimmering, however meager, of the problems that were to come, for he established two fundamental principles by which the industry should always be guided. The first was that all its progress should rest upon sound knowledge. Just as he himself had been educated under the tutelage of the master chemist, Lavoisier, so he provided that all those who should come after him should have equal education. The other was that the control of the industry should never pass out of his own family, that his sons should remain with it and their sons after them, so that it might always be a du Pont institution, always stand for those public-spirited, enterprising and indefatigable principles and standards for which Eleuthere and his distinguished father before him stood.

EXPLOSIONS

To the end that these principles might be put in force, Eleuthere himself gave his sons all the culture and training that the educational facilities of the time could command. Of sons he had three and each was sent to college, only to be returned to apply the advantages of his education to the powder business. Alfred Victor came first and first fell into the re-

sponsibilities of his father. He had finished his courses at American colleges and was about to go abroad for a finish in technique when the mills at Wilmington were almost totally destroyed by a disastrous explosion and the fortunes of the family were so impaired temporarily that he had to remain at home and assist in their reconstruction.

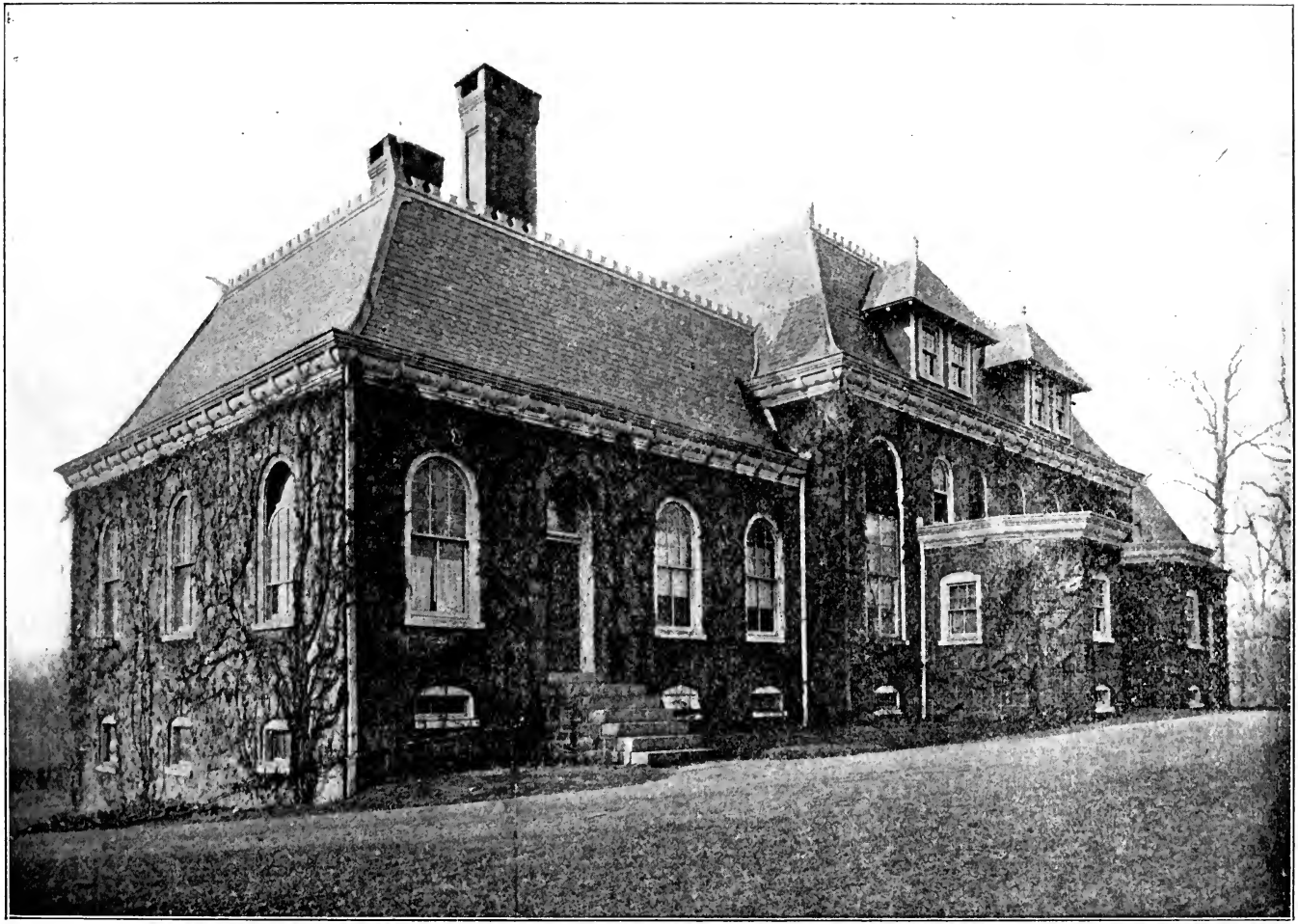
That was in 1818. Only ten years before the business had grown to an output of 600,000 pounds of powder a year, and in the war of 1812 it had supplied the entire demands of the government. So its destruction by explosion was a disaster of momentous scope for those days, and its rebuilding a task calling for resourcefulness, pluck, and greatest determination. The rehabilitation might have been accomplished by some one of less education, but powdermaking by that time was becoming considerable of an art the world over. Firearms were improving, as was army ordnance of every kind. The Napoleonic wars, which had but recently ended at the battle of Waterloo, had brought into existence many factories throughout Europe, and the pressure at the Atlantic gates for the admission of European product was so great that nothing but continued cunning in manufacture and continued and stupendous energy in trade promotion could save the day for the destroyed mills of the Brandywine. Alfred Victor, like his father, went into the laboratory and from there turned out a product so steadily improved in quality, so constantly bettered in a hundred or more respects, that not only could the foreign imports get no foothold, but by the time the war with Mexico developed, in 1846, the du Ponts were again fully equal to the extraordinary exigencies of armed national conflict.

Eleuthere, the founder, died suddenly in Philadel-

phia of cholera in 1834, but by that year Alfred Victor was so far advanced in practical skill and business acumen that the plant passed to him without a jar to its progress. For a brief time after Eleuthere's death Alfred Victor was aided by a brother-in-law, who with him weathered the terrible financial gale of the panic of 1837; but that was the only period during which any one not bearing the du Pont name had any conspicuous part in the direction of the concern.

In the very year of the naval war of 1812 a second son had been born to Eleuthere. He had graduated from West Point and had spent a few years in the army; but as the father grew old and came to the edge of the catastrophe which so unexpectedly called him, this son, Henry by name, came in from the outer world and gave himself to the family business. He was in the concern with the brother-in-law and Alfred when the 1837 panic came, and it was he, more than any other, who developed the executive power and the commercial imagination which first lifted the du Pont plant to the scale of magnitude which it still maintains—that is, the scale of physical magnitude.

During Henry's administration there came another terrific explosion, just one year after the war with Mexico. It tore holes as deep in the family prosperity as it did in the walls of the mills or in the soil upon which the mills were built. But it could not deprive the family of that one element of superior power for which Eleuthere had laid the foundation, viz., scientific, technical knowledge of the making of powder. Although the mills were down, Alfred Victor and Henry still knew how to make powder and how to make it better than any one else. Their



SECOND OFFICE OF E. I. DU PONT DE NEMOURS AND CO.

knowledge, their education, was their capital. With it they succeeded not only in a second thorough rehabilitation, but seven years later were so strongly reentrenched that they were sending supplies abroad and a little later were the chief source of supply for the munitions of war for the Crimea.

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Then came a harder test for the du Ponts than any that had yet befallen them. It was not a test of the power to survive disaster within the plant itself or panic without. It was a test of ability to meet the scientific competition of some of the keenest scientific minds the world over. For, about the time of the Mexican War, the chemists of Germany, France, England, and Austria began to experiment with nitric acid and gun cotton. They were looking for a substitute for the traditional gunpowder; and from then onward the making of explosives of every kind was an international battle of chemical wits. Two German

chemists, Schoenhein and Boetger, found the first substitute, but before it had been long in use it was discovered to be incapable of keeping long unaltered. Serious explosions took place because of its deterioration, and its manufacture had to be abandoned, just as the machinery of the plants in many places was being adapted for making it.

Then came the work of the Austrian, Von Lenk, with a combination of nitric acid and gun cotton that kept stable and uniform. But factory processes had hardly been altered to its use when it was found that gases generated from it in explosion attacked the barrels of guns, so that this invention in turn had to be relegated to use solely as a blasting powder and for filling shells and torpedoes. So injurious was its effect that the Austrian government, which had purchased all the European rights of Von Lenk's invention, forbade its manufacture altogether.

Out of this experience grew the revolutionizing invention of Sir Frederick Abel, of England, whereby gun cotton was reduced to a fine powder by beating machines and then pressed into the hexagonal and other forms in which practically all powders are still made.

The du Ponts, separated by 3000 miles of sea from all these experiments, had nevertheless to keep up with and even ahead of them or lose their trade and prestige. In their laboratories on the Brandywine they had to be as clever as the chemists in all the older laboratories of all Europe. Standing as an independent firm, in a country where each man's salvation depended upon his own wits, they had to match themselves against the imperial subsidies and the army-and-navy-supported specialists.

And not only this, but scarcely were they again at

a point of successful business amplitude when the tremendous exigencies of the Civil War interposed, disturbed all the laws and conditions of their normal progress, and placed them for four long years under the terrific strain and awful responsibility of not failing their country in the time of its need. While the Civil War was in progress, the great inventions of the Swedish chemist, Alfred Nobel—now so widely known as the founder of the Nobel prizes for art, literature, science, and peace—were first coming into view and leading the way to the discovery of the powerful and deadly nitroglycerine; and the interruption by the war threatened to leave the du Ponts far behind their European competitors.

But as in 1812 and again in 1846, so now in 1861 to 1865 the patriotism of the family worked hand in hand with the professional and technical genius handed down from the founder, and the firm emerged perhaps even stronger at the end of the crucial period than it had been at the beginning.

At any rate, when the great era of railroad building and mine sinking in the Western mountains set in, right after the war, the du Ponts, by some innate magic of power, were to the front with every facility of explosives that the intervening years had developed, either at home or abroad. With seemingly consummate ease they passed from the manufacture of explosives for the destructive purposes of battle to the manufacture of explosives for the constructive purposes of industrial evolution.

The steam railroad building called first for explosives for the making of roadbeds and tunnels, and then in turn for aid in the mining of coal to furnish the motive power. And both of these demands created new requirements in the manufacture of powder

and its corollaries. Explosives now had to be transported across the continent in jolting freight trains. They had to be carried on mule-back or in lumbering wagons to remote construction camps in the high mountains. They had to be handled, often, by untrained and careless men.

And they had to be adapted to meet all these conditions. The powerful nitroglycerin, which Nobel had invented, which otherwise was so useful, was almost unserviceable because of its liquidity. It had to be dissolved at first in wood naphtha for the sake of greater security. Then that, in turn, was found impracticable, because the nitroglycerin had to be again separated from the wood naphtha on reaching its destination.

One by one the du Ponts followed these changes, or led them, altering their costly machinery with each new process and breaking in their trained and expert employés step by step to the ever more difficult work which came before them. By the early eighties, when the great Hoosac Tunnel through the Fitchburg Mountains in Massachusetts, then the most notable engineering work of its kind on the continent, was being constructed, the nitroglycerin was being transported by the more or less cumbersome process of being first frozen before being shipped. This was a costly and awkward way of doing it, but it had to be done and machinery had to be provided for it.

Yet even this process was no more than successfully inaugurated before the redoubtable and irrepressible Nobel, of Sweden, found a way of mixing nitroglycerin with a highly infusorial earth capable of being molded into "sticks," and thus brought to the world the famous "dynamite."

Nobel in 1878 had invented a combination of nitric

EPROUVETTE, FORMERLY USED FOR TESTING POWDER.

acid, cellulose, and glycerin from which the nitroglycerin did not separate even in water and which was more powerful even than dynamite. And this substance, together with dynamite, once more altered practically the whole face of the explosives industry. It put a convenient and easily transportable explosive into the field, which was to work in coöperation with the so-called diamond drill to extend indefinitely the power of tunnel boring, of rock blasting, of foundation laying and of what not; but it was so convenient a form that for a time it almost supplanted everything else and shifted the entire business of explosive making away from the accumulated machinery and facilities of past years to entirely new machinery and new facilities.

Persons less solidly and scientifically trained than the du Ponts would have gone down under the pressure of these rapid changes and this endless competition of ingenuity. But they not only stuck to their last, they went their competitors one better. With each improved invention they had their own invention, in turn their own improvement, their own adaptation of their product to American conditions. The European makers, subsidized though they were in the main by their governments, had no such colossal range of conservative enterprises to feed as was afforded by America. They had no vast mines, and no amazing railroads such as the Rio Grande. There were no boundless stretches of forest to unstump and lay clear for the grain field and the apple tree. The skyscraper took no root abroad until long after it had made cliff dwellings of the principal streets in every leading city of America. So the du Ponts had an arena and a problem strictly their own. It could be lost to them only by their failure to live up to the

speed of the hour, only by their going to sleep while their competitors worked.

And there had been no such failure, no such somnolence in the du Pont family since first Pierre Samuel du Pont's vigilant intelligence had sought, with Turgot's and others', to forestall the French Revolution. Henry du Pont, whose great executive ability had served to build up the plant after the explosion of 1848, had lived on through the Civil War and left behind him sons as well trained as himself. Alfred Victor, the elder brother, who had been the first to succeed the original Eleuthere, left behind him four sons, two of whom had been educated, as had the father, and had gone into the firm. So when the Civil War was over and the great era of American internal development began, the firm was replenished with specialized and educated men for every branch of its fast diversifying business. There were du Ponts for the laboratories, du Ponts for the field of sale and promotion, du Ponts for the search for raw products, du Ponts for the executive offices, du Ponts for the relations with the public. And these, each and all, united their efforts in the full spirit of the founder of the firm. They acted jointly to make their product the best, to give it the widest market, to see that it yielded the best profit.

And those children of the third generation had, at the end of the war, passed their legacy, enlarged and bettered and amplified, to the fourth and fifth generations which now began to follow.

If it were not that the authentic records in the case are so voluminous and so convincing, one might think that all the review of the Eleuthere Irénée du Pont undertaking and its history thus far given was but

the praiseful wording of a paid commentator. Such utterances in subsidy are not uncommon. But in this instance the story rests on a foundation that is open to universal inspection and has often been subjected to the most searching examination.

V

MAINSTAY OF AMERICAN GOVERNMENT—UNUSUAL BUSINESS CONDUCT

THE very fact that the du Pont powder has been almost the entire mainstay of the American Government in its times of greatest crisis has led to the feeling that it would be but human nature for the makers of the powder to presume upon their singular situation and to make the public the victims of their tactical supremacy. And, accordingly, both during and after every crisis, charges of extortion and monopoly and unpatriotism have been freely made against the company. At times the charges have risen to rather startling heights. Seemingly strongly responsible persons have initiated them. Evidence which on the surface appeared most convincing had been adduced. But always, when the public investigation has gone far enough, the truth has proved so favorable to the accused that the persons making the charges have themselves been the first to withdraw them.

A few instances taken at random from the public press and the records of Congress will amply illustrate. As lately as 1906, for example—a period well within the so-called muckraking era which began with the presidency of Theodore Roosevelt—no less a person than the president of a rival powder company of some magnitude instituted a campaign to break the relations which had so long existed between

the Government naval department and the du Pont Powder Works. Writing concerning this campaign, the Washington correspondent of the conservative and careful New York *Evening Post* said:

"It is unlikely that the present close relationship existing between the du Ponts and the so-called Powder Trust and the Navy Department will be disturbed so long as the conduct of naval affairs remains in the present hands. The department is apparently perfectly satisfied with the present arrangement, and has no desire or intention to make a change."

This dispatch was published at a time when the corrective activities of President Roosevelt in all Government matters were at their height. Not a department or bureau in the entire Federal service had escaped a shaking up and cleaning out. The navy was a source of particular interest to the Chief Executive because of his former incumbency of the Assistant Secretaryship and his full knowledge of its most intimate details. Had there been any disposition on the part of the du Pont family to depart from the traditions handed down to them by their progenitors and to sacrifice their duty to their country for the sake of purely monetary gain, the President would have found it out and acted accordingly. That he did not find any such disposition was clearly set forth in a statement from a "high-ranking officer of the navy," quoted in connection with the above dispatch to the New York *Evening Post.*

Said this officer: "Our relations with the du Ponts are very satisfactory. They have not got the department in a position like the armor-plate people, where they can squeeze us. When we think that the price they make is too high, or when we find that we can

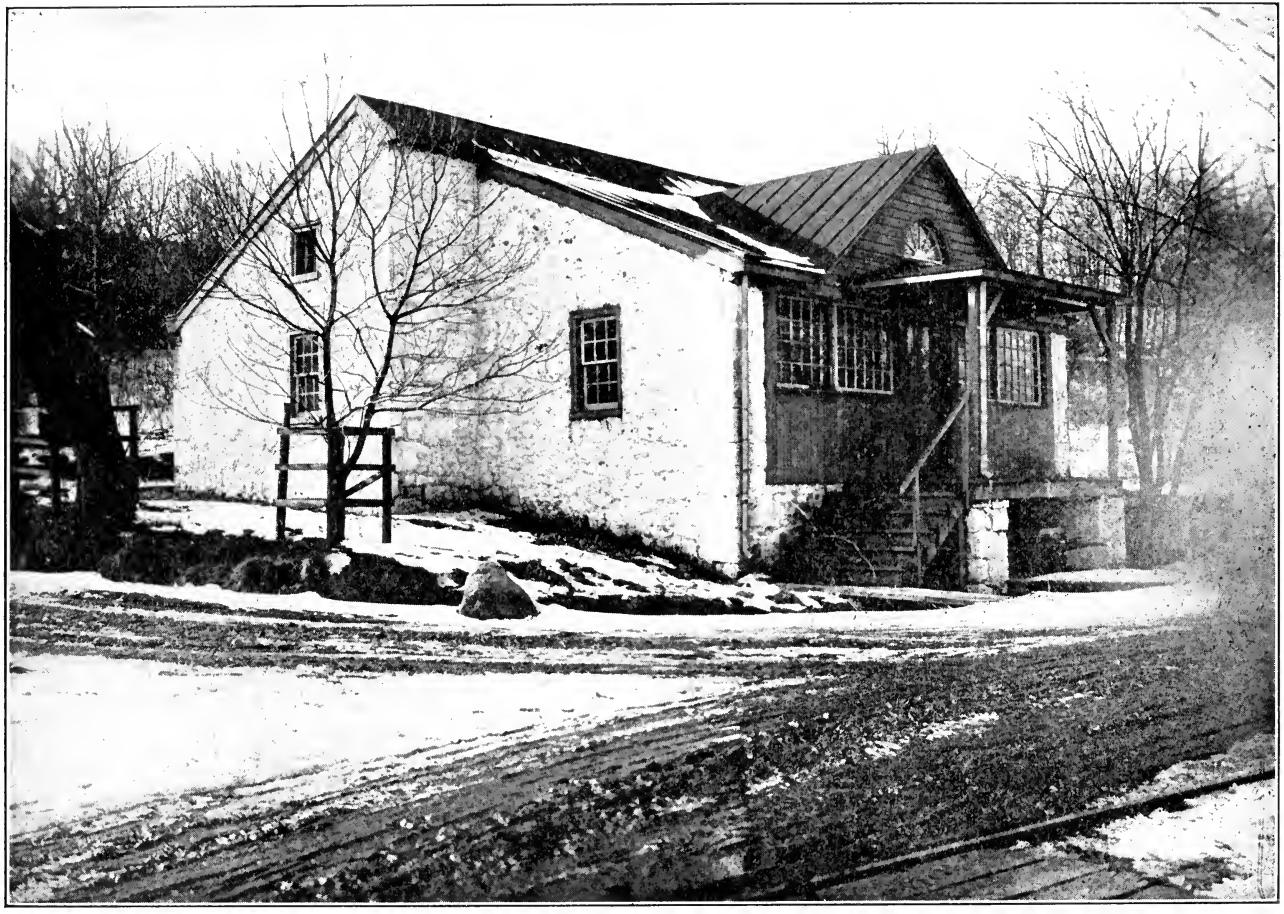
SALT-PETER REFINERY.

cheapen the cost of production at Indian Head, we go to them with our new figures, and in the past we have always found them willing to bring the prices down to what we considered a reasonable basis that affords them only a fair profit."

"Some time ago," continued the officer, "instructions were given to inspectors at the Government powder factory at Indian Head to make a close, careful tabulation of the cost of making smokeless powder. The department found that it cost about 48 cents a pound. In making this estimate, such items as insurance, deterioration of the plant, cost of supervision, interest, and other items of that sort which commercial manufacturers must reckon with, were not taken into account. Taking these things into consideration would raise the cost to about 62 cents a pound. At the present time, the department pays the so-called Powder Trust 75 cents a pound for smokeless powder. The difference between 62 cents and 75 cents the department has considered a fair profit for the manufacturer."

Ordinarily, it would hardly be necessary to go beyond such a candid and decided statement to emphasize the point. But it happens that in governmental affairs it becomes quite as necessary for the legislative branch of the public organism to satisfy itself as it is for the executive branch, even when the executive branch commands such general confidence as did President Roosevelt at that time. So, notwithstanding the attitude assumed by the "high naval officer" above quoted, Congress entered upon its own investigations of the subject and arrived at its own conclusions.

The conclusions speak for themselves. They were somewhat comprehensively voiced by a prominent member of the House of Representatives in an inter-



TYPICAL INCORPORATING MILLS.

view published in a cautious and responsible Washington paper.

Said this member: "The disposition of men who made laws for the nation to seek facts and be guided by authentic information was never better illustrated than by the manner in which they went to the bottom of the powder proposition in connection with the naval bill at the present session. A year ago a great commotion was precipitated when the powder paragraph in this bill was reached, and charges were freely made that the Government was the victim of extortion and unfair treatment. This resulted in placing certain limitations on the purchase of powder, which might have proved embarrassing to those responsible for good results in the army and navy. Mr. Foss, chairman of the committee on naval affairs in the House, wisely decided, before the bill was prepared this year, to open up the whole question and get at the facts.

"As the du Pont Powder Company, of Wilmington, Delaware, furnishes all the powder used by the army and the navy, except that manufactured at the Government plants at Indian Head and Dover, that company was asked to appear before the committee and give such information and answer such questions as might contribute to the general illumination of the subject."

The Congressman then went on to state that Col. E. G. Buckner, vice-president of the du Pont Company, responded and that the result was one of the most interesting committee hearings had in years. Every phase of the manufacture and cost of powder, he said, together with the policy pursued by the du Ponts, was taken up, thoroughly discussed and much valuable information acquired. General Crozier

HOUSE BUILT BY MR. ELEUTHERE IRÉNÉE DU PONT, AND SUBSEQUENTLY ADDED TO BY HIS SON, MR. HENRY DU PONT.

and Admiral Mason, chiefs of the ordnance bureaus of the army and navy, were present, "lending to the hearing a dignity and impressiveness quite out of the ordinary"; and these eminent authorities, before Col. Buckner left the stand, "informed the committee that all the statements he made were verified by the records of the respective bureaus."

Under such conditions, when the naval bill came up in the House in the session of which the Congressman was speaking, the very members who had caused the storm the previous year admitted that the results of the hearings were sufficient to restrain them from insisting upon the restrictions on powder purchases for which they had made a demand in the previous session.

"It might be truthfully said," added this Congressman, "that the dependence of the Government on the du Ponts, who have made practically all the powder shot in this country's wars for more than one hundred years, was emphasized to such a degree by the information secured in the hearings as to place that concern in the attitude of a quasi-governmental position."

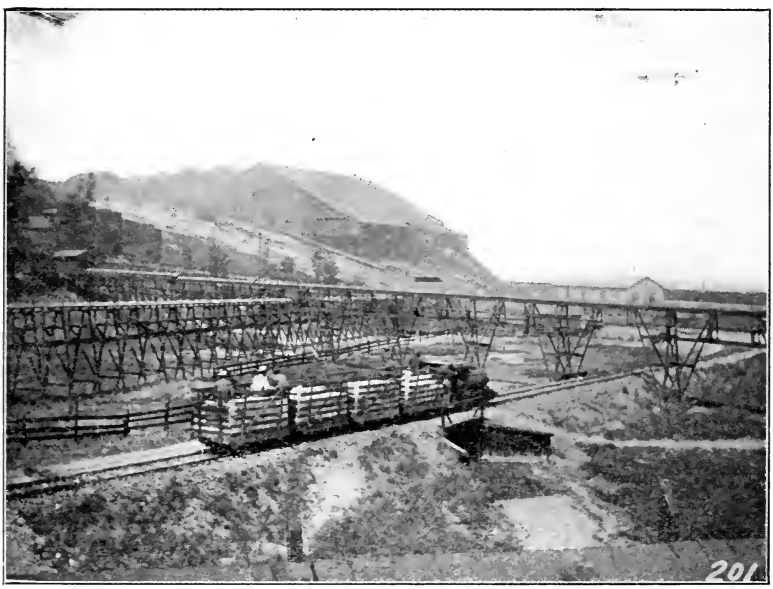
In other words, following a most exhaustive and relentless, and even at times bitterly prejudiced, examination, Congress found exactly what the du Ponts had learned from the founder of the American branch of their family must be their guiding principle in all their public relations, namely, that they must forever regard themselves as keepers of a public trust, which they must no more violate than they would violate the rights and privileges of their own families.

"Indeed," said this same member of the House of Representatives, "so close is this relationship between the

HOUSE BUILT BY MR. ALFRED VICTOR DU PONT, GRANDFATHER OF MR. T. COLEMAN DU PONT AND MR. PIERRE S. DU PONT.

du Ponts and the Government that officers of the army and navy are constantly on guard in the du Pont factories, inspecting every step incident to the manufacture of explosives."

Not only this, but the Congressional committee found that so far from taking advantage of the ex-



PLANT TRANSPORTATION OF DYNAMITE.

igency of the Government in time of war by demanding an increased price for their output, the du Ponts had made it a practice wherever possible to lower the price. The committee examined in particular the records of the Departments of War and of the Navy for the wars of 1861-5 and of 1898 and found that while practically every other contractor who had previously been selling munitions of war to the Government advanced the price, the du Pont Company alone

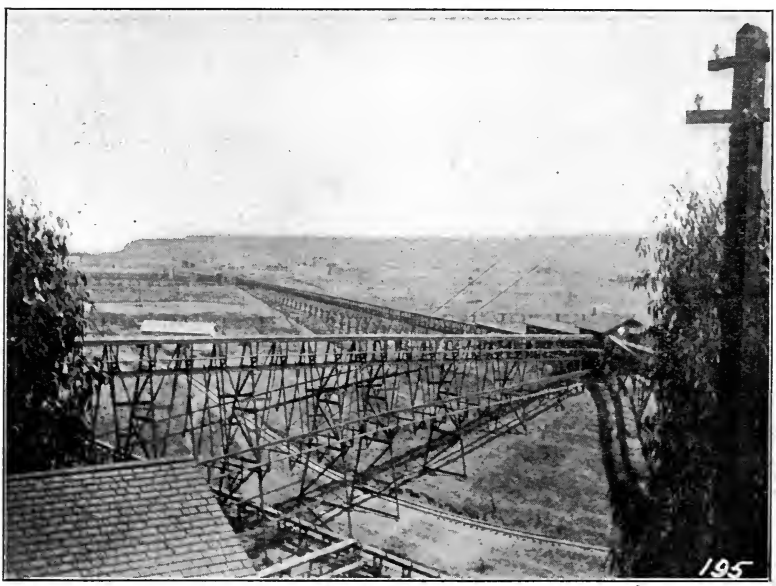
sold at no greater and, for several kinds of material, sold for a considerably less price than in times of peace.

Also, the committee discovered another incident which reflected the character of the du Pont plant. It was in connection with the smokeless powder sup-

HORSE-SHOE TYPE OF WHEEL MILL.

ply of the Spanish-American War. Smokeless powder was then first made broad use of, and it quickly developed that the demand would far exceed the capacity of the powder plants. To meet the situation, the du Pont company put in a large amount of new machinery for the manufacture of the brown prismatic powder, making a contract with the Government for furnishing a certain quantity per month.

The war, however, was quickly terminated, and the powder was no longer in demand. Not only this, but it had proved its absolute unfitness for martial service. In the normal order of things, it would have been proper for the du Pont firm to insist upon the Government fulfilling its contract, or indemnify-



TRESTLES FOR CARRYING LIQUID NITRO-GLYCERIN.

ing the firm for the loss involved in installing the machinery. But, mindful of their early principles, the firm not only did not request any indemnity but cheerfully met the request of the Government asking for the cancellation of the entire contract.

Apropos of the discovery of these facts by the Congressional committee, the Congressman quoted in the Washington paper said:

"It developed at this hearing that while the price of nearly everything else the Government was buying was increasing, the price of powder was decreasing, that paid last year being several cents below the limit fixed in the naval bill, and about 20 cents lower than other nations pay for the same powder.

CONCRETE-LINED RESERVOIR, IN A DRY COUNTRY.

"The statement made in Congress last year," he continued, "that the price of powder to the Government during the war with Spain was increased by the du Pont people, was disposed of completely when it was shown by official records that in the midst of that war the du Ponts had voluntarily decreased the price of powder three cents a pound. The records established that while the company might have gone into the Court of Claims and secured $250,000 for the unfulfilled part of the contract made with the Government when war was immi-

nent, it canceled the contract of its own motion without making any demand in lieu of cancellation. Indeed, from the facts elicited at this hearing it would seem that the du Pont Powder Company has gone to the limit of liberality in its dealings with the Government. It might have charged hundreds of thousands of dollars for inventions, formulas and processes which it presented to the Government without asking compensation. These, worked out in its shops and laboratories, have resulted in savings in the manufacture of powder and wear on guns aggregating millions of dollars."

UNUSUAL BUSINESS CONDUCT

Such unusual business conduct on the part of the du Ponts, of course, can proceed from but the one motive or principle, namely, the one so often emphasized in this review, that the manufacture of explosives, differing from the product of any other known industry, bears with it a large social and public responsibility. Carried on promiscuously and without this sense of responsibility, it would be perilous indeed to the whole fabric of government. Fundamentally, it requires coöperation of manufacturer and government, rather than the seeking of advantage by one side over the other. Eleuthere Irénée du Pont fully appreciated this, and his successors have lived up to the same attitude.

For instance, in the same interview from which quotation is here made, the Congressman added the following striking statement: "It developed that when Congress, three years ago, appropriated $167,000 to build a powder plant at Dover, New Jersey, the du Pont company not only gave the Government officials free access to all its plants, but turned over their blue-prints to them so that when the factory

was completed it represented every modern feature."

Also, this Congressman noted that "the committee was as much surprised as interested when told that the du Pont Company had recently expended $400,000 to obtain a new powder for Government use,

COMPRESSED-AIR LOCOMOTIVE.

which a distinguished admiral says is the best asset this nation could have in the event of war."

At Indian Head, as at Dover, the du Ponts assumed the same coöperative attitude toward the erection of the Government plant. One of the New York papers of the time said:

"A smokeless powder plant was erected at Indian Head in 1899 by the Government, and, instead of opposing the erection of that plant, the du Pont Company assisted the officers of the United States in every possible

way, furnishing them much valuable information in the way of blue-prints and giving them the results of their experience in the business, and doing everything possible to make the venture a success from the standpoint of the Government."

Reference to records and documents older than the Spanish-American or the Civil War would but confirm these same evidences as to the conduct and general attitude of the du Pont family and its enterprise. While many big industrial concerns of the past wonderful half-century in America have been unable to resist the temptation to make the Government their prey, the du Ponts appear never to have departed from their original principles. They have worked consistently and perpetually in the light of their earliest instructions. And in this respect they stand as an object worthy of general study in the modern business world.

A few more specific instances of later day illustrate still more: Until a few years ago, the Government furnished the company with alcohol used in the manufacture of powder. Under the process then in use, the alcohol escaped or was destroyed by evaporation. The company invented a process which recovered the alcohol and accomplished a saving to the Government of $322,000. Later it gave the Government the process for its own plants, and in one year the plant at Indian Head saved $40,000.

The du Pont Company invented a process for reworking deteriorated powder. In 1909, 432,000 pounds of Government powder was reworked by this process and $185,000 was saved. It was estimated in June, 1910, that on the 1,000,000 pounds of deteriorated powder then in possession of the Govern-

ment, the saving by this process would aggregate $400,000.

Another process invented by the du Ponts doubled the life of smokeless powder. Still another achievement has been the perfecting of the powder for small

TYPICAL INCORPORATING MILLS.

arms to so remarkable a degree as to increase the lease of life to the Government rifle supply of 600,000 rifles from 1500 to 13,000 rounds each, without increasing the cost to the Government. This alone is worth millions.

Few persons, probably, have any idea of the exactions the Government makes of the company in return for the contracts it secures for powder supply. They are such as apply to no other industry with which the Government has relations.

For example, all the powder sold to the Government could be made at a single one of the du Pont plants, save, of course, the extraordinary amounts needed in time of war. But, as a precaution against the contingency of war, the Government requires *all* the plants of the company to be kept constantly in commission. It allows none of them to remain idle. And to insure against this idleness, it makes its purchases from the various plants instead of from any one.

An idea of what this means to the company can be gathered from the statement of Col. Buckner before the Congressional committee, wherein he said that if the Government, not content with the public-spirited attitude of the company in the matter of prices, should insist upon going still further and demand yet lower prices, the company would be obliged to convert all of its plants into pure commercial factories, wherein only explosives used in mining, engineering, and the like would be produced. To reconvert the same factories into shape for manufacture of Government explosives in time of war would require three years!

Thus, as said above, the authentic records in connection with the E. I. du Pont de Nemours Powder Company take away the ground for any suspicion that the story of the works thus far told is drawn either from imagination or from the fulsome regions of hired admiration. It is a story based on solid facts. It is a story that sustains itself, however penetratingly the reader may choose to look into it.

VI

VICTOR DU PONT

ONE has only to turn his thoughts now from the material operations of the plant to the personnel of some of the descendants of the original Eleuthere to see how it comes about that a principle or set of principles, so difficult for the average man to maintain as were those passed over to his offspring by Eleuthere, have lived so long and gained, rather than lost, in their force.

Take the case of Victor du Pont, the nephew of Eleuthere Irénée du Pont, who came into being after the War of 1812 and in the midst of the strenuous economic times of 1828. This youth passed his early days in the family home and received his education at Delaware College and later at Harvard University —then Harvard College. He chose the legal phases of the powder business for his field and clung to them until his death. Said a Wilmington paper in summing up his life:

"Few men have left or ever will leave behind them a greater void in this community than has been caused by the death of Victor du Pont. . . . It is not too much to say that he won the confidence of every man with whom he was brought into intimate relations. In business matters he was a man of force, character and unbounded energy, which was quickly called into action and earnestly exerted in behalf of any interest which had a proper claim upon him. . . . He seldom, if ever, en-

gaged in the trial of causes in the courts, his inclinations being rather to perform the functions of a counselor, for which he was admirably adapted. Adding to his legal business the active control of two important financial institutions, he became, probably to a larger extent than any other man in our community, a financial adviser, upon whose legal judgment, financial ability and saving common sense a very large number of people were accustomed to rely implicitly."

Probably naturally enough, in view of the character of secrecy with which the powder-making inaugurated by his great uncle had been invested from the beginning, this one of the du Ponts carried into the legal fraternity an amount of retirement and seclusion and self-counseling unusual even in that profession. The Wilmington paper said of this phase of his life:

"There were phases of the character of Mr. du Pont known only to those who were brought into intimate relations with him, which can hardly be publicly commented upon with due respect for the seclusion in which, during life, he almost concealed some of his most admirable qualities of mind and heart."

In this brief analysis of one of the family who has died, it is perhaps possible to see why the du Pont Powder Works have so often been misunderstood and unjustly attacked. The essence of their business is secret. Their relations with the Government are secret and must be so. It would not do either for foreign governments or even for the people of the United States themselves to know most of the transactions which pass between the War and Navy Departments and the company on the Brandywine. For in these transactions are hidden the secrets of military

A PORTION OF BUILDINGS IN CONNECTION WITH THE EXPERIMENTAL STATION, DU PONT CO., ALONG THE BRANDYWINE.

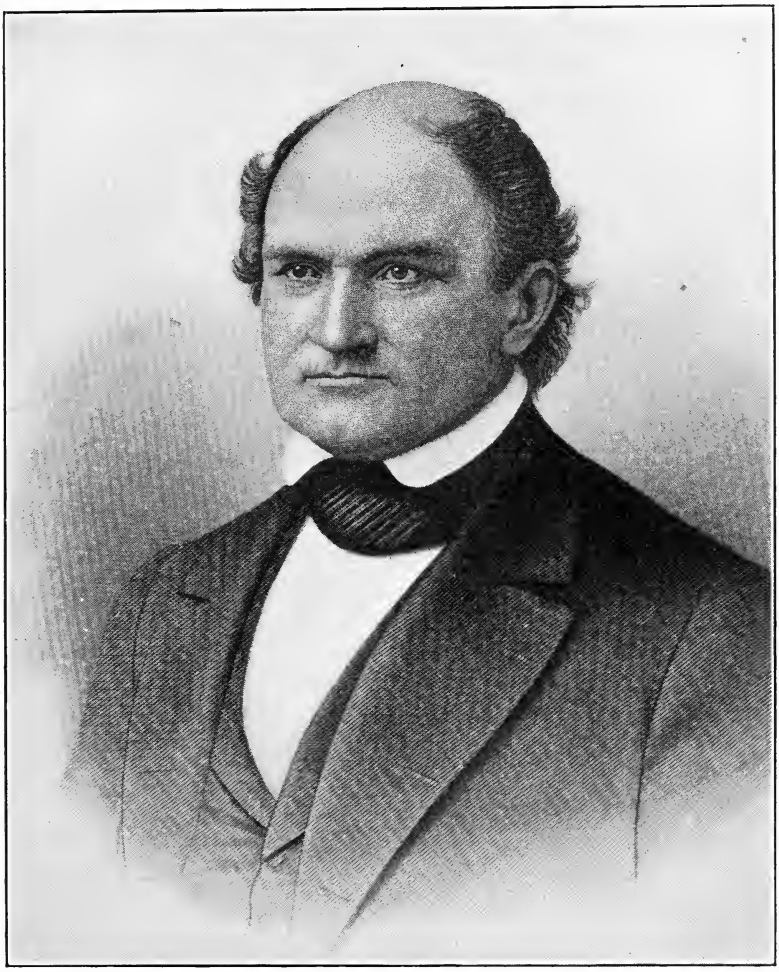
and naval conditions, the plans of military and naval organizations, the affairs of diplomacy, and even in many instances the unpublished difficulties of domestic administration within the nation's own borders.

Such is the freedom of the American press in publishing Governmental news, that the knowledge that a given powder contract had been entered into between the Government and the du Pont works might precipitate the very difficulties which diplomacy would be trying the hardest at that moment to overcome. Such delicate situations as existed prior to the Spanish War or as occurred lately on the Mexican border might be plunged into fatal chaos by the merest whisper of activity or contracts for explosives. The instinct of secretiveness of the most careful sort has therefore had to become traditional with the du Pont family. This little tribute to the late Victor du Pont shows how thoroughly instinct has been ingrained.

Another characteristic which this one of the older du Ponts possessed was thus expressed in resolutions passed by the Bar Association of Wilmington at the time of his death:

"He was singularly clear in apprehension, straightforward in action, and charitable in judgment."

Straightforwardness in action has been taught in each generation of the du Ponts, beginning with the distinguished forebear who shared so strongly with Turgot in the French Revolution. It has been the attribute which has served to preserve the company's amicable relations with the Government through year after year and administration after administration. Had the culture of secretiveness been accompanied



ALFRED DU PONT, PRESIDENT 1837-1850.

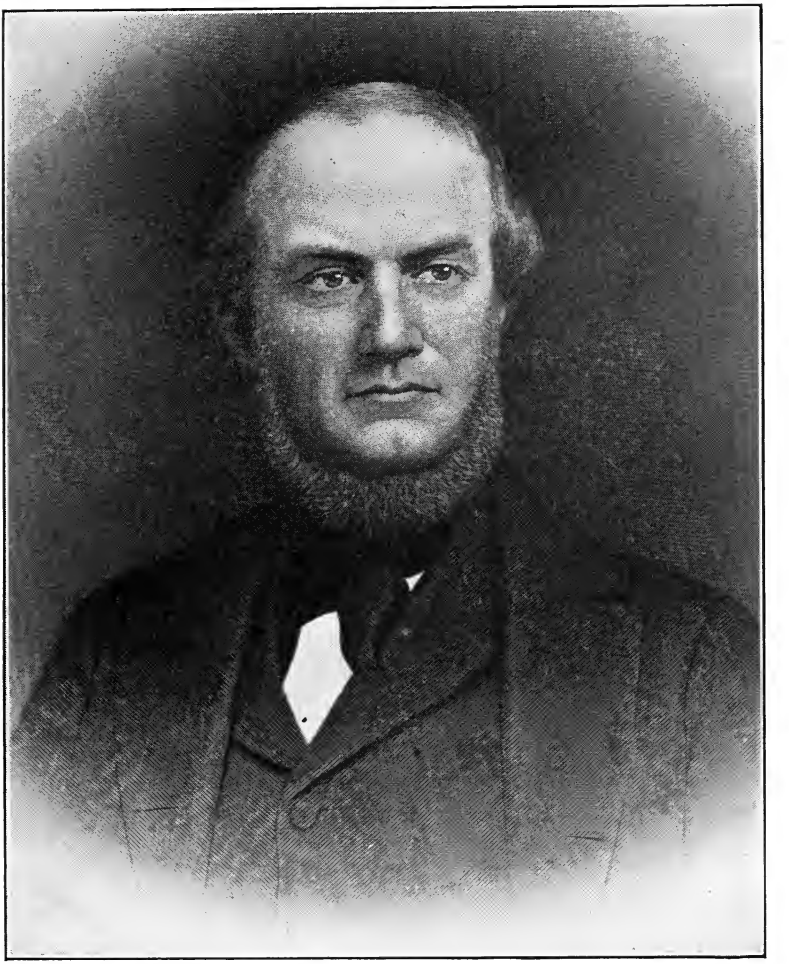
by the culture of evasion, deceit, or equivocation, it would have been impossible for the patriotic relationship to continue.

Nothing, probably, could more beautifully and perfectly reflect the ideals to which the du Pont family are taught to look than the tribute paid to Victor du Pont at his funeral, by the late Thomas F. Bayard, former United States Senator and Ambassador to England. Said Mr. Bayard:

"I have known him, and from the time that we were little children together until we were gray-haired men an intimacy existed between us such as, I think, never existed before between two men so different. He was a rare man, and though I have known men of greater force in expressing themselves, never have I known a man with a stricter adherence to truth than this simple gentleman.

"In his family there have been warriors—men who were heroes—but never could the family boast of a more truthful and courageous man than this lawyer. Nature cast him in a mould of refinement. . . . He was a man with a singular refinement of mind. For it is not the boisterous and stormy sea with its foaming waves that reflects the heavens, but the calm lake that reflects truly the beauties which hang on high. It was this faculty of retaining the image of all things passing before him that enabled him to guide safely, not only himself but those who entrusted their affairs to him. He did not see things with the distorted eye of ambition, prejudice or anger. Indeed, I have never known a man so singularly devoid of ambition.

"Yet he had ambition. His ambition was to live according to his ideas of right, dignity and modesty. The object of his ambition by self-control he arrived at and never lost. His gifts were never showy. His mind and soul were serene.



HENRY DU PONT, PRESIDENT 1850-1889.

"He naturally shrank from the excitement of the court; and several times when I asked him to take cases with me I was unsuccessful in obtaining his consent. But his judgment, which is the be-all and end-all, was strengthened by repose and study and was counseled by the moral influences of his nature. Thus this man, who seldom raised his voice in this or any other forum, acquired an influence unequaled by any other man in the community. Toward him radiated love, respect and confidence.

"This man was the fruit of the union of noble men and women. . . . His death is a loss to every man, woman and child of the community in which he lived."

It is of singular interest that even in the practice of law, this one of the du Ponts lived chiefly in a fiduciary atmosphere. Where his relatives were engaged in the more material work of powder-making and, in that occupation, as previously stated in this review, resting the larger measure of their success upon their execution of the confidence reposed in them by the Government and handed down to them by their predecessors, Victor du Pont was living his life as an attorney chiefly in the assumption of functions of trust.

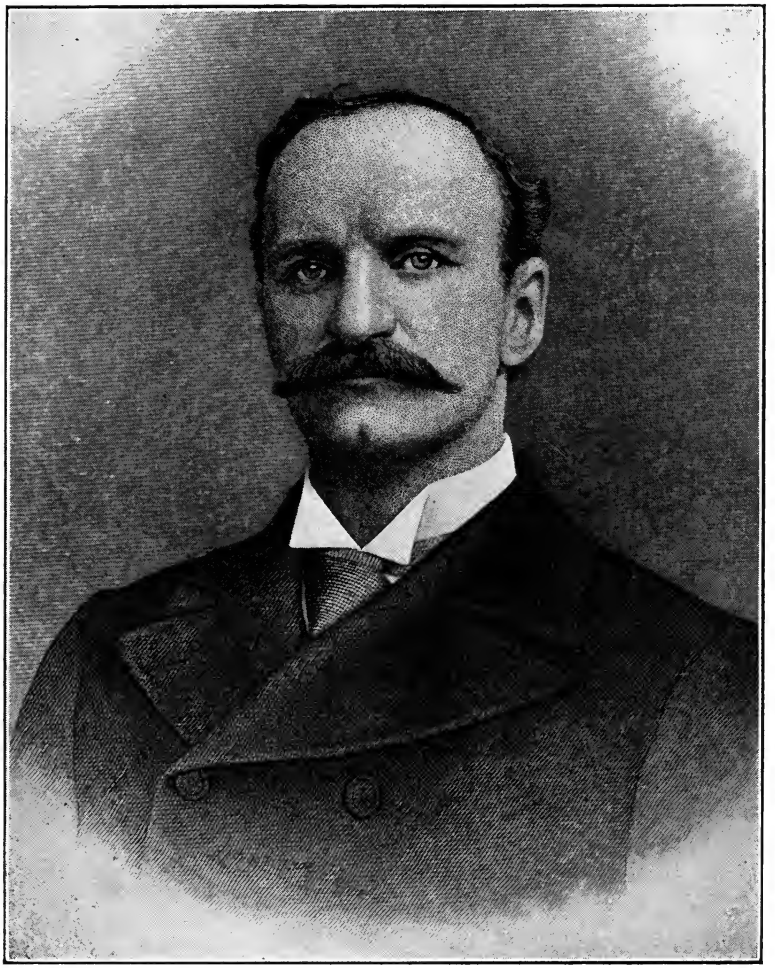
Said another Wilmington paper, speaking of this phase of his career:

"His integrity was so spontaneous, so natural, so invariable that it came to be recognized as his chief characteristic quality. He was known and described in this way, just as some men are spoken of as eloquent, or industrious, or painstaking. . . . It thus came about that his services to the business community in a fiduciary capacity attained very large proportions. Whenever a private trust in the matter of estates, etc., was to be established his services were secured, and the amount of property thus managed by him ran into the millions."

EUGENE DU PONT, PRESIDENT 1889-1902.

"It is not likely," continued this paper, "that, in the seclusion of his own thoughts, the idea ever occurred to him of getting the advantage of any one. He accorded naturally, and as a matter of right, to every one all that belonged to him, and an opponent's interests were as safe in Mr. du Pont's hands as they were in his own. To be self-seeking at the expense of another was foreign to his nature."

In this last sentence may be seen, doubtless, the general spirit of the du Pont family which has always prevented them from taking advantage of the Government and has always led them to coöperate with that Government, even to their own detriment.



T. C. DU PONT, PRESIDENT 1902–.

VII

A FAMILY OF POWDER-MAKERS—ALWAYS READY FOR A PUBLIC EMERGENCY—ALFRED VICTOR DU PONT—ALEXIS DU PONT—LAMMOT DU PONT

THE history of the E. I. du Pont de Nemours Powder Company is not merely a history of gunpowder. It is a history of patriotism, achievement, and bravery. The growth of a great industry appeals to the imagination, but the devotion to ideals and patience with the everyday task that sometimes go to make that growth possible are even more striking.

We have seen that for many years the du Ponts were practically the only powder-makers in this country. The very names of the few unlearned makers who preceded them have passed from the memory of men. To-day there are perhaps fifty other manufacturers of explosives, but the du Ponts turn out more of these products than any other producer, not only in the United States, but in the whole world. No industry in the State of Delaware exceeds theirs in size, and yet if the founder of the great industry could see the plant to-day, the mere magnitude of its operations would not appeal to him. That which would arrest his attention as a true Frenchman would be the development of his family and its continued and unwavering devotion to the standards which he set up.

Eleuthere Irénée du Pont undertook the manufac-

ture of powder in America because of the inferior quality of the domestic product. He brought improved machinery from France and he made better powder than the colonists had ever used. That his posterity have followed his example, there is a century of success to prove. But Eleuthere Irénée did more than make good powder. As was said at the conclusion of the last chapter, the general spirit of the family has always been such as to prevent them from taking advantage of the Government. For this they deserve every praise, but it must not be forgotten that the founder of the industry himself set them this high ideal.

The only war fought by this country with other than du Pont powder was the Revolution. If Eleuthere had been making powder then, the war might have ended sooner in the Continentals' favor. Said a historian of these times: "Food could be had if it could be transported; clothing could be secured or done without; but arms and, above all, ammunition did not exist in the country in quantities sufficient for the prosecution of the war, and could not immediately be produced there." Washington wrote to the Governor of Rhode Island: "No quantity of powder, however small, is beneath notice." At the siege of Boston the attack was put off for nearly a year because of the lack of ammunition.

Only ten years after Eleuthere set up his works in competition with British makers, a step which he was told would wreck his fortunes, came the War of 1812. The coast was so completely blockaded by British cruisers that not only was the country unable to purchase any powder abroad, but it was difficult enough for the du Ponts to import the saltpeter they needed. This difficulty, however, was surmounted,

and the war was fought to a successful conclusion with du Pont powder.

When the war broke out Eleuthere Irénée du Pont, as we have seen, not only put his plant and all its resources at the command of the Government, but his brother, Victor Marie du Pont, headed one of the many companies which Delaware offered to her country. As the war centered about the Southern States, Delaware was one of the chief points of attack. The E. I. du Pont de Nemours Company, therefore, worked unceasingly that ammunition might reach both land and naval forces with as little delay as possible.

Early in the war the du Ponts helped fit out the *Wasp,* which on her way to the West Indies fell under the observation of the British frigate *Frolic.* The little *Wasp,* with her thirteen guns and du Pont powder, promptly began operations, and so well did she fight that no one was left on board to haul down the British flag when the *Frolic* was finally compelled to surrender.

Not only did the du Ponts themselves do wonderful work during the war, but their employés felt themselves honored if they were allowed to accompany the wagon loads of ammunition on their dangerous journeys from the factory to the quay at Edgemoor. English, Welsh and Irish flocked to the powder mills, and the name of the du Ponts was still so powerful in France that many French refugees sought employment with the company and worked shoulder to shoulder with the stanch Americans.

Then Eleuthere furnished the ammunition for the expedition of General Jackson against the Seminole Indians in 1818.

In the following year Major S. J. Long set out

OLD POWDER WAGON.

from St. Louis to explore the West, and to him the du Ponts supplied the black grains which made the trip possible. On his journey Major Long discovered Pike's Peak.

At about the same time the states of South America were engaged in many conflicts, some against European aggression, and sympathy with them was strong in this country. To these states great quantities of powder went from the du Pont works. During this early period also the powder works were strained to their capacity by the demand of settlers in the West for the ammunition needed in their struggle with Indians and wild beasts.

Eleuthere Irénée du Pont left three sons who carried on the industry: Alfred Victor, Henry, and Alexis Irénée. Alfred Victor was president from 1837 to 1850, and Henry took charge from 1850 to 1889. During the régime of these two presidents the industry of powder-making grew from one of insignificant size to the greatest of its kind in the world, and one of the largest of any description whatsoever in this country. The uses of explosives during this long period were extended and revolutionized far beyond the possible dreams of Eleuthere, and the chemical and mechanical advances in their manufacture were in themselves revolutionary. During Henry du Pont's administration was also fought the greatest war in human history, and the one which consumed the most gunpowder.

What manner of men were these who, instead of devoting themselves to lives of idleness, welcomed their father's trust and developed it in so many directions?

DU PONT POWDER WAGON CARRYING POWDER TO LAKE ERIE FOR COMMODORE PERRY.

[Painted expressly for the du Pont Company by the late Howard Pyle, at Florence, Italy, early in the spring of 1911, as the subject for that Company's 1912 calendar.]

ALFRED VICTOR DU PONT

Alfred Victor du Pont was born in France in 1798, and was educated at the Mt. Airy Seminary at Germantown, Pennsylvania. He entered Dickinson College in 1814, where he remained until 1816, when that institution was discontinued. His father intended him to study in France, but the family fortunes were so shattered by the explosion of 1818 that this was not feasible.

Even at the age of fourteen Alfred had been interested in the making of gunpowder, and could not be kept away from the dangerous mills. Education has always been a necessity with the du Ponts, or, rather, they have always felt it to be a necessity. Not able to send his son to France to study at the same wonderful laboratories where he had worked, Eleuthere placed young Alfred, who had already an extended education for those days, under private tutors at home before allowing him to enter the business.

Alfred and his brother-in-law, Antoine Bidermann, assisted their father until his death in 1834. Bidermann was in charge then for three years until his retirement and Alfred alone remained in charge until 1850, when his health became impaired. From his father he inherited scientific ability, and from his grandfather scholarly and literary tastes. Through the panic of 1837, the big explosion of 1847, and the war with Mexico he worked steadfastly. The many explosions which had taken place led him to devise safeguards and facilities for preventing accidents. His life has been described as uneventful, but he was none the less a remarkable man. Besides having ability he possessed marked originality. Of him the National Cyclopedia of American Biography has said:

"His heart, like his father's and his grandfather's, was full of liberality and generosity, and he was ever prominent in deeds of kindness and benevolence to the poor and afflicted."

Henry du Pont, who followed his brother Alexis as president, alone of the sons of Eleuthere Irénée lived to see the Civil War. Alfred and Alexis both died previously, Alfred in 1856 and Alexis in 1857.

ALEXIS DU PONT

Alexis was never head of the family industry, but associated himself with it at an early age and worked at powder-making until his death. He was impulsive and enthusiastic, and put his whole soul into all he undertook. These qualities he devoted not only to business pursuits, but to church work and temperance, in both of which causes he was an ardent worker.

Alexis died from injuries received from an explosion. He had been working with his men toward the end of a day in 1857, when through some accident a spark was generated. It is said that he was trying to shift a heavy box, which in sliding across the floor slipped and started the spark. It was Saturday, and only a few pounds of powder remained in the room, but that was enough to cause a sudden blaze. Realizing the danger and calling to his men, he rushed from the room and threw himself into the millpond close at hand. Here they were safe, but Alexis saw that sparks were flying toward another mill where several tons of powder were stored. Ignoring the warning cries of his laborers, he jumped out of the water and climbed upon the roof of the mill which he feared would explode. The men handed him buckets of water, but he failed to quench

the fire and when the explosion came, he was hurled against a wall with such force that he died shortly in great agony.

Explosions are not as frequent now as in the old days of powder-making. Science and invention have worked apace to prevent disaster. The percentage of accidents in the use of explosives has been reduced to a minimum, as we shall see in greater detail in another connection. Their manufacture is still no child's play. As recently as 1890 fourteen persons were killed in a great explosion in the du Pont mills, and in 1880 another du Pont (Lammot du Pont) lost his life in the dynamite and nitroglycerine works at Thompson Point. He was a son of Alfred Victor, who was president from 1837 to 1850. Although Lammot was never titular head of the industry, his services to it, without reference to his tragic death, were perhaps the most romantic of any of the long line of du Ponts.

Although Alexis and Lammot, son and grandson respectively of the founder, have been the only members of the family to lose their lives in explosions, many others have worked heroically when danger threatened. In the very first explosion that took place in the little mills built by Eleuthere the loss would have been greater had it not been for the courage of members of the family. In 1812, only four years after the modest enterprise had its start, there came a heavy explosion one Sunday morning in March. No thought of the powder mills entered the minds of the church-going folk in Wilmington. What took place is thus graphically described by Muriel Baily in the *New Amstel Magazine* for December, 1911:

"The earth shook and the noise was deafening.

The majority of people thought that the steamboat which plied between Wilmington and Philadelphia had blown up—it was called Milnor's boat, and made a trip one way each day; at that hour it would have been full of passengers.

"As no reports came from the pier and no calls for help were reported, many considered it an earthquake and proceeded on their ways. When, however, they had about recovered from the first shock, another and a heavier explosion occurred and they were more than frightened.

"The third detonation almost lifted people on the streets from their feet. It was only when they looked to the northwest and saw the vast columns of smoke rising in cloud piles, that they realized whence the trouble came. Writers of the time say that the smoke seemed to be spangled with stars, to string into strange shapes ready to fall at a second's notice upon the city and extinguish it. And so wonderful was the sight, even at noontide, that many forgot fear and gazed in astonishment and admiration.

"The first real knowledge of the source of the trouble came when a horseman galloped wildly through the streets, calling to the citizens to raise their windows. A second rider followed almost immediately, crying: 'Abandon your homes. The grand magazine will soon explode.'

"Friends' Meeting was in session. When the call came from other churches, the worshipers hurried away without order, but the Friends, calm and self-possessed, walked quietly two by two, out into the street, and there waited without emotion for what was to come. There were few daring enough to venture toward the Brandywine, and they were chiefly boys and women who had loved ones there.

"Strangely enough, E. I. du Pont had driven to Philadelphia on the morning of the disaster. The friends whom he had been entertaining—among them Colonel Grouchy, of France—were already in their hunting suits, preparing for a trip. At the first intimation of danger they rushed to the works, and their courage and bravery saved many a life.

"It is said that a workman, noticing the flame on a companion's sleeve in one of the mills, shouted, 'We are all lost,' and, with one other man, had sufficient presence of mind to recognize the danger, rush to the edge of the stream and swim quickly to a shelter beneath the bridge. The pounding mill went first, the graining house followed, and the magazine exploded last. Lancaster, forty miles distant, felt the detonation. There were thirty-five killed and six wounded.

"Colonel Grouchy and members of the du Pont family saved the dry house and the refinery, through a courage so fine that it inspired the others to the utmost efforts. If it had not been for their personal heroism there would have been nothing left for E. I. du Pont, on his return from Philadelphia, but ruins. As it was he found two acres of desolation. In those days it took one whole day to reach Philadelphia by steamboat, twelve hours by stage or private coach, and a message of the disaster could not have reached M. du Pont earlier than twelve hours after its fulfillment. On his return his grief was great. He granted immediately to the widows of those killed a $100 annuity; Philadelphia raised $600 for the relief of the sufferers."

DU PONT BUILDING, WILMINGTON, DEL.
Home of the du Pont Company.

LAMMOT DU PONT

It has been well said that if any one is blown up along the peaceful Brandywine it cannot help being a du Pont, so many of them have lived close to the powder mills. Lammot du Pont had personal charge of the dynamite and nitroglycerine works, and while engaged there on the afternoon of March 29, 1884, a man rushed in to tell him that one of the mills was afire and begged him to save himself. But Lammot, who had proved his courage during the Civil War, thought of everything but himself, and rushed into rather than away from danger and certain death.

Born in 1831, he prepared for college at private schools, and was graduated from the University of Pennsylvania in 1849. Entering the family pursuit he gave his attention to the chemical branch, and made such important improvements in black powder as to increase its explosive power to the point of totally altering the industry. In 1880, with other members of the family, he organized the Repauno Chemical Company for the production of Atlas powder and dynamite, with works in New Jersey and general offices in Philadelphia. Of this separate company he was president until his death. Valued as his services were in improving the product, it is but human nature that Lammot should be longest remembered for qualities, perhaps no more worthy than that of industrious application of talent to business affairs, but certainly more picturesque. I refer to his signal bravery and daring feats during the Civil War.

When the war broke out Lammot was barely thirty years old. But he, as well as General Henry du Pont and other members of the family, were in con-

stant consultation with President Lincoln, members of the cabinet and high officers of the army and navy. Many months before war was declared Lincoln called them to Washington, and in 1860 Lammot, still in the twenties, was given one of the most important missions a man could have. He had predicted a probable exhaustion of saltpeter, and as England was the one place to get more, he was despatched thither with the proper credentials to bankers and others.

The importance of the mission in determining the issue of war could hardly be exaggerated, for it later developed that the lack of saltpeter was one of the chief handicaps under which the South suffered.

Lammot had arranged that $500,000 in gold be shipped to him by the next steamer. Upon arriving in England he at once bought up all the available supply of saltpeter, and in a few days the brokers were delivering it in great quantities. They urged him for prompt payment, especially as his purchases had driven up the price; they thought that in the event of his being unable to pay and thus forced to cancel the orders, they could sell at a big profit. He appealed to the Barings and to Brown, Shipley & Co., for funds, but they would not advance him so large a sum. Finally he called upon Peabody & Co., and this firm was willing to advance the money if he could prove his identity. Even Brown, Shipley & Co., to whom he had letters, were not willing at first to affirm they knew him. But he made such an earnest plea, that at last the bankers gave in and allowed him the necessary cash. He paid for the saltpeter and bought more, but his anxiety may be imagined when the second ship arrived without bringing the $500,000.

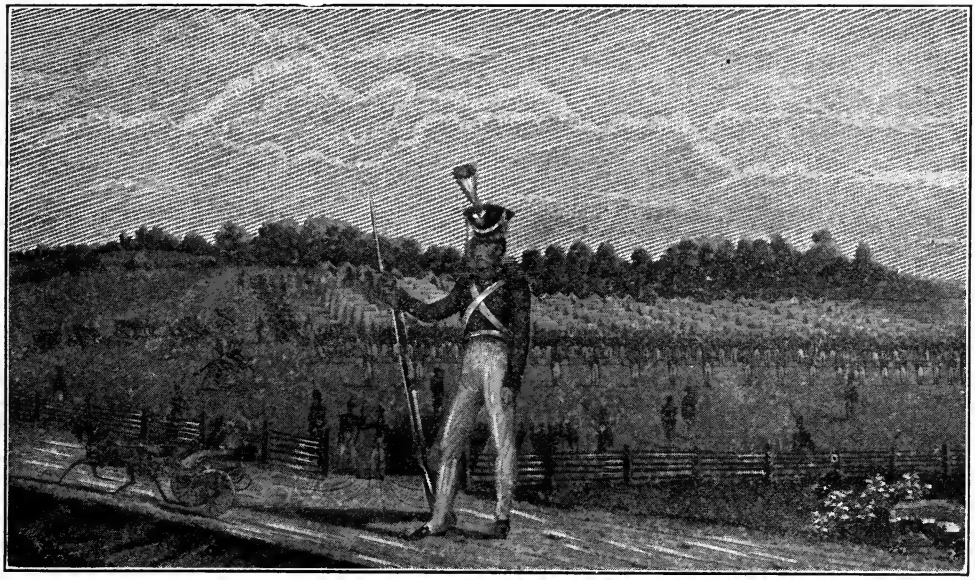
The third ship brought the gold, but meanwhile the London *Times* had come out in opposition to the shipment. As soon as Lammot knew of this he chartered a ship and gathered together a crew, consisting partly of men from vessels captured by the Confederate cruiser *Alabama*. Just as the last of the big cargo was being placed on board, a customs officer reached the wharf with orders to stop his sailing.

Lammot du Pont was equal to the occasion. He demanded the officer's authority and agreed to go with him to the customs house to see his credentials, although he probably knew well enough that the British government had decided not to allow so much saltpeter to leave the country. Before accompanying the officer he whispered to the captain: "Load every pound of saltpeter as quickly as possible, and be ready to sail at a moment's notice."

On their way to the custom house, Lammot induced the customs officer to have luncheon with him, and so much time was consumed in jollity, that the captain had an opportunity to get every pound of the precious cargo on board. Lammot found when he reached the custom house that the order to stop the shipment came from Lord Palmerston, the British premier, but none the less when he returned to the ship, he gave instructions to sail on the high tide, at four the next morning. When the time for sailing arrived, a file of redcoats was on the wharf and, despite his strategy, Lammot could not get his shipful of saltpeter out of port.

He at once returned to the United States and went to see Lincoln. Boldly he suggested that the American Government threaten war with England if permission to ship the saltpeter was not given. Secretary Seward gave him the necessary credentials, and he turned about and sailed for England again.

When he called upon Lord Palmerston the premier refused to see him, and four times he called only to receive the same rebuff. The last time he rushed past the attendant, who tried in vain to bar his passage, walked quickly into the premier's private of-



AMERICAN TROOPS GUARDING DU PONT POWDER WORKS ON THE BRANDYWINE, NEAR WILMINGTON, DEL., DURING THE WAR OF 1812.

fice and laid his card upon the desk. Lord Palmerston made the best of the situation, and when the American stated briefly that he must have permission to ship the saltpeter, replied that he would call a conference and inform du Pont of the decision later in the afternoon. When Lammot returned he was told that permission could not be granted, whereupon he gave the prime minister to understand that war was the only alternative, and stated that he would sail for America on the next day.

Later in the evening, just as he was finishing his dinner at Morley's Hotel, Lord Palmerston called

on him in person. The American did not lose his coolness at this distinction, and was not satisfied when the premier said a permit would be granted next day, but demanded one on the spot. The prime minister left his carriage, walked into the hotel and wrote out a permit, at the same time telling him that he "was at liberty to state confidentially to Mr. Lincoln that scarcely for any cause would England at that period go to war with America."

Who can doubt that the intrepid behavior of one member of the powder-making family had no little to do with this fortunate decision?

The purchase of saltpeter in England is the most famous of Lammot du Pont's adventures, but an even more picturesque, although less important, feat was his blockade running of British frigates during the Crimean War. During the siege of Sebastopol the Russian government ran short of powder, and ordered a shipload from the du Ponts. The English government heard of the order and sent frigates to lie off the Chesapeake and prevent shipment. But Lammot, although only twenty-five years old at the time, took charge of the transport, outwitted the frigates and got away without trouble.

Lammot du Pont raised a company of volunteers during the Civil War, but his services to the Union cause were primarily those of one who supplied to the best of his ability the one all-important munition of war.

On the actual field of battle there were no lack of du Ponts. Samuel Francis du Pont and Henry Algernon du Pont were never associated with their kinsfolk in the powder industry, but they served their country with the same steadfast patriotism. Samuel Francis was for nearly fifty years in the naval serv-

ice. More than half of that time he actually spent at sea. He was one of the country's greatest naval commanders, and won many of the most famous of the sea victories of the Civil War. His name is perpetuated in Washington, D.C., where Du Pont Circle was named after him by act of Congress, and by Fort du Pont at Delaware City.

No less distinguished were the services of United States Senator Henry A. du Pont in the other branch of the nation's fighting arm. He fought in many battles of the war, and was promoted and decorated for gallant and meritorious service. Congress gave him a medal of honor for "most distinguished gallantry and voluntary exposure to the enemy's fire at a critical moment" during the battle of Cedar Creek.

Thus the du Ponts worked for the cause they believed the most vital period of their country's career, on sea and land, in the factory and by diplomacy of the highest order.

VIII

HENRY DU PONT

FEW men have seen such tremendous strides in an industry over which they presided as did Henry du Pont, second son of Eleuthere, and president of the company from 1850 to 1889. During the later years of Alfred du Pont's management there had been a rapid development in the building of canals and mines. This required blasting powder, which at first was merely an inferior grade of explosive. But in 1856 the introduction of sodium nitrate so cheapened the process of manufacture that it was possible to introduce blasting powder as it is known to-day.

Then came the Civil War with its enormous demands for explosives. In 1860 General Rodman began his experiments, which altered the whole course of powder-making for the Government. At about the same time the process for making high explosives was discovered and the development has gone on ever since.

Following the Civil War there ensued a period of industrial expansion, such as the building of railroads, tunnels, giant office structures and so on, and for all this growth the proper explosives had to be provided. All this took place during Henry du Pont's presidency.

But Henry du Pont was more than a very successful powder-maker. He fought the battles of his

country as well as those of a business career. Born at the Eleutheran Mills, near Wilmington, Delaware, August 8, 1812, he received his early education at the same school as his elder brother, the Mt. Airy Seminary, Germantown, Pa. In 1829 he was appointed a cadet at the West Point Military Academy, from which he was graduated in 1833. As brevet second-lieutenant of the Fourth United States Artillery he saw service in the Creek Indian territory, but in 1834 he was called to take up the equally serious duties of powder-making.

After the breaking out of the Civil War, Henry du Pont not only supplied the Union armies with powder, but he was an ardent political supporter of President Lincoln and of the Union cause. Although he had been a Whig, he became the leader of the Delaware Republicans and was named by them for presidential elector in 1868, 1876, 1880, 1884, and 1888. He regarded political work as a patriotic duty, and actually filled the humble position of challenger at the polls, as well as inspector of elections, for fully forty years.

Not only were the interests of his state imperiled in the war, but the industry which his ancestors built up and upon which his life work was spent was more imperiled than anything else in the state. Upon the safety and continued operation of that industry depended the success of the Union arms. It has been said that the requirements of the Government for powder during the Civil War were not what they would be in a war of similar magnitude in these days of high explosives and improved guns. But the strain upon the du Pont works was none the less severe. For one thing there was serious lack of skilled labor when the war broke out.

But most important was the necessity of unceasing vigilance. Danger of spies and lawless persons hovering about, had ever to be guarded against. Many disastrous explosions took place, whether because the enemy had secretly reached the mills, or because of the strain put upon the works, no one ever knew.

Early in 1862 there were Confederate raids into Maryland, and it was feared that an attempt might be made to attack the powder works. Just before the battle of Gettysburg, a plan was formed to destroy the mills of the du Ponts nearest to the Confederate lines. But the owners received warning and were prepared to blow up the buildings themselves, rather than allow them to fall into the hands of the enemy. At all times it was felt that the home of the powder industry was uncomfortably close to the seat of warfare.

If the du Ponts had sympathized with the Southern cause, who can say how differently the war might have turned out? But there was never a question concerning the loyalty of the country's powder-makers. For more than twenty years Henry du Pont was in the military service of his state, and this meant more than merely wearing decorative titles. He had been aide-de-camp to Governor Cooper of Delaware in 1841, and from 1846 to 1861 he was adjutant-general of the state. In May, 1861, he was appointed by Governor Burton major-general of the Delaware forces, but he accepted the position only with the stipulation that his control of these forces should be absolute, and not subject to interferences of any kind.

General Henry du Pont's first order required every man in the service to take the oath of allegiance to the United States Government, or to surrender his arms. This meant the immediate elimination of the

element which secretly favored the Confederate cause. His action was interfered with by certain state authorities, but he finally sustained his position by procuring from General Dix, the Federal commander at Baltimore, a force of troops. From that day forth there was no question as to where the state of Delaware stood in the great conflict.

Such are the bare outlines of General Henry du Pont's life. These are his larger achievements in the field of statesmanship and industry. But great as they were, the man himself will be longer remembered for his personality and character. Fifty years after a great event, it is hard to fire the imagination with the narration of broad and general achievements, no matter how noble they may have been. But the little incidents and stories, these are what live. General Henry du Pont's life was filled with just such incidents and characteristics as ensure long and affectionate remembrance in the minds of other men.

To reconstruct as vividly as we can this remarkable personality is justified, not only on the ground of historical narrative but even more because of the interest and value which attach to the story of any strong and distinctive nature.

IX

THE STORY OF DYNAMITE—THE NEW FARM HAND

BEFORE dwelling further upon the lives of those who by their industry and patriotism made possible the production of powder when it was most needed, let us turn for a while from the service of the men to that of the product itself. There will be no one to dispute that the country needed powder in the wars of 1812 and 1898, and if there are some who believe the cause which the du Ponts supported in 1861 was not the right one, they will surely admit that it would have been a fortunate thing for their own lost cause if the powder-makers had sided differently. Nor will there be any one to deny the value to this country of having had a supply of good powder during those long years when bold men painfully and slowly fought their way against hostile tribes of Indians and wild beasts, toward the far West.

But there are men who object to war on any ground. It is the steadfast purpose of this enlightened age to do away with warfare. Peace conferences are being held with increasing regularity. The reduction of armaments is discussed in and out of season. A prize is given yearly to the person who has worked most or best for the fraternization of nations, the abolition or reduction of standing armies, and the calling in and propagating of peace congresses.

Probably there is no greater force which makes

for peace than the invention of high and powerful explosives, for warfare is being rendered so deadly that men realize more and more the necessity of peace. Indeed, the peace prize spoken of above is given yearly from the bequest of Alfred B. Nobel,

SUBSOILING WITH DYNAMITE—LIGHTING THE FUSE.

the Swedish inventor of dynamite and other high explosives, who died in 1896, leaving his fortune of $9,000,000 to the founding of a fund, the interest upon which should yearly be distributed to those who had most contributed to the good of humanity.

Thus the very manufacturers of explosives are working to make war impossible. It cannot be repeated too often that explosives are primarily constructive, rather than destructive. At the present time not more than 10 per cent of the du Pont output

RAILROAD CONSTRUCTION—APPROACH TO A TUNNEL.

WHERE NEW YORK CITY'S WATER SUPPLY WILL COME FROM.

is used for military purposes. By far the greater bulk of all explosives are used for strictly commercial requirements. Attention has already been called to the fact that our railroads, tunnels, mines and great buildings would have been impossible without explosives. There are no greater civilizing forces than dynamite and blasting powder.

Railroads that cross yawning chasms, bore through mountains, and wind around precipitous cliffs, would have never been constructed if the manufacturers of explosives had not kept abreast of every scientific discovery. The Panama and Sault Ste Marie canals, the tunnels under New York City, the coal, iron, silver, gold, tin, lead and copper mines, the quarrying of stone for purposes of fluxing minerals, making cement, paving streets and building houses would have all been either impossible, or incapable of any but the slowest and most painful accomplishments, without the use of explosives. Such are some of the achievements which may be traced in no small degree to the high standards and efficiency of the du Ponts.

To appreciate just what has been done for this country by the use of explosives, and how they may be made still more useful as time goes on, we must have a clearer idea as to just what an explosive is. The well-known composition of ordinary gunpowder has been referred to, and various steps in the advancing science of manufacturing other explosives have been related. The theory of explosives is simple enough, and if it is borne in mind, much in their use which would otherwise be difficult to explain is easy to understand.

Explosives are solids or liquids which can be changed almost instantaneously by a spark, great heat, or powerful shock into gases having many hun-

AN OBJECT LESSON IN SUBSOILING.

(Note. The corn to the left was grown on ground that had been subsoiled with dynamite.)

dred times the volume of the explosive in its original form. Coal and wood are changed into a large volume of gas (steam) by burning, but the process is slow; and water is changed into a large volume of gas (steam) by heating, but also slowly. Explosives differ from these other substances by the rapidity of the change.

When a small volume of explosive suddenly expands into a very large volume of gas, this gas exerts a strong pushing force in every direction because it requires a much larger space than the explosive which produced it. If the explosive is confined within a narrow space, just large enough to hold it, that is, if it is closely confined before it is exploded, the gas in escaping to the open forces out and carries along with it the material which shuts it in. The efficiency of an explosive depends chiefly upon the proper putting together of a few comparatively simple ingredients, and success in their manufacture depends primarily upon an eager, systematic, and continual search for new and better ways of doing the work.

From this simple explanation of the theory of explosives two deductions may easily be drawn. If the object is to remove material, it may readily be seen that the uses of explosives must constantly expand as science and engineering find more materials to deal with. At one time no man would have been bold enough to imagine that he could bore through a mountain five to ten miles long. In just the same way men may do things to Mother Earth in years to come which no one dreams of to-day. In the second place it follows that chemistry would continue to devise new and improved explosives, and this is just what is taking place. The object being to re-

move material at reduced cost, the constant tendency of the explosive industry is toward providing a material which will perform the work at a less cost than the method which it supersedes.

BLASTING A STUMP—"A TOUGH CUSTOMER EASILY REMOVED."

There is a Greek word "dynamis" which means "power." Thus dynamite aptly derives its name. It has been explained that dynamite is made from nitro-glycerin, a very high and dangerous explosive, together with wood pulp, earth or other ingredients, the resulting admixture greatly reducing the danger but not the power of the compound as compared with pure nitro-glycerin.

There is a popular misconception of dynamite in the public mind. Newspapers in reporting outrages such as bomb throwing by anarchists, demented persons, and blackmailers, safe cracking by burglars, and

other intentional efforts to destroy life or property by the use of high explosives, incorrectly report them as perpetrated with dynamite. There is also a tendency in the press to call every high explosive by the

A FIELD OF STUMPS PROPERLY TREATED.

name dynamite. As a matter of fact, safe breakers and bomb throwers very rarely use dynamite cartridges; their tool or weapon is pure nitro-glycerin. Dynamite would not do for this sort of work, as it is too difficult to explode. The confusion of the two substances in the public mind gives dynamite a bad name which it does not deserve.

It is said that nearly half a million persons use dynamite every day. These include miners, blasters employed on road and railroad construction, quarrymen, farmers, and many others. A record of all ac-

cidents to all users of dynamite in the year 1910 shows casualties of less than one-eighth of one per cent, and most of these are known to have been caused by failure to observe a few simple precautions.

THE SAME FIELD EIGHT MONTHS LATER (NOTE THE SPLENDID CROP OF CELERY).

Of course, dynamite should be used with great care and by responsible persons only, but such persons can use and handle it with surely as much safety as they handle gasoline, coal oil or matches. A few rules as to its use having once been mastered, dynamite can be put to work almost as safely as steam. The reason so many people fear dynamite is because it is something they do not understand, they are not accustomed to handling or using it, and they know its highly concentrated power.

Those who have not read Robert Louis Stevenson's fantastic tale, "The Dynamiter," will do well

to amuse themselves with it. Time and again the leader of a desperate band of anarchists, one Zero by name, attempts to blow up London by planting dynamite cartridges, but the explosions do not take place owing to various defects in the arrangements. Finally, one cartridge does go off, but not until the author has provoked much mirth over the many fiascos.

The story is true to life in that the explosiveness of dynamite depends altogether upon having properly made detonators. It is the detonator that is sensitive and sets off the main explosive. Dynamite is not so sensitive to shock that it is likely to explode from a jar or even from dropping it a considerable distance. It must have a hard, sharp shock, and this the little detonator gives it. These detonators do require careful handling, and must be kept away from the explosive until the blast is to be set off.

Blasting explosives are divided into two classes: "Low Explosives," or blasting powders, which are exploded by a spark, and "High Explosives," including dynamites, which are set off by a hard, sharp shock. Blasting powder is used for many kinds of coal mining, quarry and general excavating, but is not generally applicable to any blasting about the farm or many other important purposes. It is used in such vast quantities, however, in mining operations that in 1909 there were produced in the United States 9,339,087 kegs of 25 pounds each, a quantity far in excess of any other class of explosive.

Nothing will so clearly disclose the advance in the manufacture and use of explosives, and especially of dynamite, as the figures of the Census Bureau. From 1904 to 1909 the quantity of dynamite produced in this country increased 35 per cent, or from 130,920,-

BLASTING A DITCH—DRILLING AND LOADING THE HOLES.

829 pounds in 1904 to 177,155,851 pounds in 1909. A graphic idea of the increase in the use of explosives for commercial purposes during the last twenty years may be gathered from the census figures.

PRODUCTION OF EXPLOSIVES IN 1904 AND 1909

Explosives	1904 Pounds	1909 Pounds
Dynamite	130,920,829	177,155,851
Nitro-glycerin	7,935,936	28,913,253
Blasting powder	8,217,448 [1]	9,339,087 [1]
Gunpowder	10,383,944	12,862,700
Permissible explosives	.....	9,607,448
Other explosives	6,303,825	7,464,825

PRODUCTION OF DYNAMITE IN 1909, 1904, 1900, AND 1890

	Pounds
1909	177,155,851
1904	138,920,829
1900	85,846,456
1890	30,626,738

The newest, most picturesque, and one of the most promising uses of dynamite is on the farm. The little cartridges have won for themselves the name of "The New Farm Hand," and they have been declared by some as of greater value than irrigation. So fast is their use growing in lessening the labor of farm work that in a single six months' time the du Pont Company received inquiries from thirty thousand farmers in regard to the use of dynamite.

Explosives have long been used in blasting out stumps, but it is not so generally well known that an

[1] Number of kegs of 25 pounds each.

entire tree can be felled in the same way. The blast lifts the tree straight up a foot or so; then it falls, generally with the wind. When stumps are blasted out, whole or nearly so, it is often necessary to split them up. This can readily be done by putting dynamite into auger holes. It is even possible by using blasting powder to split a log up as smoothly and evenly as if saws or wedges were used, and this method is, of course, much easier and quicker than any other.

When properly used dynamite will excavate ditches, cleaning them out to grade, giving the sides the correct slope and spreading the earth excavated over the land some distance away. In the same manner much valuable land can be saved by blasting channels to straighten and shorten the course of creeks and streams. It is not necessary in this work to blast a large ditch or channel, for if the current is once started through a small one it will soon wash it out to the proper size. In a fraction of a second it is possible to excavate a ditch 1,000 feet long, 6 feet deep, and 12 feet wide without having to re-shovel any dirt.

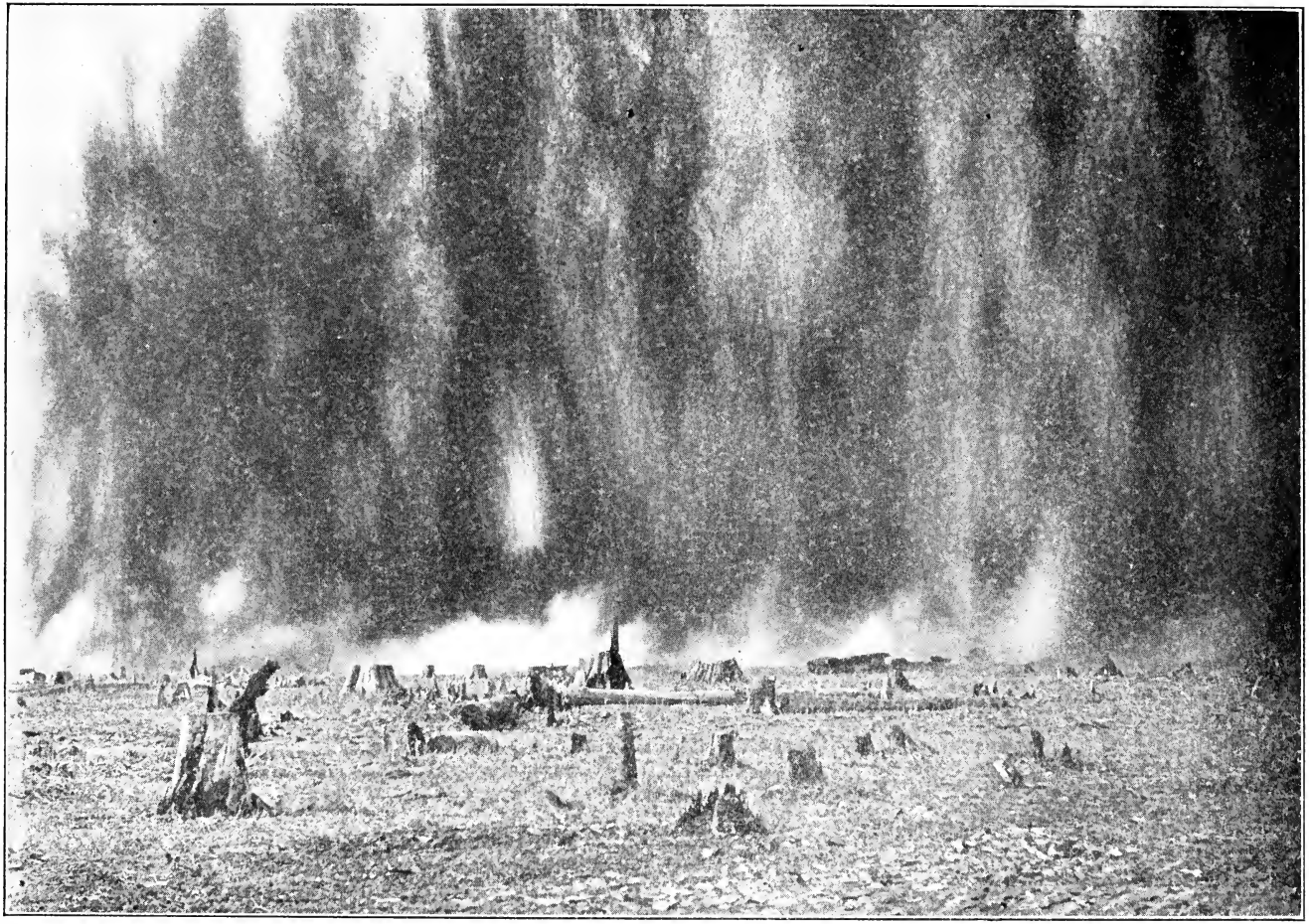
Blasting a ditch is a very simple matter and the result is a nice, clean ditch of the required depth and width, the earth being spread evenly over the ground, along the banks; turning in the water clears away what little of the dirt may have fallen back into the trench after the blast.

The cost of ditching with dynamite averages from 9 to 11 cents per cubic yard, compared with an average cost of 25 cents per yard when the work is done with pick and shovel. Swamps and ponds, except where they are close to rivers, lakes, or the ocean, are caused by spring or surface water collecting on low

ground without a lower outlet and which is so underlaid by clay or other subsoil that the water cannot sink through. When it is not practicable to drain such places by ditching, they often can be permanently dried up by shattering the impervious subsoil in the lowest places by dynamite, thus affording natural drainage outlets.

There are about seventy-seven million acres of land in this country which are now of no use because they are too swampy. This equals about one-sixth the entire cultivated area of the country. It is estimated that by drainage the value of this land can be increased about three billion dollars above the cost of drainage. These swamp lands are exceedingly rich in humus and valuable plant foods, and when drained and prepared for cultivation they will produce larger crops than any other existing soils. Farmers have been using dynamite for draining swamps and wet fields for many years, and much valuable farm land has already been reclaimed and made available for cropping by so doing. The cost of the work, including the price of the explosives used, is very small compared with the value of the land reclaimed.

In most parts of this country the surface soil is not thick enough to supply vegetation with sufficient moisture and plant food to insure the maximum growth and production. The subsoil is too compact and hard for plant roots to penetrate, and consequently greatly hinders the successful growing of crops. Many plans have been tried to overcome this hardness, among them being draining, irrigating and breaking the subsoil with specially designed plows, but none of these methods have proved satisfactory, and it is generally conceded now that the only way



BLASTING A DITCH—THE BLAST.

thoroughly and economically to increase the thickness of the surface soil is to pulverize the subsoil with dynamite.

"Plant food is dissolved in water," writes W. T.

BLASTING A DITCH—AFTER THE BLAST.

Spillman, agriculturist in charge of Farm Management Investigations, Bureau of Plant Industries, U. S. Department of Agriculture. "While a plant is growing, a constant stream of water flows up through it and evaporates at its leaves. For every pound of increase in dry matter made by the plant, from 300 to 500 pounds of water flow up through it.

"Plants in their growth make use of thirteen elements, nine of which they secure directly from the soil. These are called mineral plant foods. They are phosphorus, potassium, calcium, magnesium, sodium, iron silica, chlorin, and sulphur. Soil con-

sists mainly of small particles of rock. Nearly all kinds contain more or less of these mineral plant foods. Every year the soil water dissolves off a thin surface layer from each particle, and plants appro-

BLASTING A DITCH—AFTER THE WATER HAS BEEN LET IN.

priate this water, thus securing their mineral plant food. Hydrogen, another important element of plant food, is also secured from water.

"In order to produce a ton of hay on an acre of land it is necessary that the growing grass pump up from that ground approximately 500 tons of water. In order to supply this enormous quantity of water, the soil must not only be in a condition to absorb and hold water well, but must be porous enough to permit water to flow freely through it.

"In addition to acting as a water carrier for plant life, soil must permit a proper circulation of air

through it. Nearly half of the volume of ordinary soils is occupied by air spaces. Soil which becomes so compact as to stop the air passages is too wet for most crops and needs drainage, for plant roots must be supplied with air and the soil must be porous enough to permit of its free circulation. One of the most important objects of plowing is to loosen up the soil and mix fresh air with it."

It is not necessary, therefore, that the root of a plant shall come in actual contact with all of the plant food elements of the soil needed for the sustenance of the plant or tree. Plant roots have the power to draw from the surrounding soil the necessary elements of plant food, provided the soil is of such a character as to permit the passage of these elements through it.

Water or moisture is the carrier of these plant food elements through the soil and into the plant roots. This clearly indicates the importance of a porous soil which will permit the free passage of water through it, in order that plants growing upon the surface may be properly nurtured for rapid and healthy growth. It is because the action of an explosive on soil causes it to become thoroughly loosened and aerated that trees planted in blasted holes show so much stronger and healthier growth than trees planted under old conditions.

Dynamite can also be used to great advantage in the cultivation of fruit trees. It is valuable when planting trees because the explosion of a whole or half cartridge of dynamite will excavate the hole for the tree instantly, and will loosen the soil for many yards around, so that the tree roots have a much better opportunity to spread out than they do when the hole is dug with a spade or similar tool. Occasion-

APPLE TREE—TWO YEARS AND FOUR MONTHS OLD—PLANTED WITH A SPADE.

ally during the life of the trees, small charges of dynamite should be exploded midway between them and some three or four feet below the surface of the ground. This tends to keep the soil open so that it will hold moisture and the tree roots can easily spread, and also helps to keep the ground free from grubs. When older trees begin to fail it is of much benefit to detonate charges eight to ten feet away from them.

Some time ago it was the prevailing idea that dynamite was unnecessary for tree planting unless the soil chanced to be underlaid with hardpan, in which case the explosive was regarded as valuable for breaking through the hard soil. It has been found by experiment, however, that trees thrive better when planted in blasted holes than in hand-dug holes, even when no hardpan is encountered.

The explanation of this is simple. It is because the explosion of the dynamite loosens up the soil for yards around the spot, kills all grubs, worms or other animal life likely to injure the young tree and thus makes root growth easy; whereas digging the hole with tools tends to pack the earth around the roots and retard their growth.

Few persons realize the depth of tree root expansion. In one of the "Farmers' Bulletins," issued by the United States Department of Agriculture, is shown a view of a cross section of orchard land, indicating that a tree has sent its roots downward 21 feet into the soil. This is natural growth. Under normal conditions a healthy tree will seek its food in this way, but suppose a layer of hardpan is encountered at a depth of five or six feet? The roots must then spread out laterally for twenty feet or more. The result of this unnatural sidewise growth is that

APPLE TREE—TWO YEARS AND FOUR MONTHS OLD—PLANTED WITH DYNAMITE.

each tree in the orchard is compelled to go over into the feeding supply of its neighbor, and consequently does not receive the necessary amount of plant food properly to nurture it and allow of its rapid growth. Its yield of fruit is also lessened by this forced encroaching of one tree on the feeding ground of its neighbor. Then, too, a brief dry spell exhausts all the moisture from the thin feeding ground of such a tree, stopping its growth or killing it.

Dynamite blasting proves a simple and effective remedy for this condition. The blast breaks up the hardpan and permits the roots to take their natural downward course into the lower strata of soil in which plenty of plant food elements are available. Under these conditions, one tree is not interfered with by another; each one receives the benefit of all of the soil allotted to it at the time the surface was measured and laid out at planting time.

It must not be assumed from the above that dynamite blasting is beneficial only when the top soil is underlaid with hardpan. It is of the utmost importance to assist a tree, especially a young one, to send its roots out into its feeding bed as easily and rapidly as possible. The more porous and loose the soil, the more rapid will be the growth. Even in the loamy soils of Oregon, generally admitted to be the most perfect for fruit tree culture found in the United States, blasting has proven extremely beneficial in forwarding the growth of young fruit trees.

Other uses to which explosives can be put besides those already enumerated in these articles are the digging of holes for posts and poles by merely boring a few holes with an auger and using a small quantity of dynamite, sinking wells, breaking up frozen ore piles and frozen material in railroad cars, opening

log jams and ice gorges, destroying wrecks and razing buildings.

No doubt as time goes on still other uses will be found for that greatest of all workers, dynamite. Its

OLD ADVERTISEMENT OF E. I. DU PONT DE NEMOURS POWDER COMPANY.

very name means power, and in this age of wonderful machinery no machine has yet been found that does as much work as this powerful benefactor of mankind.

The du Pont Company has ever been the pioneer in the field of explosives, both in research and inven-

tion. It was the first to inaugurate a national campaign of advertising and demonstration to develop farming with dynamite. The fact that this is a very recent development, comparatively speaking, that it is in reality a new phase of agriculture, only goes to prove that now, just as it was a hundred years ago, the E. I. du Pont de Nemours Powder Company is first in its field.

X

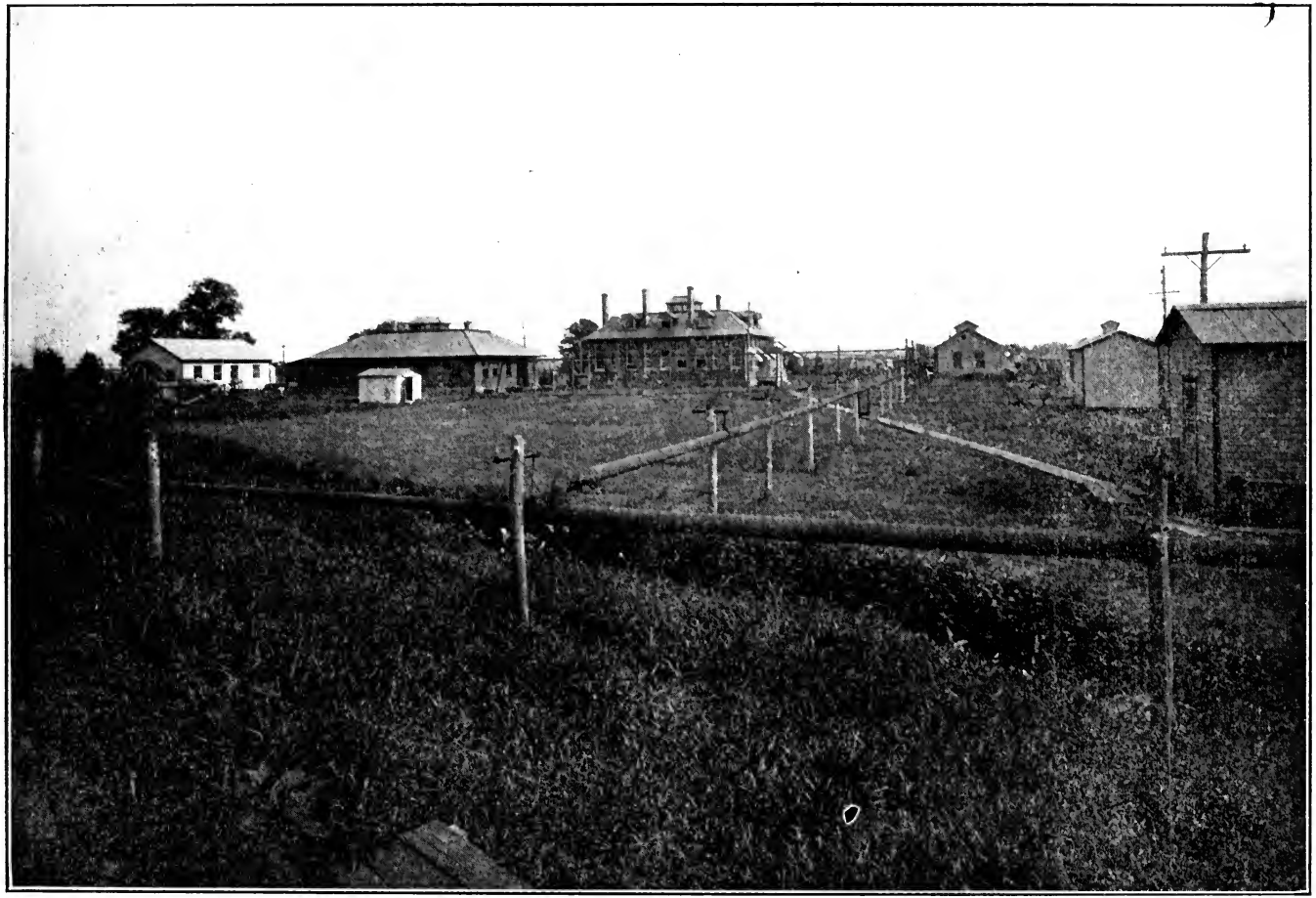
THE REPAUNO WORKS

THERE are few industrial concerns of greater size or more extensive organization than the E. I. du Pont de Nemours Powder Company. Many of its departments are larger than numerous entire business enterprises. But however great this industry has grown and however greater it may grow in the future, practically all of its activities are based upon the initiative of the du Ponts of earlier and simpler days.

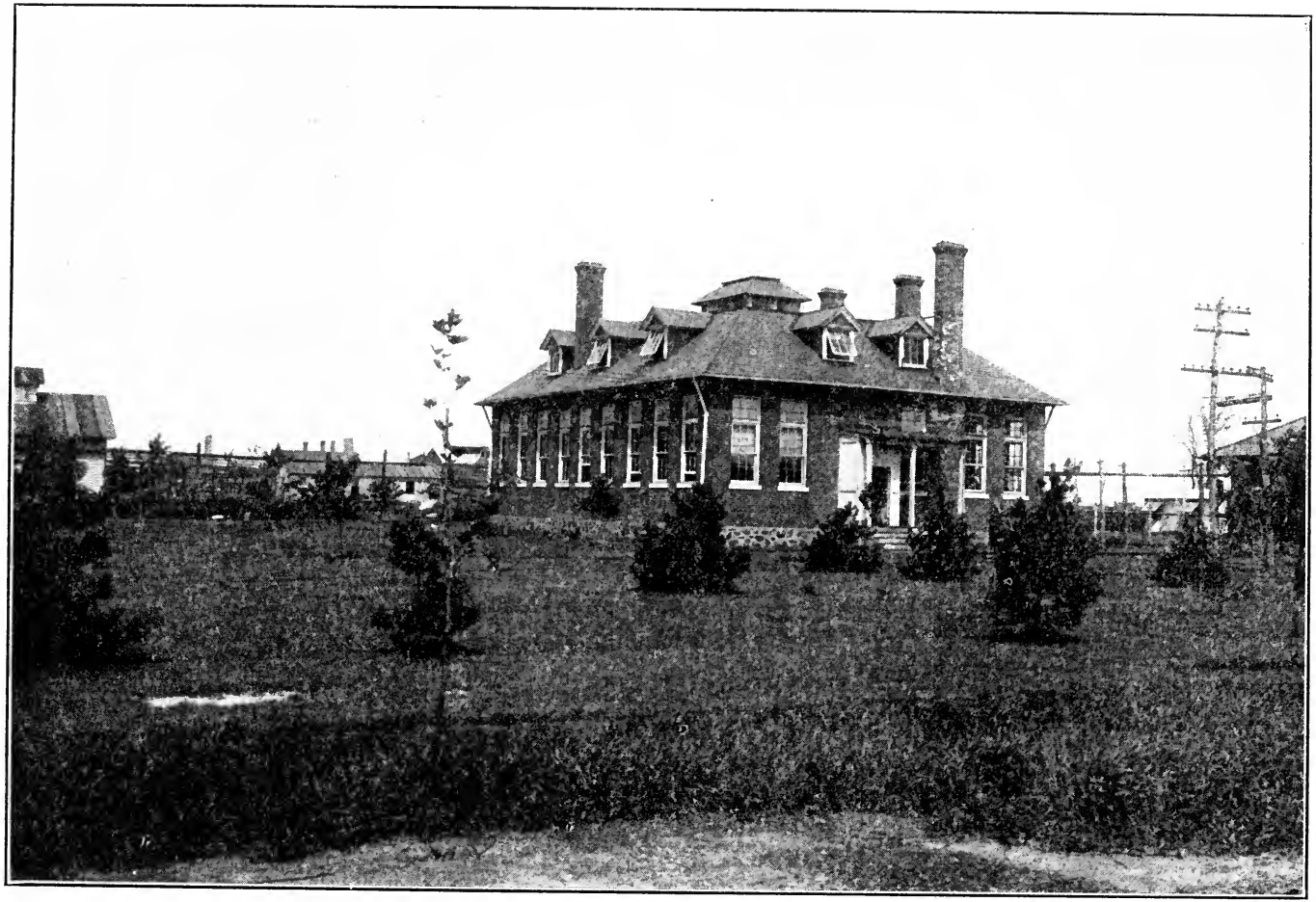
Travelers who journey up or down the Delaware River have noticed on the New Jersey shore a few miles above Chester, Pa., a manufacturing plant stretching along the banks for some distance. The place is teeming with activity. While a few of the buildings are of brick and of considerable size, most of them are small wooden structures scattered over a wide area.

This is the largest dynamite plant in the world. There are four hundred separate buildings scattered over 1640 acres of land.

The Ardeer Works of the Nobels Explosive Company, Ltd., of Glasgow covers a greater area and employs more workmen, but in the production of dynamite its output is only one-third that of the Repauno Plant, which one year ago produced over 50,000,000 pounds.



EASTERN LABORATORY, REPAUNO WORKS.



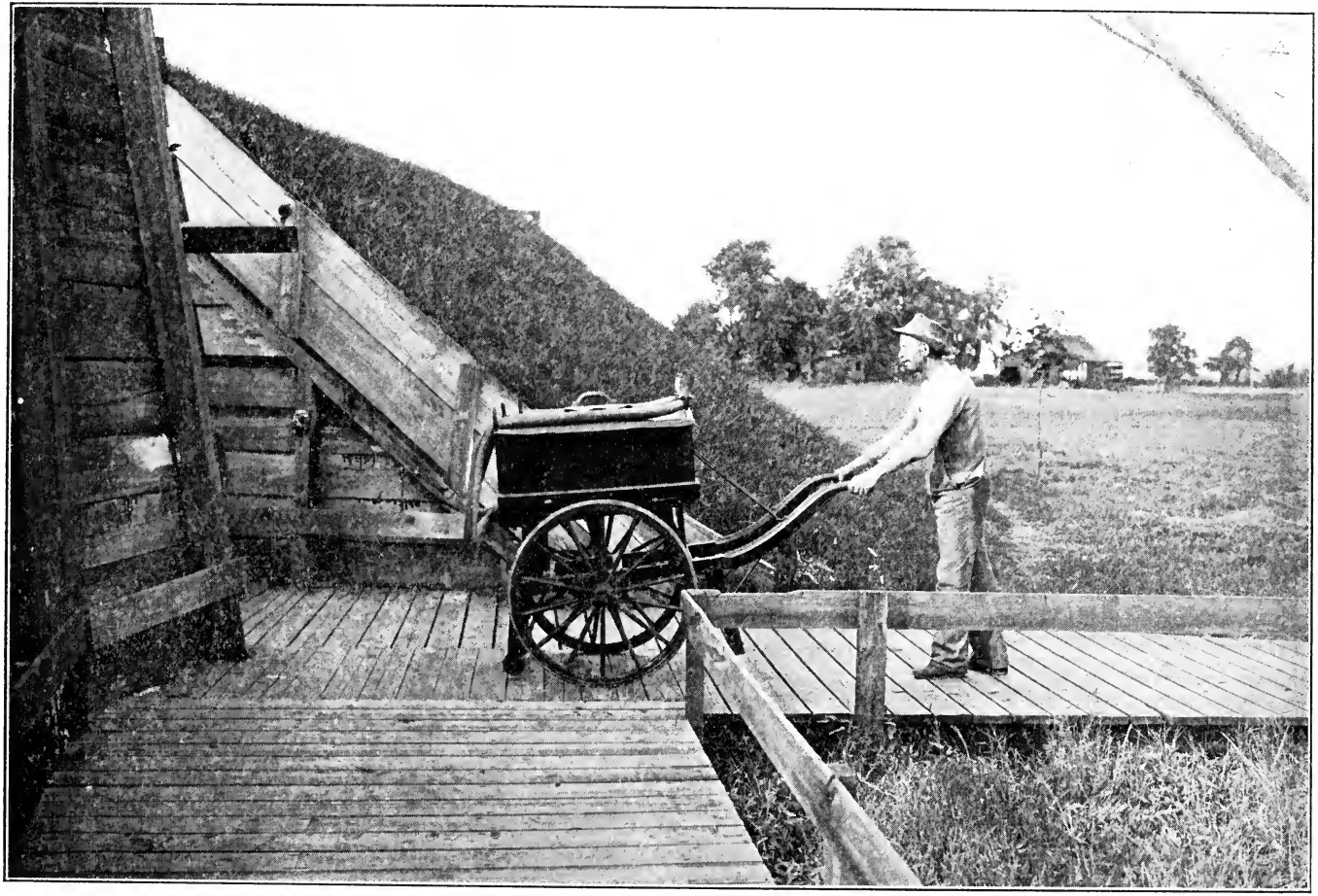
MAIN BUILDING, EASTERN LABORATORY.

Great as is this dynamite plant, it must ever be associated with the small undertaking fathered by Lammot du Pont in 1880. Not only did this patriot have foresight enough to realize the important future which dynamite would have, but many of his mechanical contrivances are used to this day. Upon the sound beginning for which this grandson of the founder of the business was responsible rests the greatest dynamite plant in the world. The original plant consisted of a single nitrator for the manufacture of nitro-glycerin, a separator, mixing and packing houses, magazines, storage warehouses and a power plant.

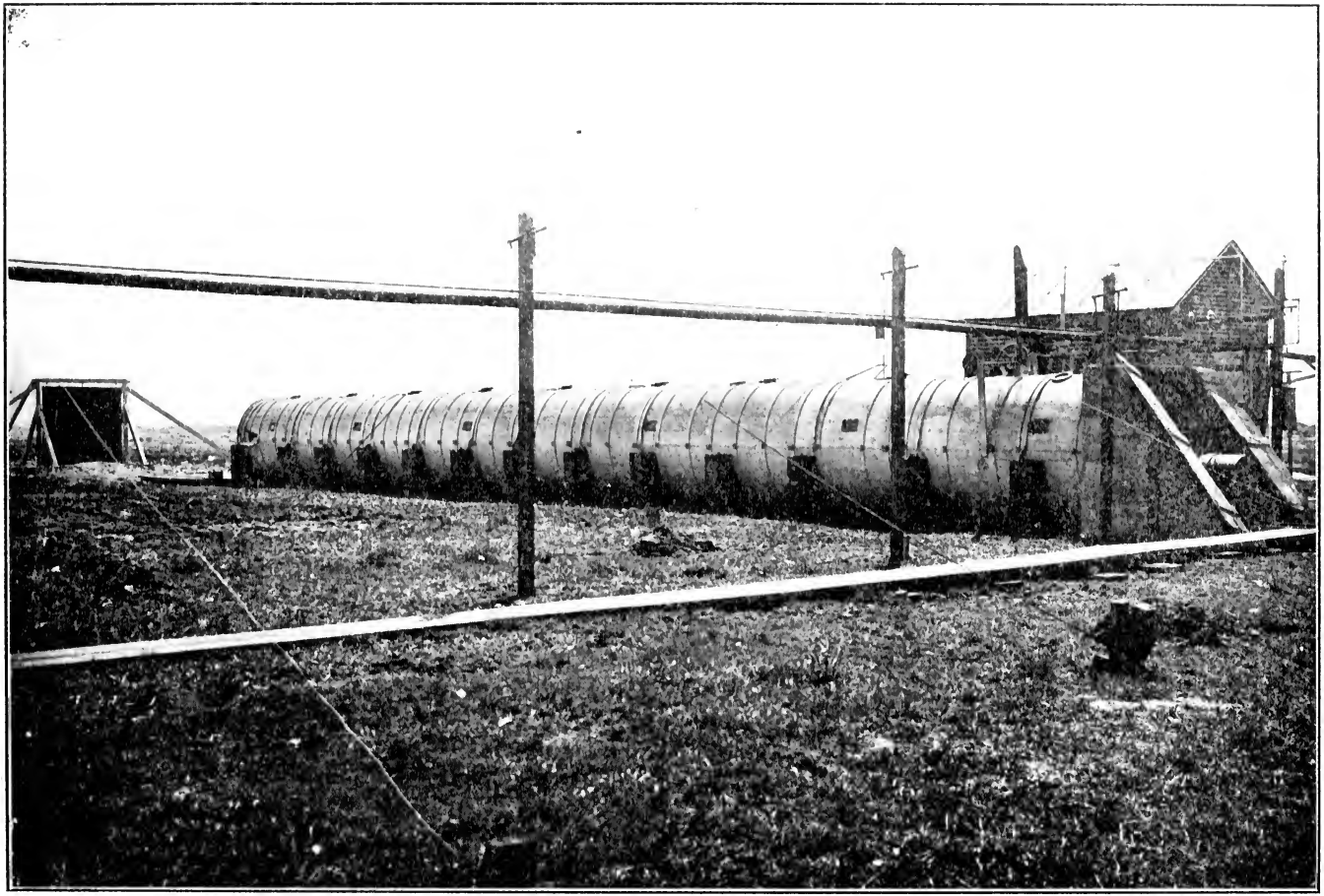
As the business expanded, other buildings were erected. One group was devoted to the making of nitric and sulphuric acids, which are employed in the production of nitro-glycerin. A glycerin refinery was added, two more nitrators were put in, and at length the plant assumed its present proportions.

The Repauno Works had been in operation about two years when complaint was made by the state authorities that the waste acids were polluting the waters of the Delaware. Thereupon Mr. du Pont set about devising a process for recovering the spent acids and restoring them to their original strength. He was engaged upon this problem when he was killed by an explosion in 1884. The task was taken up by others who finally solved it.

The layout of the Repauno plant is such that the buildings in which nitro-glycerin and dynamite are made are isolated from those devoted to other purposes. Hence when the visitor arrives he sees no indications of the dangerous character of the industry. In the distance, to the left, is located the Eastern Laboratory, a group of one-story structures



SHOWING HIGH EARTHEN BARRIER AND CART CARRYING NITRO-GLYCERIN.



TESTING GALLERY, EASTERN LABORATORY.

SPECIAL EXPERIMENTAL BUILDING.

devoted to experimental and testing work, which together with the Company's other experimental stations deserve an article by themselves.

To the right stretches a group of buildings such as might be observed in any large manufacturing plant. They include the power station, the glycerin refining station works, the storehouses, the acid works, the machine and carpenter shops, the administration building and other structures of a similar character.

From appearances no one would suspect that the work carried on was of an unusual character. Once in a while the visitor hears a sound like the discharge of a cannon from the direction of the testing gallery, as if a salute were being fired, but that is all. The men whistle at their tasks and there is no sign of strain on their faces. There is no outward evidence that the place is not as safe as any other business establishment.

And yet not more than ten minutes' walk from this spot is located a nitro-glycerin plant where the most powerful of modern explosives is produced in large quantities. The nitrating house, however, is shut in by high earthen barriers as shown in the accompanying illustrations, so that in case the charge in the tank suddenly "lets go" the other buildings in the vicinity will not be destroyed.

Much of the work outside the Danger Zone is interesting, especially the acid-mixing works and the glycerin-refining works. The Repauno plant makes every detail of its product, and the making of the proper acids and the refining of glycerin are of the highest importance. Near the glycerin refinery is a field of many thousands of steel drums containing

C. LINE REPAUNO WORKS.

crude glycerin as it comes to the plant. Glycerin in this state is almost black. It is about as heavy as warm cylinder oil and is a by-product of the soap industry, being a constituent of both animal and vegetable fats.

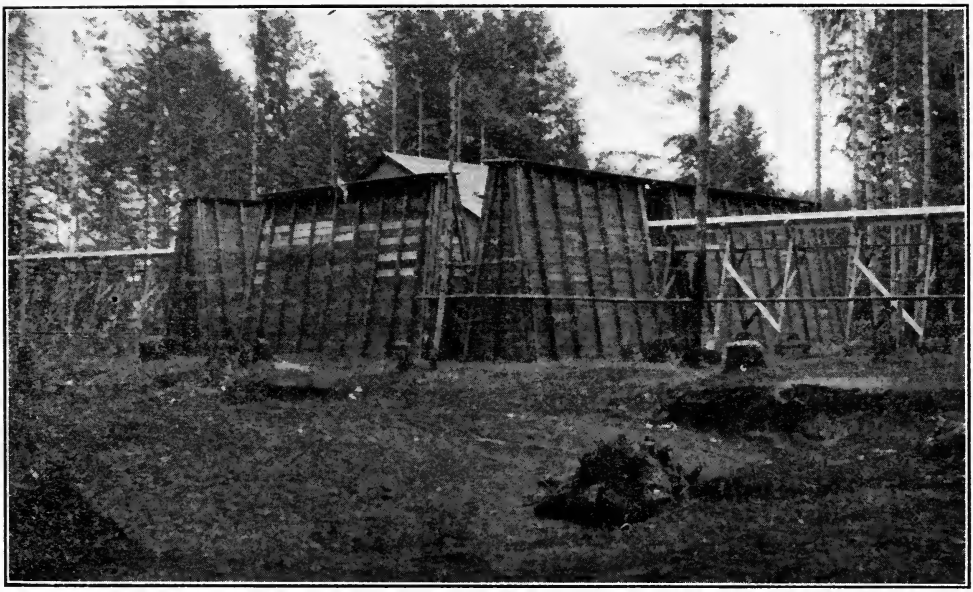
Before entering the Danger Zone the visitor must exchange his shoes for rubber-soled tennis slippers to prevent any possible friction from the steel nails. A spark near nitro-glycerin is the one thing least relished in a dynamite plant.

The nitrating tank in which the mixed sulphuric and nitric acids and glycerin are brought together to make nitro-glycerin is located in a small wooden building. A flight of steps leads to the single room where the work is carried on. The place is as clean as a new pin. Rubber mats cover the floor, and every piece of exposed metal is as bright as elbow grease can make it. On one wall hangs a blackboard on which is kept a record of each charge made. Two men, the foreman and his assistant, are the only persons regularly allowed in the building.

The mixture is worked in batches of about 2500 pounds. The foreman stands watching a thermometer which records the temperature of the bubbling, seething mass in the covered nitrating tank. When the glycerin, which flows into the tank in a small stream, comes in contact with the acids, heat is developed. If the temperature of the mixture rises above a certain degree, red fumes are given off, and unless it is quickly reduced by artificial means an explosion takes place.

In order to keep down the temperature, a shaft to which paddles are attached is kept revolving in the tank thoroughly to agitate the mixture. In England and on the continent compressed air is forced into

the mass from the bottom for the same purpose. In addition a refrigerating mixture is constantly being pumped through coils of lead pipe that line the



SEPARATING HOUSE.

inside of the tank. Should the agitator for any reason fail to work, or the flow of brine through the pipes cease, even for a few minutes, the nitro-glycerin would explode, killing the workmen and wrecking the plant.

One day the engineer in charge of the California Powder Works carelessly allowed the fire under the boiler to get so low that the steam pressure was not sufficient to keep the agitator going and it stopped before the nitrating process was completed. Immediately the mixture began to smoke, that is, give off red acid fumes. The workmen, knowing that the

mass would soon explode and being unable on the moment to think of any way to prevent it, ran from the building.

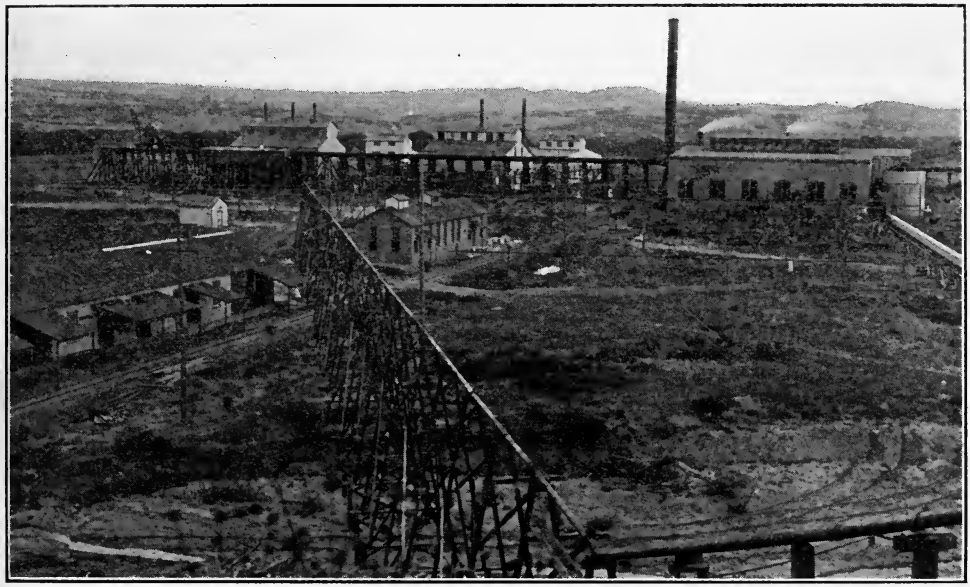
On their way to safety they met William Willson, the superintendent, to whom they explained the situation. Without a moment's hesitation Mr. Willson, ignoring the peril he was incurring, hurried to the building they had just left. By this time the room in which the nitrator was located was so filled with the acid smoke that he could scarcely breathe, but he did not flinch. His one idea was to prevent an explosion at any cost to himself. He remembered that the hand wheel that used to turn the agitator before steam power was introduced was still in place. His only chance was to reach it and turn it with every ounce of physical force he could muster. Perhaps he was already too late and the nitro-glycerin death would get him.

Nevertheless he stumbled through the blinding, suffocating smoke until he felt the handle in his hand. Then he turned the wheel with frenzied speed. He realized that unless he could lower the temperature of the contents of the tank within the next few minutes his career as a dynamite-maker would end there and then. And so for nearly an hour his arm worked back and forth like the piston rod of an engine until the acid fumes gradually disappeared, the temperature was reduced and the process of nitration was completed. Then utterly exhausted by his efforts Willson sank to the floor.

Fortunately such incidents are of rare occurrence. But the composure and nerve of the foreman as he stands by the tank are admirable. Outwardly he is as calm as a man boiling harmless fats, and yet he knows that if the fumes once appear he may meet

the death of several other men who have been blown to pieces on the same spot.

When nitro-glycerin was first manufactured in this country at the old Giant Powder Works in San Francisco, it required one hour and thirty minutes to com-



POWER HOUSE AND ACID PLANT, LOUVIERS, COLORADO.

plete the process of nitration. To-day, because of the many improvements introduced during the last decade, forty-two minutes are sufficient. With three nitrators at work the Repauno plant has produced as high as 80,000 pounds of nitro-glycerin in a single day. This means that each nitrator turned out from ten to twelve charges of from 2500 to 2800 pounds.

A long, narrow, elevated bridge, along one side of which runs a covered lead trough, connects the nitrating house with the separator, or nitro-glycerin building, an eighth of a mile distant. When the process

of nitration is completed, the nitro-glycerin, which is lighter than the mixed acids, is drawn off into a trough through which it runs to the separator. Here alkalis and water are mixed with it to remove any traces of acid which may yet remain. Then the pure nitro-glycerin is placed in lead storage tanks ready for use.

This separator building is considered the most dangerous on the grounds, because here the liquid stands and acid nitro-glycerin rises to the surface. While in this state the liquid is subject to spontaneous explosion, and explosions in this building are more disastrous than those occurring in the nitrating building because it frequently contains 10,000 pounds of nitro-glycerin whereas in the nitrating tank there is never more than 2800 pounds of the substance.

Michael Connolly, who has worked at Repauno for twenty-five years, and is now a foreman, is one of the few men who has had the nerve and good fortune to face an explosion in the separator building and escape with his life. A number of years ago while at work drawing a charge, the mass suddenly began to smoke. Connolly did not run but had the good sense to turn on the compressed air and let it flow through the smoking mixture in the tank. Inside of ten minutes the danger point was passed, but when Connolly was later asked how he felt he replied laconically, "As weak as a rag."

As one stands looking into the separating tank a man enters the room from the opposite side pushing a queer rubber-tired cart. Mounted on springs between the wheels is a square enclosed box in which nitro-glycerin is carried to a dynamite-mixing house several hundred feet away. The smooth, elevated board walk connecting these two buildings is the

DELAWARE, LACKAWANNA & WESTERN CUT-OFF.

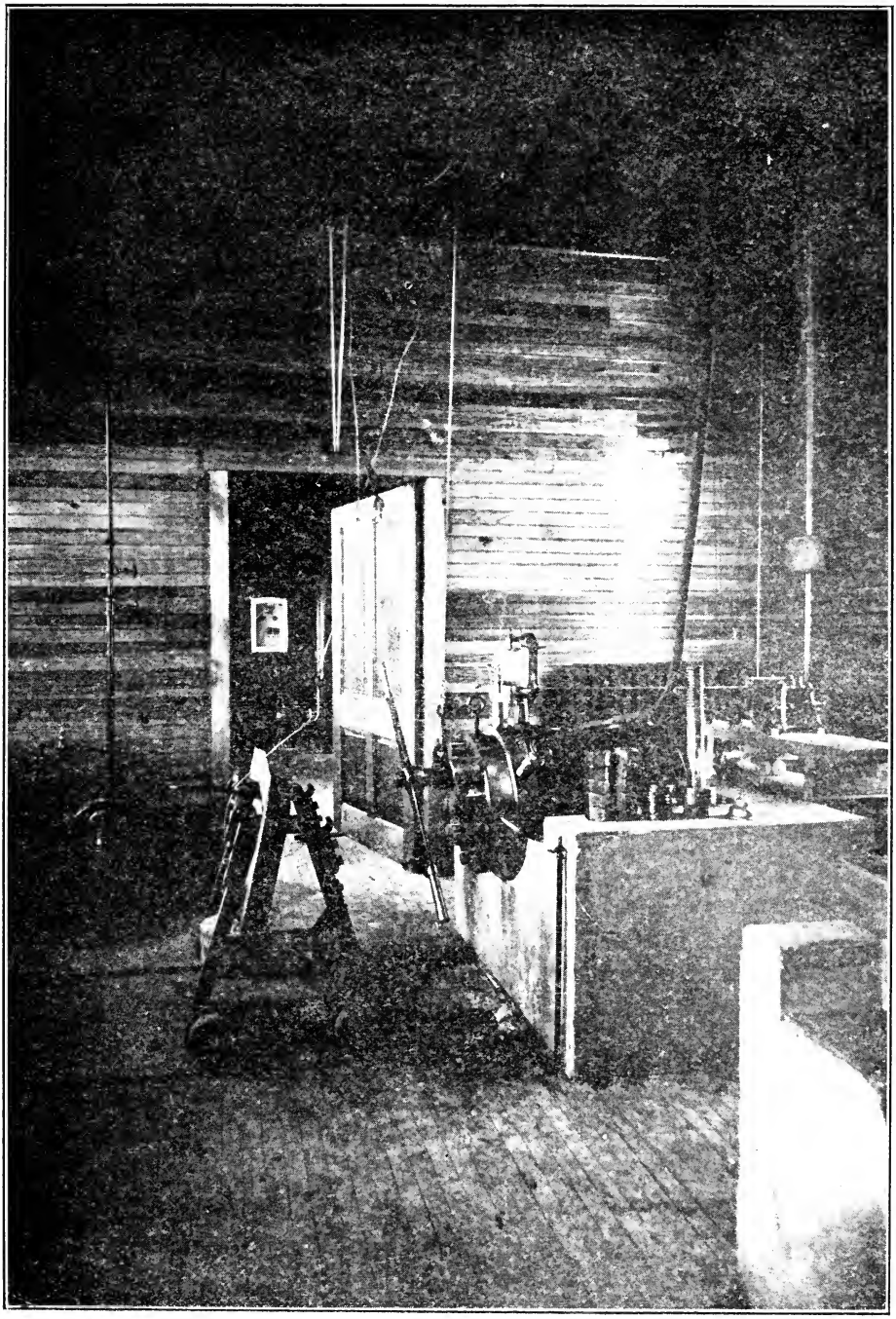
pathway which this man travels many times daily. His cart holds about 250 pounds of liquid lightning. He walks with a slow shuffling gait, keeps his eyes fixed on the cart every moment and does not risk his life by stubbing his toe.

In both the nitrating and separating houses any drop of nitro-glycerin that falls to the floor is at once washed away with alcohol and water and soda. Plain water is useless for this purpose because it does not dissolve the explosive. Every drop of the liquid must be removed, for even the most minute particles can be exploded. A small spark is as dangerous as a big one among 10,000 pounds of nitro-glycerin.

The visitor arrives at the dynamite-mixing house at about the same time as the man with his cart whose dangerous load is carefully drained, through rubber hose which was a part of the cart equipment, into a pug mill where it is mixed with other ingredients already prepared. A pug mill consists of a large wooden tub about ten feet in diameter in which are set two large, hard-rubber-faced wheels about eight feet in diameter and a foot thick. These wheels, in a double rolling, circling movement on the inside of the tub, thoroughly mix the nitro-glycerin and the dynamite dope, consisting as before stated principally of wood pulp.

A few other ingredients are included to produce a balanced formula which gives a minimum explosive effect without the production of objectionable gases or smoke. In appearance this mixed dynamite looks much like brown sugar as it is removed by wooden shovels from the pug mill to wooden boxes which are loaded on the common low flat cars and wheeled to the loading houses.

The dynamite-loading houses are very interesting.



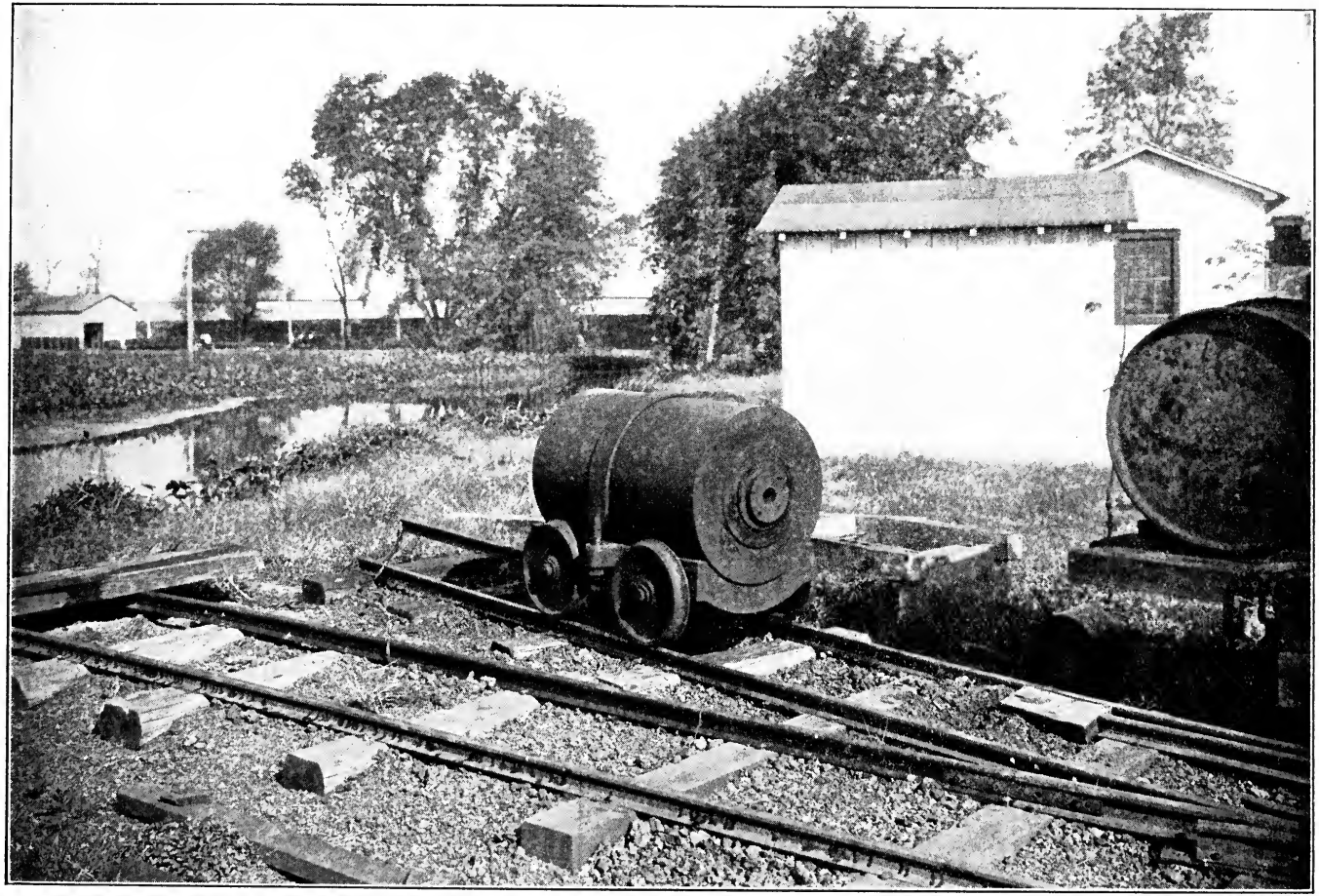
DRUCKMESSER (PRESSER GAUGE), REPAUNO WORKS.

The machinery is operated by two attendants and run by pneumatic power. The center of the loading machine is made of a square revolving container, each side of which carries about two dozen shells. When the dynamite is shoveled into one end of this machine the operator at the other end turns a small lever which looks like an air-brake handle on a street car.

At each turn of this power lever the machine makes a quarter revolution and the dynamite falls into the open ends of the cartridges, where it is pressed firmly into place by a series of wooden plungers. Another turn of the machine brings a new set of shells into position and at the same time dumps the loaded cartridges into a trough from which the operator transfers them to larger boxes, in which they are transported to isolated packing houses to be prepared for shipment. Of the seven machines constantly in use at Repauno one has loaded 32,000,000 pounds of the explosive without an accident.

Under the rules of the Interstate Commerce Commission manufacturers and railroad employés must exercise great care in loading cars with explosives. The boxes must lie flat on the floor; machinery or other articles made of metal must not be piled on top of them; and detonating caps, fuses, or fireworks cannot be carried in the same car with them. While dynamite must be handled with care and respect, under ordinary circumstances it can be hauled from one end of the country to the other with as little danger as sand. It is said that stray bullets fired by hunters have been responsible for more explosions of dynamite in railroad trains than anything else.

There are several instances on record in which cars loaded with several thousand pounds of dynamite have been smashed to pieces in a railroad wreck without causing an explosion.



MORTAR FOR USE IN CONNECTION WITH TESTING GALLERY.

A few years ago a car containing over thirty thousand pounds of dynamite was left on a siding at the top of a steep grade. The next morning the car in some inexplicable manner got away from the train and started down the incline. By the time it reached the bottom it was going at a speed of 18 miles an hour. On the track just ahead of it stood a car loaded with 35,000 pounds of dynamite. The runaway crashed into it, splintering its walls and scattering the boxes, some of which burst open, along the track, but there was no explosion.

In an accident at Potsdam, N. Y., October 3, 1897, two hundred cases of dynamite were smashed and the contents of 56 were thrown about over the ground and yet, strange to relate, nothing happened.

There are three separate units, each complete in itself, in the Repauno plant. They are similarly equipped and have a like capacity. If any of the three is put out of commission by an accident the others can continue operation independently and without interruption. New units can be added as the demand for dynamite increases.

In order to turn out still larger quantities of dynamite and other high explosives the works must be able to produce greater quantities of nitric and sulphuric acids. Fortunately the company's present acid plant has a capacity far in excess of its needs. The supply of iron pyrites, which is obtained from Canada, appears inexhaustible. The straight acid tanks have a storage capacity of 10,000,000 pounds and the mixed tanks of 1,500,000 pounds. The glycerin refinery, which takes the product imported from France, Holland and England, can double its output by working another shift of men at night. The great nitrate of soda storehouses can hold 70,000,000

pounds of this indispensable chemical at one time.

With unlimited capital and a staff of expert chemists and workmen that has no superior, the du Pont Company is in a position to maintain indefinitely its prestige in the high-explosive field.

NORTHERN PACIFIC TUNNEL, KELSO, WASH.

The visitor is struck by the lack of fire apparatus. Formerly there were hose and fire buckets, but several men were killed in their efforts to save plants that had caught fire. As a result, the company removed the apparatus and instructed its men that whenever buildings catch fire or an explosion threatens, to make their escape at once. Thus the company considers human life as of more value than property. Its consideration for the employés has been notable throughout its entire history. Men remain with the company year after year in spite of

the occasional fatal accidents that occur. There is no more interesting chapter in the story of the du Ponts than that which deals with their treatment of working-men.

XI

CHEMICAL AND EXPERIMENTAL WORK

TO the success of any great enterprise many causes contribute. Life and industry are both complex. It is only the amateur who glibly says this or that is the only true cause. The man of experience and knowledge knows better. The reader who has followed this narrative need not be told that many elements have combined to make the E. I. du Pont de Nemours Powder Company one of the country's most successful and useful enterprises. Surely it is not for the writer to dogmatize on just what was the leading factor which brought about this result.

Bearing in mind then the complexity and diversity of such a large industry, it is yet possible definitely to attribute a large measure of the prosperity of the du Pont explosive business to a spirit of constant dissatisfaction with the merely satisfactory. The company has always sought to progress and improve upon its product. It has never remained content with old methods and old formulas provided there was any hope of finding better. Of course it has not been alone in this policy. There are many other great industries where talent never rests. But the du Pont business is remarkable in that such a consistent program of advancement should go hand in hand with great age.

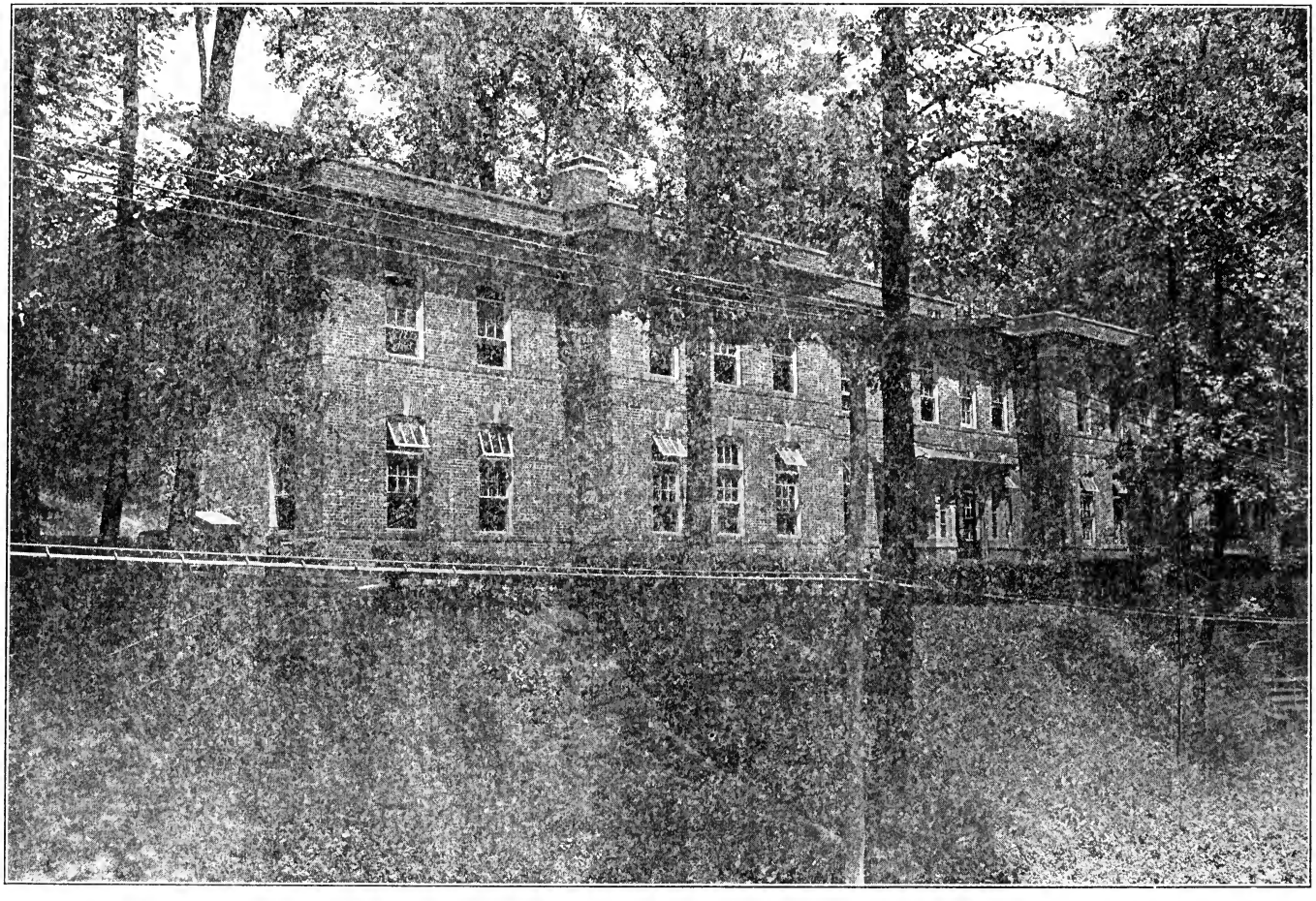
The majority of large industrial concerns in this country date from the decade which ended in 1901

and 1902. Before that period they either did not exist at all, or their then component parts were so scattered and small that it is almost impossible to say that the vast corporations and holding companies of to-day have any relation to the insignificant plants of the nineties. Most American "aggregations of capital" are "brand new."

Not so with the E. I. du Pont de Nemours Powder Company. Its corporate form is not the same to-day as it was twenty years ago. It may include more powder mills to-day than it did at an earlier period. But in essence it is the same as the far earlier enterprise. The business was founded in 1802. It bears the same name to-day that it did in 1802. The same family still control its destinies. In other words, the du Pont business is really exactly one hundred years older than the great bulk of modern industrial corporations.

Mere age is not necessarily a thing to boast of. We are not responsible for our years any more than we are for our height, or the shape of our heads. But age with honor, age with clear vision, and age with the spirit and vigor of youth is a thing to boast of. True enough, a corporation is a creature that knows no death. Or at least it is self-renewing. But the sober truth is that age in business often brings moldy methods, worn-out formulas, disastrous self-contentment. Therefore it is remarkable, it is praiseworthy, to find an old business enterprise easily in the van of industrial progress.

In a sense, explosive making is strictly a chemical business, and if it is to move forward, it is an experimental business. Gunpowder has been made for centuries. It could still be made in the old way, and powder might be manufactured in great quantities



MAIN BUILDING—OFFICES AND LABORATORIES.

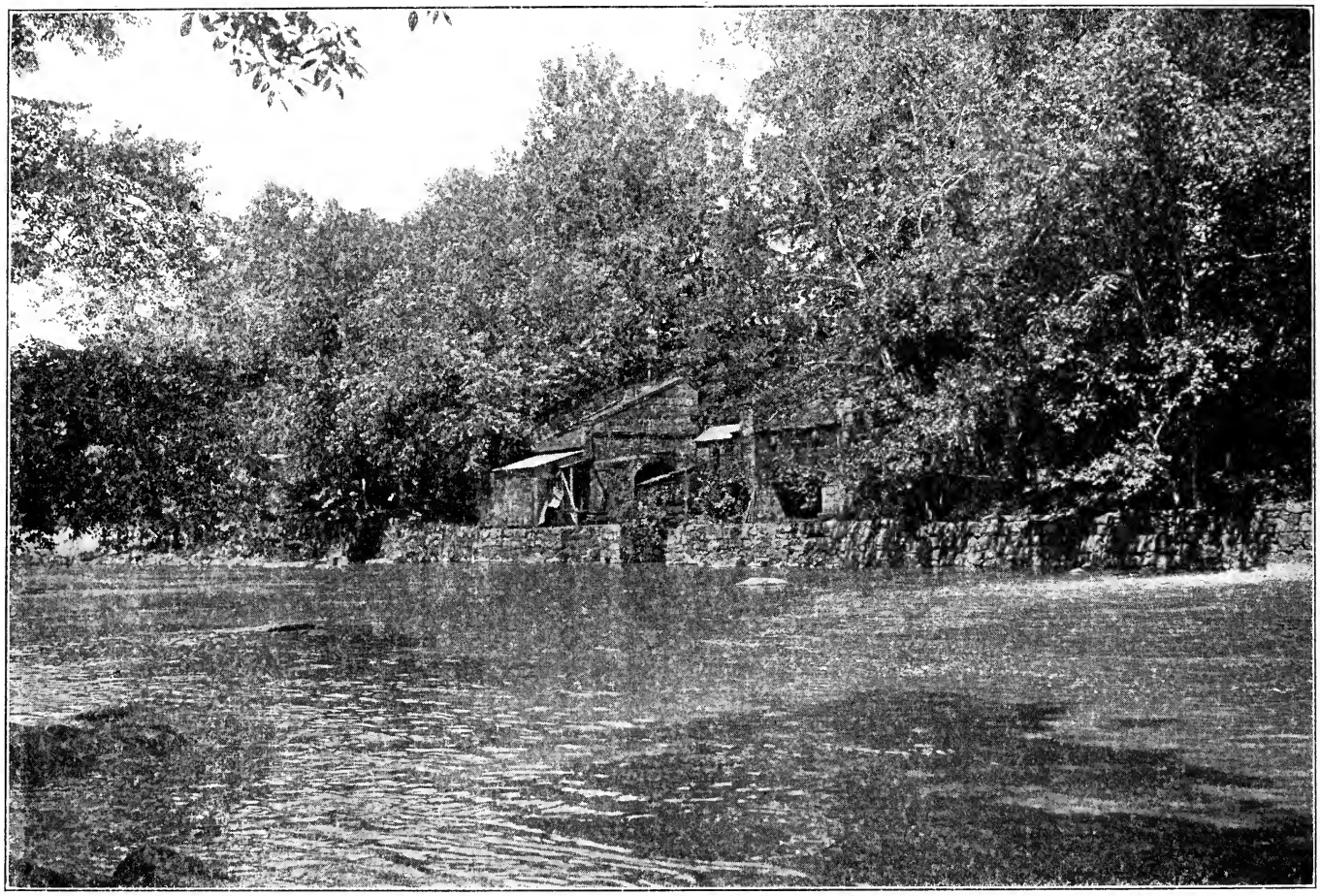
without any elaborate scientific research. But to devise a product which is safe to manufacture, which is safe to handle, which is of high quality, which is low in price, and finally which is exactly and best suited to the use to which it is put—there is a task which the scientists and the chemists may never be done working upon. And to judge from the surprising extent and amount of scientific and chemical work which the du Pont Company is always engaged upon, and the ability, eagerness and ambition of the men who carry on this line, it is evident that the *limits* of usefulness and importance of this branch of the industry are almost *limitless*.

To just what extent has the chemical and experimental work contributed to the success of the du Pont business? It is never possible to answer such a direct question, but an idea of the weight which the directors of the company attach to these activities may be obtained from the annual report for the year 1911, which says:

"Our Experimental Laboratories and our Technical Division, which are engaged in discovering new uses for explosives and in recommending more economical methods to our customers, have continued their efforts in a satisfactory manner throughout the year and we believe that no small part of our success is due to the operations of these two divisions of the industry."

If the work of any one department of a business is well done it is never possible to estimate to the full the beneficial effects upon the business as a whole. So it cannot be told to the last dollar how much the chemists and scientists have saved the du Pont Company.

As compared with Germany, this country has been

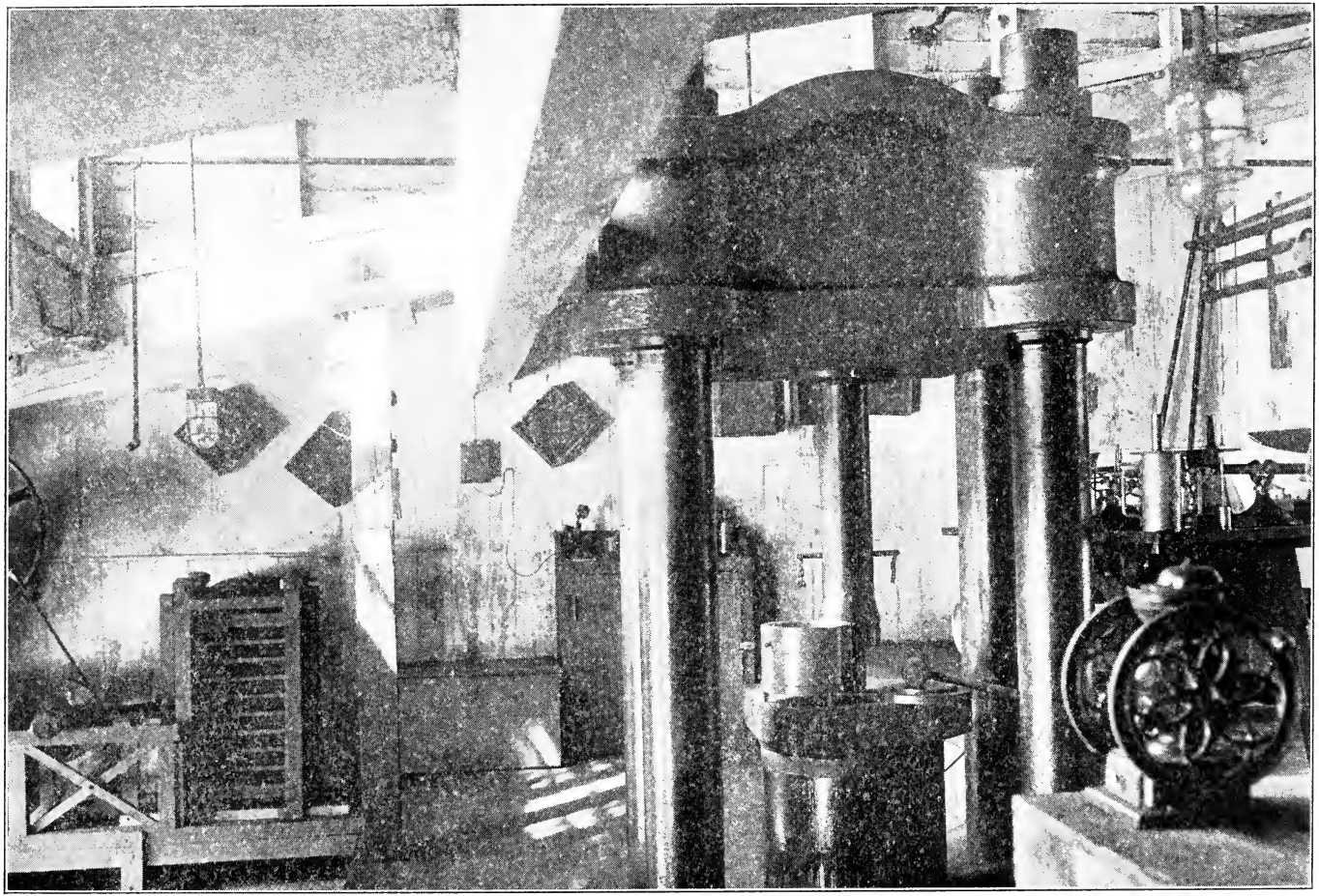


PART OF BLACK POWDER BUILDINGS.

slow in taking up technical chemical research work in connection with its great industries. For a long time manufacturers in this country did not appreciate the direct pecuniary advantages of extensive investigation into so-called theoretical questions. But recently this situation has been changing simply because it has been discovered that research work has been highly profitable, and as a result, large laboratories have been established in connection with great industries. In this field as in others the du Pont Company has been much of a pioneer. It is doubtful if even to-day there are any larger or busier chemical laboratories connected with manufacturing companies than the two which the powder makers maintain.

The chemical work is directed from the head office of the company at Wilmington and is under the charge of a Chemical Director, who occupies a position with the company of unusual importance for an American industry, although in scientific Germany such a position is not unique. Besides the general directing force in Wilmington there are two experimental laboratories and a staff of field chemists who maintain a chemical control, as it were, at the various plants. They closely follow the operations and are at hand if anything goes wrong. A force of chemists may stay at one plant from one to six months to follow the operations there.

As for the two laboratories, or experiment stations, it may be said in a general way that the work which they carry on is the advance guard of the entire explosive business. At these laboratories are tirelessly pursued such objects as the invention of new explosives, entirely different from any yet discovered, the improvement of safety in manufacture and use,

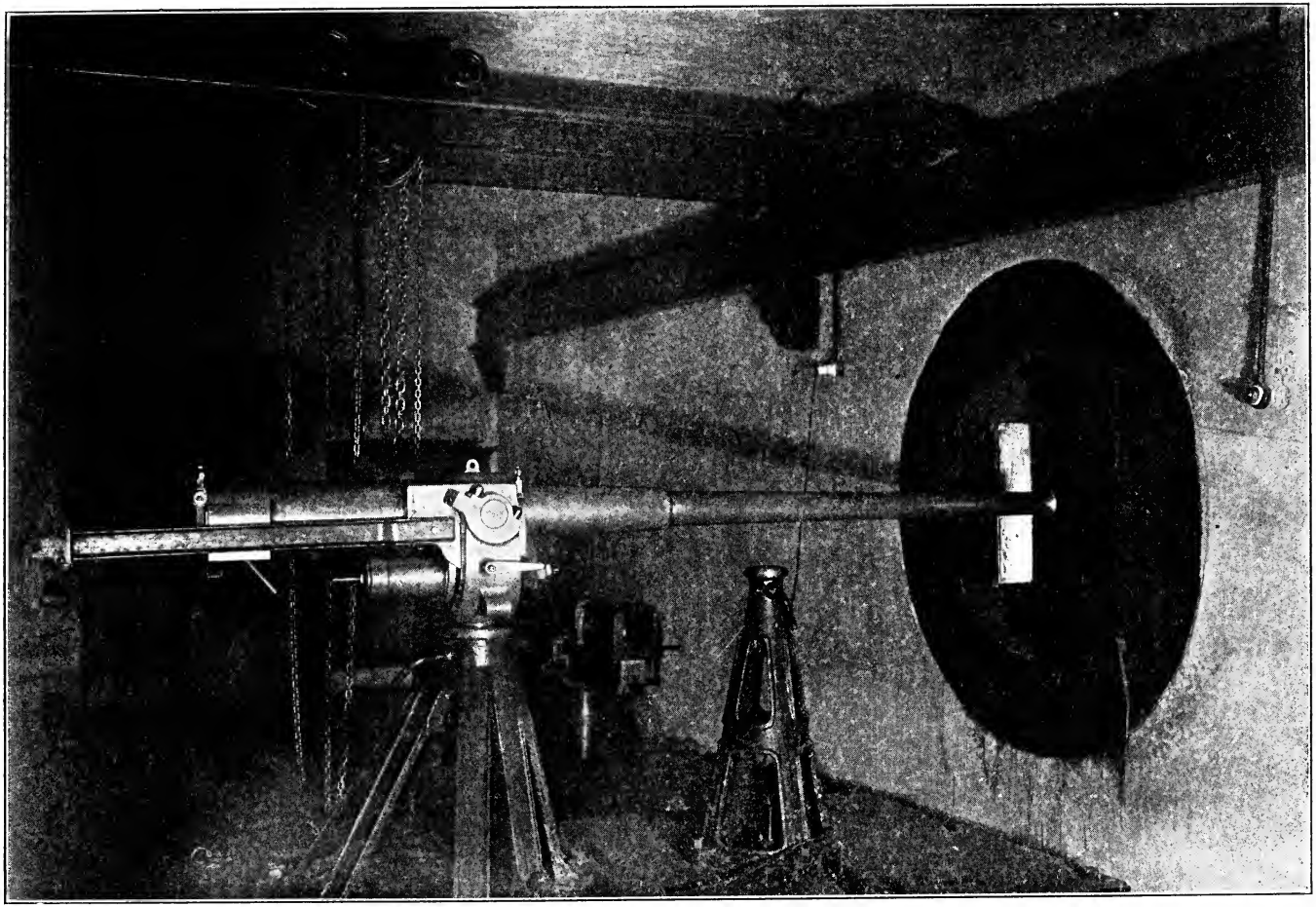


EXPERIMENTAL BLACK POWDER PRESS HOUSE.

the improvement of processes and quality, the examination into complaints of products in the market, the study of behavior of products in the market as well as of those which have not yet been put upon the market, the recording of all manner of tests, the keeping of exhaustive records of yields and the cutting down of costs, and the development of new permissible explosives for use in coal mines. At both laboratories miniature plants are maintained for the manufacture of both old and new explosives. For one and a half to two years new explosives have been made only at the experimental laboratories. Not until the chemical department had followed this long period of study of the new products were they turned over to the operating department. At times the miniature plants of the chemists have made as much as ten to fifteen thousand pounds of a new explosive and this product has been sold to the trade.

It is impossible to describe in this general way all the activities of the chemical laboratories, and a clearer idea of the many ways in which old explosives are studied and new explosives invented may be gathered from a more detailed description of each of the two stations. To speak of a "detailed description" usually implies dullness to the average reader, and while the writer may fall short of conveying any adequate idea of the almost breathless interest which any visitor will feel while watching the delicate tests and experiments which are carried on in these places, he can at least do greater justice to this important work by describing the two stations separately.

On the outskirts of the city of Wilmington, along the shores of the Brandywine, lie the scattered buildings of the Experimental Station, where is carried on all the chemical and experimental work in connection



INTERIOR UNDERGROUND RANGE.

with smokeless and black powder, where new problems brought to the company's attention by outsiders are considered, where the ballistic work is conducted and where the highly important experiments and tests made in conjunction and coöperation with the United States Government are cared for. The Experimental Station is the technical and scientific aid of all departments of the company, except the high explosive department, which is so important as to require an experiment station all its own, and besides developing new explosives and uses for them solves the difficulties met in the manufacture, storage and use of old powders.

Adjoining the Repauno dynamite works on the Delaware River is the Eastern Laboratory, which is devoted solely to the study of high explosives, which term, to all intents and purposes, means dynamite. The future may bring forth other high explosives, but to-day dynamite is the great commercial high explosive and at the Eastern Laboratory it reigns supreme. At each of the laboratories, or stations, there are employed no less than thirty trained chemists, roughly speaking, and including laborers who assist the chemists, each station has in its employ about one hundred men.

The Experimental Station consists of a large group of buildings along the banks of the Brandywine where formerly stood many of the old black powder mills. These mills in fact still stand there, but have been turned over to the chemical department to be used by it. Some of them were built in 1829. The Experimental Station was begun in a small way about 1903, and has developed rapidly to its present proportions. Here are carried on investigations into everything which the chemists could investigate, except

high explosives. It is the central scientific station for the company, and is one of the most complete experiment stations in the United States.

The Station is practically an independent plant. It has a large, handsome central building where are located offices and laboratories. Then there are a machine shop, carpenter and plumbers' shops, electric light and power plants and boiler house. On one side is the Brandywine, across which is a city park. In all other directions is land owned by various du Pont interests, as there is room for expansion. The spot is secluded. The mechanical part of the station, carpenter shop and so on, are near the entrance, as of course they have no elements of danger. On the slope of the hill rising from the river and back of the shops are the firing and shooting ranges. Scattered in the woods along the river and beyond the main building, which occupies a central location, are the powder magazines and the old black powder mills. The buildings are small, fire-proof and isolated, the more dangerous ones being far back in the woods. Thus it is seen that even in the laying out of an experiment station the company uses every possible foresight not only to produce the most efficient results but to prevent accident and loss of life.

For many years the formula for black powder remained unchanged, but work had been done at the Experimental Station on its improvement, and after certain results had been secured the new formula was used first for one- and two-pound samples, than for one- and three-hundred-pound samples, and finally an entire mill was turned over to its manufacture and one hundred and fifty lots of three thousand pounds each were made. Thus it is apparent that the chemical department does not drop a new thing as soon

as it is discovered. The new process or compound, or whatever it may be, is carried on until there remains little doubt as to its value.

A very complete system is in force for keeping in touch with the various departments—both for giving and receiving information. Each member of the professional staff at the Station writes a weekly report which goes to the Director. These reports are summarized weekly, then monthly reports are made and summarized at the end of each month, and finally each year has a report to itself. In this way there is at all times available a complete résumé of the work being carried on. The work is carefully divided and sub-divided. There are three professional departments at the Station, a chemical department, a mechanical department, which experiments with machinery, and a ballistic department, which studies the behavior of powder as used with all manner of arms and ammunition. Including the mechanical and ballistic forces there are about thirty-five university-trained men. In the largest of the three departments, the chemical, there is considerable subdivision. Not to mention all the branches of work upon which the chemists are engaged, it may be said that attention is constantly being paid to black powder, smokeless powder, general chemical work such as the study of raw materials, organic research work, the study of artificial leather, etc.

Important progress is constantly being made toward the improvement of artificial leather. This is not merely a by-product of the explosive industry. The raw material is especially selected and made for the purpose of producing fabrikoid and other similar products. The fact that the basis of these products is also one of the materials which is used in making

certain explosives does not indicate that the company regards its pyroxylin mixtures as of subsidiary importance.

Too much stress cannot be laid on the fact that the company is steadily seeking to improve the quality of its products. But this does not mean that the Ex-

INTERIOR SMALL ARMS RANGE.

perimental Station is not run on a business basis. There is a complete willingness to spend great sums of money on what may seem to be purely scientific work. Many months were spent in determining the exact freezing point of nitro-glycerin. But while there is no stint in expenditure the directing force knows at all times just what every test and experi-

ment is costing. A complete set of accounts is kept, and each expense is considered carefully.

Space does not permit a detailed description of every test which is made at the Station. But even the visitor who spends a chance hour there cannot but be fascinated by the expert and delicate work which is in progress. There are several magazines where samples of powder are stored from a few days to a year and are under almost hourly examination for changes or deterioration in their quality. At times there are from 500 to 1000 samples being thus tested. The temperature in such magazines is always high, being the maximum allowed on a warship. The tests of the British, French and German Governments are applied as well as those preferred by the American War and Navy Department. Many samples of powder are purposely made bad to see how they will act under these various trying conditions.

There is another magazine where powder is subjected to such a high temperature as to force its explosion sooner or later. But the samples do not need to be watched, for their detonation blows out a piece of sheet iron which by connection with clockwork in another building shows exactly when the explosion occurs. One of the most interesting sights is the underground shooting gallery, where experiments are made with small artillery.

Those who have followed at all closely the history of the powder business are familiar with the great saving effected on old powder by the United States Government purely through the good will of the du Pont Company. Formerly powder subjected to severe conditions or which had become obsolete because of changes in guns was a dead loss to the Government and was dumped at sea. But the Company

discovered a method of reworking this powder which it turned over to the Government without compensation. Part of the process of reworking old powder is carried on at the station.

Officials of the Army and Navy are constant visitors at the station, and the company works in harmony with both the Army and Navy for the improvement of the powder used by the two branches of the service.

Although the Eastern Laboratory deals only with dynamite and related subjects, this is no small affair, for there are at least fifteen distinct and different kinds of dynamite made by the company, and of each kind there are many grades, sometimes as many as ten, representing different strengths. The entire staff of the Laboratory is engaged in the study of these different kinds and grades of dynamite. Besides a director and assistant director there are about thirty trained chemists, a professional photographer, an office force of six men, carpenters, plumbers, pipe-fitters and many laborers.

Although the director and assistant director are in the last analysis responsible for the work carried on, much of the direct responsibility is placed upon the chemist in charge of each investigation. As the visitor goes from place to place he is struck with the intelligence and responsibility of the various young chemists who are directing this or that line of investigation. They gradually become authorities on the subject they are pursuing and in this way the best results are obtained. Here, as at the Experimental Station, only chemists who have had a professional training are employed.

There are always many separate lines of research being carried on at the Laboratory, and the men con-

ducting these researches often have a number of other chemists working for them. They are under his direction and only indirectly responsible to the Director and Assistant Director. In addition all the laboring men are furnished whom the chemists can profitably employ.

The Eastern Laboratory is about ten years old. It has slowly developed into a great plant in itself, for there are no less than seventy-six buildings, spread over about fifty acres of ground, in use here. Such a great number of buildings is required partly because of the constant carrying on of actual manufacturing operations by the chemists and workmen attached to the Laboratory.

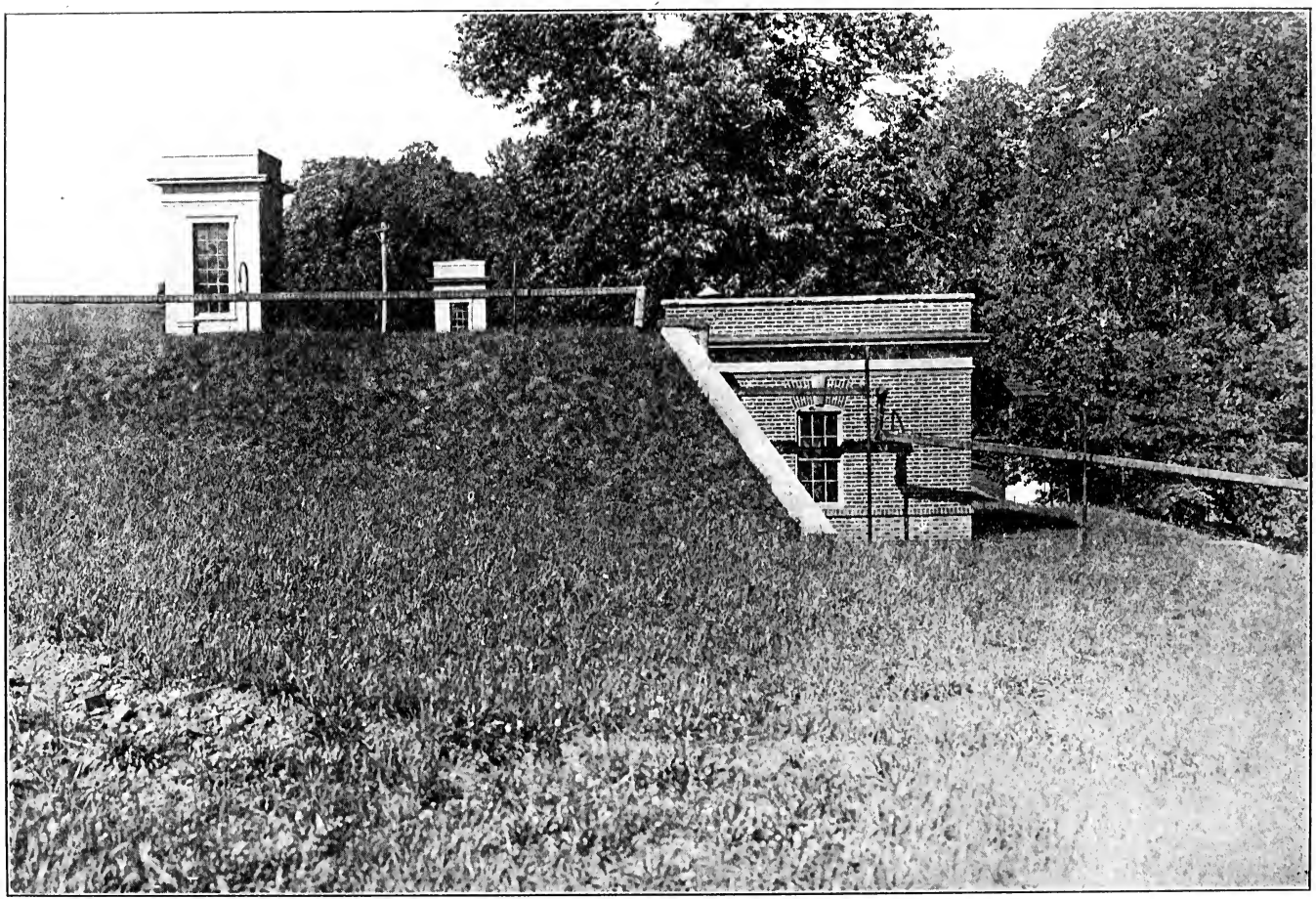
The visitor who has never been in one of the company's dynamite plants is just as greatly impressed by what he sees in the small experimental plants. All the apparatus is of the same material and practically the same model as that used by the operating department. There is the same business-like attention to the work in hand. A few hundred pounds of nitroglycerin, or N. G., as it is commonly known on the banks of the Delaware, require just about the same respect as several thousand pounds. Every detail of manufacturing dynamite is studied and actually carried out at these small plants. Even the way the cartridges are loaded comes in for observation from day to day by the keen-eyed scientists.

XII

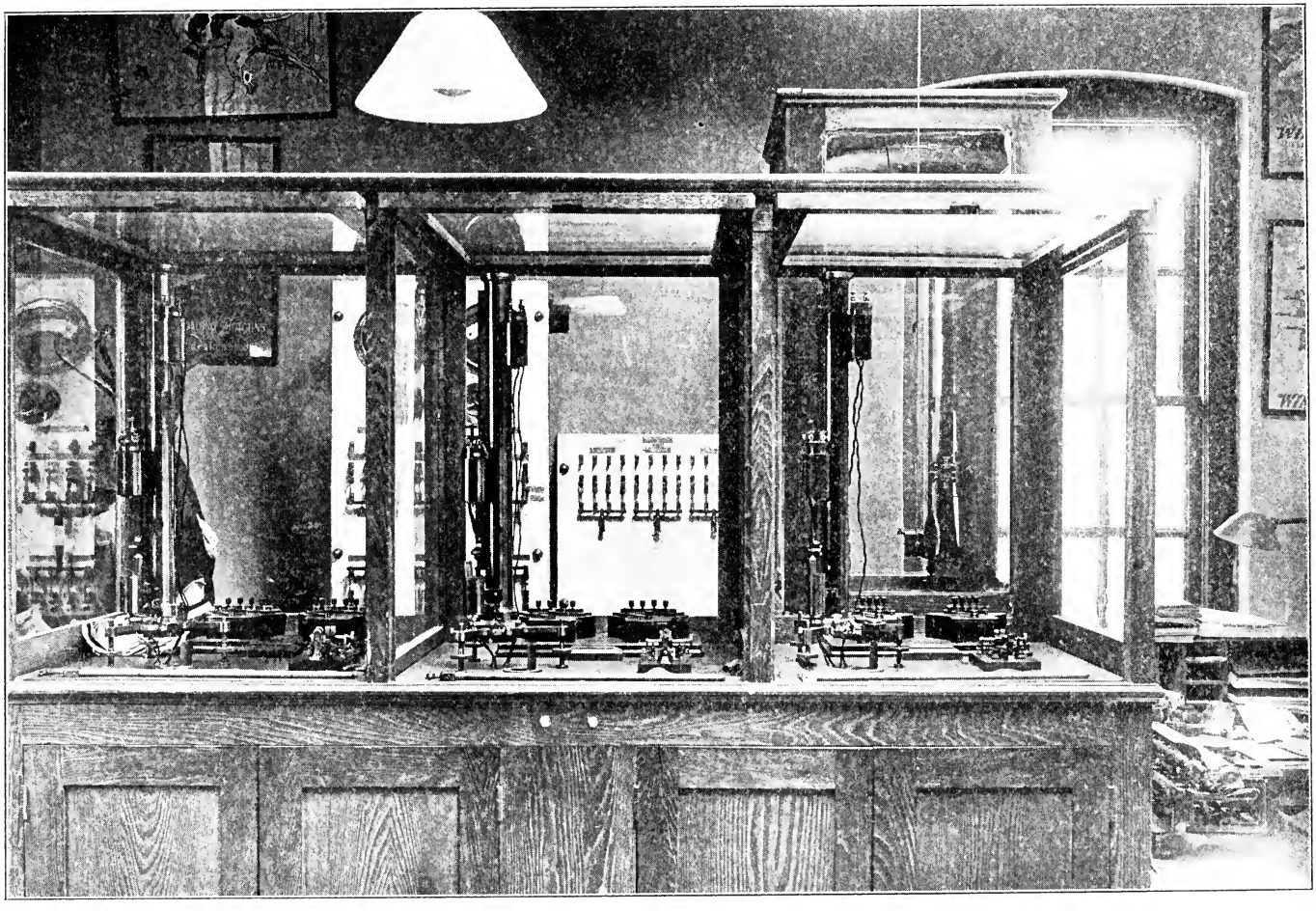
TESTING

MANY are the tests to which the various kinds and grades of dynamite are put. One of the most important is the pressure test. A stick of dynamite is securely locked within a great steel machine, the druckmesser, or pressure gauge, and there it is detonated. So securely is it folded about by the layers of steel that the sound of its detonation reaches the outer world merely as a click. There is no need of describing the damage that one stick of dynamite would do in an ordinary place, but so delicate as well as strong is the druckmesser that the dynamite which goes off within it sets in operation an apparatus which pencils a slight line upon a piece of paper, the direction of the line indicating the amount of pressure of the explosive within. The test is very accurate. The temperature within the druckmesser at the moment of detonation is as high as 3000° centigrade, or more than 5000° Fahrenheit.

A test which the non-technical visitor can far more readily understand is the very simple but accurate method of determining velocity. Not only must the chemists know the amount of pressure exerted by the explosives which their company makes, but they must discover in all cases how soon that pressure develops —in other words—the velocity. For example two half sticks of dynamite are wrapped in a roll of paper



ENTRANCE AND TARGET HOUSES OF UNDERGROUND RANGE FOR 6-POUNDER GUN.



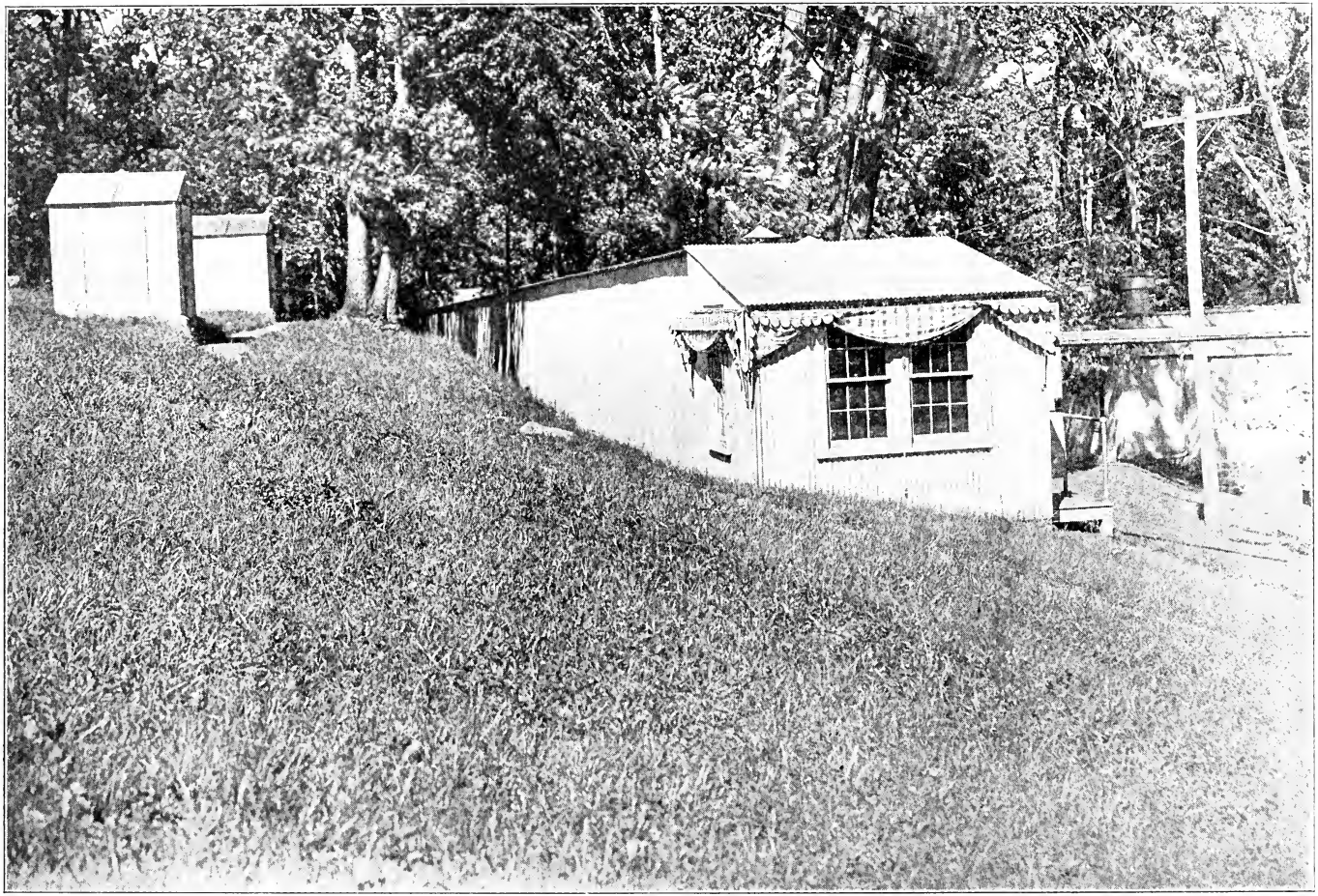
CHRONOGRAPHS FOR MEASURING VELOCITY OF PROJECTILES.

and one of them is detonated. By knowing the distance between the two sticks, how soon the first sets the second off, and by measuring various marks which the detonation of one or both makes upon adjoining pieces of metal, the men in charge can measure to the nicest point the velocity of the particular explosive under observation.

Great care is taken in testing detonating caps, and several entire buildings are devoted to this branch of the work. A particle of one of the explosives used for caps is placed where a tiny hammer falls upon it. If the detonation does not result from the hammer's first drop, ninety-nine other attempts are made by the patient operators from precisely the same height before the hammer is lifted a fraction higher. Each one of the hundred drops of the hammer which fails to set off the explosive as well as those which do set it off, is recorded by the chemist in charge.

No section of the work at the Eastern Laboratory is of greater human interest than the testing of permissible explosives or those which have passed certain tests prescribed by the Federal Bureau of Mines. One of the chief uses for explosives is the breaking up of coal in mines, and until recent years the fatalities in collieries from the use of improper explosives were shocking in number. In 1906 eleven per cent of the deaths in coal mines were due to gas or dust explosions. But in 1907 Congress established a testing station in Pittsburg under the Geological Survey, and the du Pont Company has been foremost in meeting the requirements of this Government testing station.

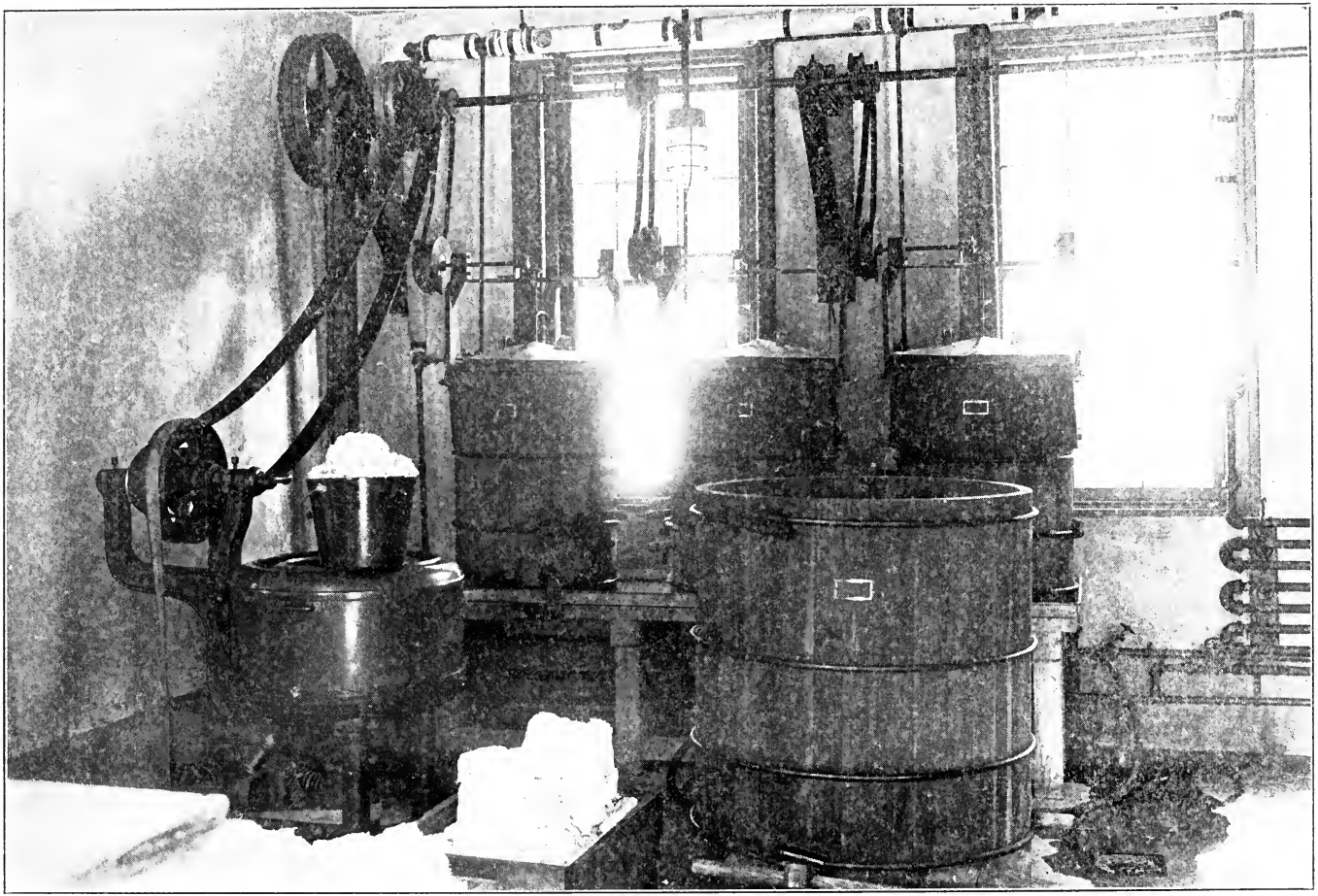
In the first year's work of that institution, twelve manufacturers submitted 29 explosives for examination. Of these, 17 passed all the requirements and



200-YARD ACCURACY RANGE.

were admitted to the list of permissible explosives. The du Pont Company submitted seven powders and all were admitted. The reason that the du Pont Company has been so successful in having its products admitted as permissible explosives is because they are so thoroughly tested beforehand at the Eastern Laboratory. The company has spent enormous sums in setting up apparatus expressly for the purpose of discovering whether its explosives are as safe as they can be made.

The testing gallery for permissible explosives at the Eastern Laboratory is a duplicate of the one used by the German Government, the first government to take up the subject of finding safe explosives for coal mines. The gallery consists of a long steel cylinder into which are poured dust, pulverized coal and other substances found in coal mines. Into this gallery are fired various explosives by means of a cannon or mortar. The gallery is open at the farther end and there are outlets at the top and windows through which the effect of the explosive may be witnessed. Four sticks of a permissible explosive fired into a mass of dust, gas and pulverized coal result in only a few puffs of harmless-looking smoke, whereas half a stick of a non-permissible explosive set off in the same amount of dust, gas and pulverized coal results in a frightful outpouring of thick, black smoke and ugly-looking flames. The chemical tests of coal-mine explosives include analyses of the explosives, chemical examination of combustion, stability, exudation and other tests necessary to determine the effects of storage and keeping qualities. The physical tests involve besides the use of the gas and dust gallery already described, the ballistic pendulum, and Trautzl lead blocks employed to measure the unit of

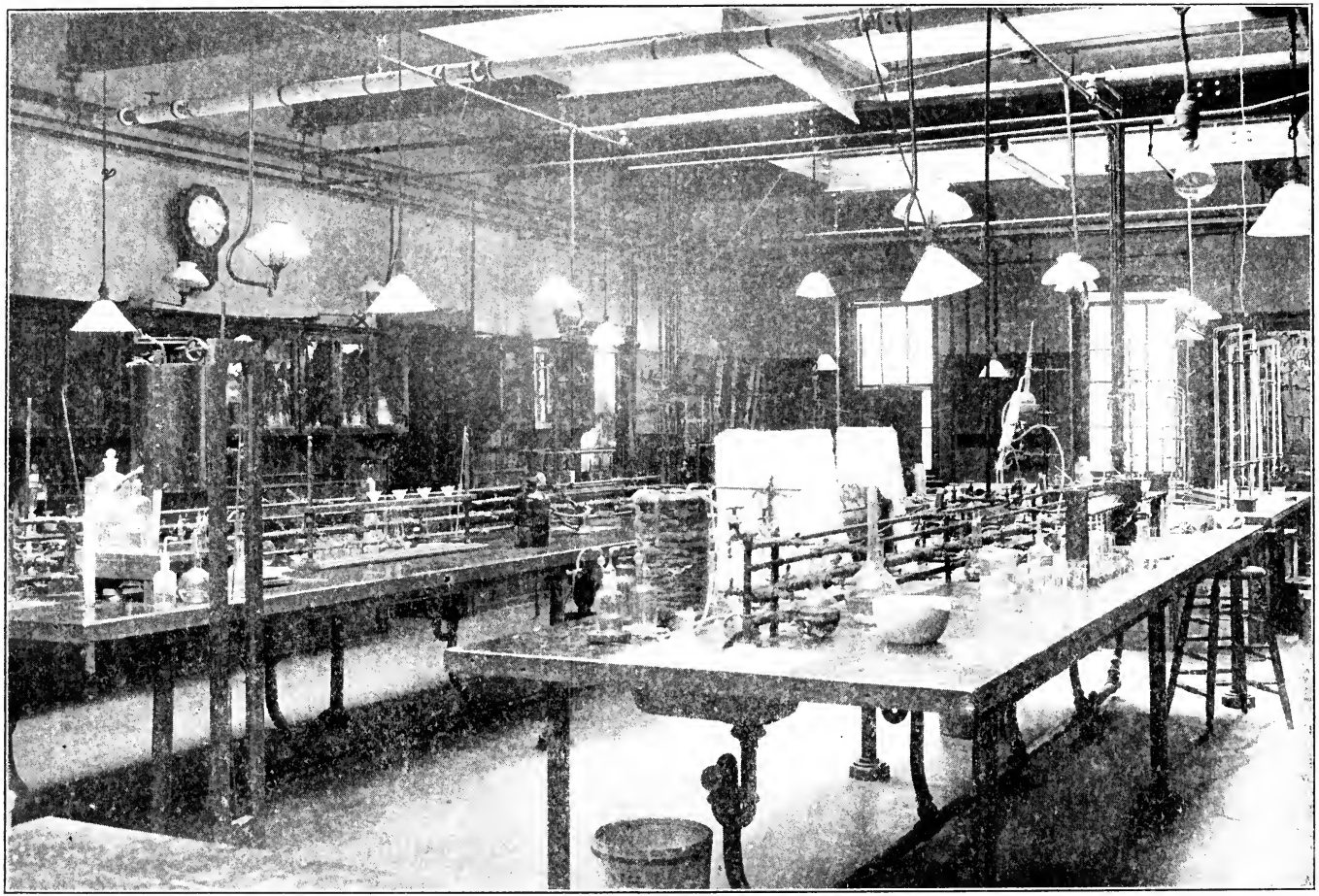


PART OF EQUIPMENT FOR EXPERIMENTAL PURIFICATION OF NITROCELLULOSE.

disruptive force; the calorimeter which measures the heat given off by the detonations; the rate detonation apparatus, used to determine the velocity with which detonation travels through a given length of explosive; a flame-testing apparatus for measuring the length and duration of flames generated by explosives; an impact machine, designed to determine the sensitiveness of an explosive to shock; and the pressure gauge already spoken of.

If all the work at the Eastern Laboratory were completely or adequately described, it would transcend the limits of one article. But the writer has wholly failed in his purpose if the reader has not gathered the idea that the du Pont Company has devoted every possible means to improving and perfecting its product. The expense of maintaining the two experiment stations is equal to the total expense of many large business enterprises. Of course this would not be maintained if they did not pay in a commercial sense. But there are comparatively few manufacturers who have a sufficiently enlightened business sense to enter experimental and scientific work on such a large scale.

The best results are obtained from the two experiment stations only by fair treatment of the men employed there. They are rapidly promoted as they show fitness for their work, and they are also awarded bonuses of stock for unusually meritorious work and the accomplishment of some definite result such as inventions and the development of new processes. The bonus system applies as well to other departments of the company. Its workings, and in general the treatment of its employés past and present by the du Pont Company, will be the subject of the next chapter.



PORTION OF THE MAIN LABORATORY.

XIII

THE DU PONTS AND THEIR WORKMEN

IN any modern industry of great magnitude, the problem of dealing with, and properly handling, the workers is almost as vital as turning out the product itself. As the relations of labor to capital receive closer and closer attention from all classes of thinkers, the task of adjusting these relations in a satisfactory manner must receive increasing attention from the large corporations.

The fair and friendly relations between the workmen and the members of the du Pont family have long existed and a brief glance at the measures adopted by the company for looking after the welfare of its men and interesting them in turn in its own welfare may not be amiss.

At the present time the force of laborers employed by the company is so large and the plants are so scattered, that the old intimate relations between the owners and the men are no longer possible. But there has always been some official who has taken a particular interest in the laborers, and the company is now as ready as it always has been to provide for disabled workmen and to look after the families of those who are injured or killed. The dangerous character of the business has always had full recognition from its managers.

The du Pont Company was early among the large corporations to adopt a system of profit sharing. Its

profit sharing or bonus plan, while by no means unique, is regarded as more than ordinarily generous. Bonuses are of two classes. The first class covers those cases where awards are made to employés for inventions, or other conspicuous service. The second class includes awards which are made to those who have contributed most in a general way to the company's success, and the amount awarded in these latter cases is governed by the amount of the company's surplus earnings from year to year.

In both classes of bonus awards the certificates of stock are issued in the names of the beneficiaries, but they do not actually receive the stock until the earnings of the company have reached a total equal to the par value ($100 a share) of the stock thus awarded. But in the meantime the beneficiary receives all dividends on the stock, and if he leaves or is discharged he is given either in cash or in stock an amount represented by the accumulated earnings on his shares from the time they were awarded to him until his employment terminates. If a man dies, the bonus stock at once becomes fully paid up or earned, and without having to wait for further earnings to accumulate it goes to whomsoever he may have designated for the purpose.

Since 1909 the company has offered each year two thousand shares of preferred stock to its employés at about the market price. In some years the privilege of substituting subscriptions to common stock has been granted. Employés may pay for their stock in as small an amount as $2 a month per share. They also may pay as much at one time as they please. They receive all dividends from the time they subscribe. They are charged interest at 5 per cent on the price at which they subscribe for the stock and are

credited with 5 per cent on all payments they make for it until it is paid up in full.

An employé can get back at any time the amount credited to the payments on his stock. If he is laid off because of slack work at the mills, he can continue his payments if he cares to do so. The same is true of those who are ill or disabled. If a subscriber has paid more than the minimum amount on his stock he can stop payments for a time if he cares to do so. If he dies, his estate can continue the payments if desirable until the shares are paid up in full.

The company also manages a Savings Fund for its employés. Deposits may be made of not more than $2,000 in any one year, and 5 per cent interest is paid. The men are allowed to have deductions made from their wages or salaries and credited to the fund. By sending in the proper draft they are enabled to make withdrawals. When a man leaves the company he is expected to withdraw his deposit.

The pension system is an important feature with the du Pont Company. After fifteen years' of continuous service, an employé is eligible to apply for a pension. If a pension is granted, payments are made monthly and there is given for each year of service an amount equal to one and one-half per cent of the highest average monthly pay for any year of his service during the last ten consecutive years. After a pension has been granted its payment and continuance are governed by the provisions of the Pension Plan. The continuity of service on which the granting of pensions is based is not considered broken by absence due solely to illness or injury, or because of leave of absence duly granted or by reason of temporary suspension or dismissal made necessary by shutting down of mill work or reduction in force.

It is interesting to note that an increasingly large number of employés have subscribed for stock, all the various offerings except the first having been considerably oversubscribed. Both because of their subscriptions for stock and because of their holdings due to bonus awards, the number of employés who own stock has rapidly increased. In 1907, there were 218 employés interested in the company as shareholders, and they comprised 27 per cent of the total number of shareholders. By 1909 the number of employés who owned stock had increased to 524, and in 1911 no less than 990 employés were shareholders, comprising 45 per cent of the total number of holders. It is believed that where such a large body of employés actually own stock in a corporation they will be more directly interested in its welfare and will feel that they are partners as well as workmen.

XIV

SMOKELESS POWDER AND THE SPORTSMAN

GUNPOWDER, or black powder, the first explosive of which man has any record, still is employed for various purposes in all parts of the world and is consumed in vast quantities. But we have seen in previous chapters what strides have been made in the use of that far newer and more powerful explosive, dynamite, and also there has been related something of the nature of and early experiments in yet a third class of explosives, smokeless powder. It now remains to narrate briefly a few of the benefits and uses which have followed from the general introduction of smokeless powder.

In the combustion of ordinary gunpowder there is given off a large amount of solid matter, which not only clogs the gun, but produces an opaque cloud of smoke which envelops the gun and the gunner. Scientists have calculated that military gunpowder evolves 57 per cent in weight of ultimately solid matter, which is either thrown into the atmosphere or remains behind to foul the gun. It also has been stated that a 110-ton gun can project at a single discharge 528 pounds of this solid matter, from which it is plain that in modern warfare the ship or force of troops using such explosives would soon be so enveloped in smoke as to make impossible any clear view of objects at a distance. With the appearance of modern Colt, Hotchkiss and Maxim machine guns and magazine

rifles with their automatic arrangements enabling an almost incredible rapidity of discharge, and the rapid-fire Gatling gun firing more than 1200 rounds of small arm ammunition in a minute, the problem of smoke became one of intense importance. In other

TARGET PRACTICE ON THE LAWN.
The use of Smokeless Powder makes this a clean sport.

words a powder had to be invented for military purposes.

As compared with gunpowder the modern nitrocellulose explosives, of which smokeless powder is one, are not only cleaner but give an increased penetration to projectiles. Smokeless powder occupies about one-third of the space of its equivalent in black powder and therefore is of prime advantage for military uses.

All the smokeless powder manufactured for commercial purposes is used in connection with field sports and their allied sports of target shooting with

rifle or pistol, and trap-shooting with the shotgun. It is only within the last twenty-five years that the use of smokeless powder in shotguns has become at all general, and even now the number of cartridges loaded with "good old black powder" that are shot away every year in this country is almost beyond belief, and runs up into the many millions.

The general adoption of smokeless powder for use in shotguns has in its way been almost if not quite as important in its results on sport in the field or at the trap, as has the use of smokeless powder for military and naval purposes in the big guns and rifles of the army and navy. With black gunpowder it was practically impossible to see the result of a shot until an appreciable space of time had elapsed after the shot had been fired. When smokeless powder is used, the result of the first shot can be seen almost instantly and a second shot quickly fired if needed.

One incentive for manufacturing smokeless powder has been the rapid increase in trap, or "clay" pigeon, shooting. The use of ordinary black powder at a gun club where perhaps several hundred contestants are entered would be too disagreeable to make the sport attractive. Yet the usefulness of black powder is far from being a thing of the past, for it is still largely used in rifles, pistols and shotguns for certain purposes. Its cheapness as compared with smokeless powder ensures it a steady market.

Probably in the whole wide range of uses to which explosives are put there is none more attractive and more full of interest than trap shooting. The work of the du Pont Company in aiding this rapidly growing sport is an instructive example of enlightened business policy. The company devotes a great amount of ingenuity, considerable money and a staff

of trained men to stimulate interest in the formation of gun clubs and to advance the sport of trap shooting. At first glance it is difficult to see where the company profits much from such a policy. The sum

SHOOTING OFF A TIE IN A PRELIMINARY HANDICAP MATCH.

which is spent for powder in shooting at clay pigeons as compared with what is spent for guns, cartridges, targets and traps is small. But the policy of the du Pont Company has always been to employ every means possible to promote the various uses of powder, particularly for constructive and amusement purposes.

Trap shooting was not originally an American sport. It came from England, where live pigeons were shot at, and for a time such was the custom in this country. A few states still permit the shooting of live pigeons, but public sentiment generally is against it. The "clay" pigeon has almost univer-

sally been substituted in this country and its shooting requires fully as much skill and gives as much zest to the sport as the killing of live birds. Strictly speaking the pigeons are not made of clay. They consist of river silt and tar molded together by hydraulic pressure.

Most of us have a natural instinct for hunting, or at least for shooting. We delight in burning gunpowder. Americans as a nation have an inherent desire to use firearms, and the fact that they use them well is shown by the recent success of the American shotgun and rifle teams at the Olympic games, and other recent international shooting contests.

The growing scarcity of game in this country and the ever increasing strictness of game laws make the shooting of game more and more difficult and expensive, even for those who have no sentiment or compunctions against it. Trap shooting is an all-the-year-round sport. Weather makes but little difference, and where the hunter of live animals can find only one or two opportunities to get away from business in the very short open seasons which the laws permit, the hunter of clay targets can walk or ride to his gun club every Saturday, or oftener, and "slaughter" the saucer-shaped silt and tar birds to his heart's content. There is no "bag limit" as in shooting living creatures, and the shooter may always pursue his sport in comfort and whenever convenient to him or to her.

It is a little known fact that trap shooting ranks next to baseball in importance as a national sport. In certain respects it is even more important than baseball, because every one interested in it can be a contestant. The baseball enthusiast's participation in his favorite game is largely mental. But every

member of a trap shooting club shoots. It is stated on good authority that there are more trap shooters than golfers in this country. There are nearly forty million targets, or clay birds, shot each year, a fact which gives some idea of the number of participants

HAZARD TROPHY MATCH IN BRADFORD, PA.

in this sport, as a shooter is not likely to fire at more than fifty or one hundred birds in an afternoon.

Trap shooting affords healthful exercise, companionship and complete forgetfulness of business cares. It is a manly sport because it steadies the nerves and gives self-confidence. It requires a quick and intent mind, and the muscles must work in harmony with the mind. But practice is the essential thing, and one does not need to be a heaven-born shooting genius to attain good scores. As a sport it is essentially

democratic, because the taste for shooting is one which is found in all classes.

Of graver importance is the fact that trap shooting makes shooters out of men who would otherwise have no opportunity to learn to handle a gun. If it were not for trap shooting this country might be seriously embarrassed in case of war. There are few facilities remaining in the more thickly settled parts of the land for using a rifle, and while trap work is with the shotgun, it nevertheless teaches men how to handle firearms. It is the one means we have for keeping Americans in shooting trim. While trap shooting develops field shooters, it does not develop the fever for game killing, because work at the traps satisfies the instinct for using firearms. The trap shooter who goes after game has no desire to kill everything in sight. Many trap shooters are members of the various societies for protecting and propagating game.

Trap shooting discourages professionalism and is also a sport which, to use a term more understandable to the athlete or sporting man than to the general reader, is "on the level." It appeals to men of brawn and athletic ability in other lines, as is shown by the fact that several professional baseball players have taken their places at the firing line. Women, too, are taking it up eagerly. Many of them use smaller guns and are proving themselves competitors for high honors.

In this connection it may be noted that with a Maxim Silencer it is possible to shoot clay targets in a back yard without danger. Other variations on the ordinary method of shooting consist of going out in a boat and having a trap throw targets over the water, or shooting off the end of a pier, or having a trap concealed in the top of a tree or in bushes for

the purpose of throwing the clay birds from unexpected places.

Perhaps the greatest benefit to be derived from this sport is that it requires intense concentration of a pleasurable pursuit. Thus the brain worker finds

TRAP SHOOTING AT EUGENE DU PONT'S COUNTRY HOME.

real relaxation and exercise, but without the extreme physical exhaustion which comes from many sports. At a regular gun club a squad consists of five shooters who shoot in rotation, changing their position after a given number of shots. The trap is sprung at the command "pull," throwing the target not less than forty-five yards, nor more than fifty yards, with a rise of between six and twelve feet, at a point ten yards from the trap.

The "pigeon" is thrown from the trap at an unknown angle and in a manner that gives a decidedly

birdlike flight to the targets. The determining of leads, angles, elevation and the allowance for wind interference require a high degree of judgment.

To promote the best interests of this sport and to increase its scope the manufacturers of guns and ammunition have formed the Interstate Association for the Promotion of Trap Shooting. Prominently identified with this movement is the du Pont Company. Under the auspices of the national body are annually held six tournaments, each of which surpasses in number of participants the national events of any other sport. These shoots are known as the Eastern, Western, Southern, Pacific Coast, Post Season and Grand American Handicaps. At the premier events held at Columbus, Ohio, in July, 1911, nearly five hundred shooters were on the firing line, while in the Eastern Handicap at Wilmington, Delaware, in July of the same year, two hundred and ten men participated.

At any of these shoots may be seen feats of marksmanship which are simply astonishing; the shooters smashing the swiftly flying targets with machine-like regularity. Many of the scores show from ninety to ninety-eight breaks, out of a possible hundred. On these occasions, Gilbert, German, or any one of fifty or more noted shots, is accorded the same hero worship which greets the Ty Cobb or an Eddie Collins on the ball field.

By no means do the big events named cover the list of important contests, for of scarcely less note are the Westy Hogan tournaments given by professionals for amateurs only, the Pinehurst, N. C., Mid-Winter Handicap, and some twenty other shoots more or less national in character. There are also thirty to forty state shoots held every year. The Interstate Asso-

ciation formulates and enforces the rules under which practically every contest is held. For the shoot to be recognized and the participants qualified to compete for championship titles, medals, trophies, cash prizes and other rewards for skill, the event must be

GRAND AMERICAN HANDICAP, COLUMBUS, OHIO.
In this squad are a well known woman shooter and a one-armed expert.

registered and made subject to the supervision of competent officials of the Association. During the present year the Association appropriated $20,000 for the refunding of the entrance fees to unsuccessful shooters. This is known as the "Squier money-back system" and is but one of the many provisions made to place the sport on a high plane of fairness and equality. Records of all shoots and the scores of over twelve thousand shooters are on file at the Association's office.

The du Pont Company endeavors in every way to

encourage the formation of gun clubs. It corresponds with persons who wish to form such clubs, gives them plans for club houses and elaborate and detailed information in regard to the shooters' equipment, rules for shooting and rules for clubs. Instructions to beginners are furnished and experts are sent to aid in establishing clubs and in carrying out tournaments after the clubs are formed.

The company also gives each year a solid gold trophy to amateurs who break 100 targets straight and to professionals who break 125. This shooting must be done in registered tournaments to count, and only when du Pont powders are used by the contestants. That it is not an extraordinarily difficult thing to get one of these trophies is shown by the fact that in one year no less than 104 were awarded. Finally it may be noted that trap shooting is rapidly being taken up by country clubs, and the most prominent magazines dealing with country life subjects have now recognized the importance of the sport and are devoting much space to it.

The du Pont Company has long recognized the necessity of both protecting and propagating game. It favors game laws which will protect and lengthen the life of game rather than laws which will make the greatest present amount of shooting and therefore the greatest demand for powder. Its policy in this respect is simply broad and enlightened business. In 1911, along with other manufacturers of ammunition and arms, the company became a member of the newly formed American Game Protective and Game Propagation Association. Among the honorary and advisory members of the association are Theodore Roosevelt, Henry L. Stimson, ex-Secretary of War, John Burroughs, and Dr. Henry van Dyke; an officer

of the du Pont Company is one of the directors. The company gives $5,000 a year for five years to the Association, and one of the directors of the powder company has personally given a large sum.

The objects of the Association can best be explained in a very suggestive extract from one of its recent bulletins. This extract shows that the Association is doing the most practical kind of work. After calling attention to the recent floods in the Mississippi Valley and noting that all the loss and suffering did not fall upon man, the bulletin goes on to say:

"That nice balance which exists between the various forms of animal and vegetable life when undisturbed by man and which naturalists call the balance of nature, has been rudely overthrown by the floods coming after the hand of man had already turned the scale against the creatures of forest and field. A vast stretch of territory, once teeming with both large and small game, has been submerged. Every nest that was not in the tree tops, in an area some two hundred miles wide and many times as long, has been destroyed. Probably countless thousands of birds and small animals perished. The larger animals such as deer and bear fared better, but the case of the former is a pitiable one. In response to calls for assistance, accompanied by rumors that hundreds of wild deer were marooned and starving on small islands in the neighborhood of Vicksburg, Mississippi, the Association sent out one of its special agents, Mr. P. S. Farnham, to investigate. Mr. Farnham took a trip up the Sunflower and Yazoo rivers and found that the actual conditions were not overstated in the reports. On every mound that showed out of water, were found deer which had been driven by fright and hunger to seek shelter among the natives, who,

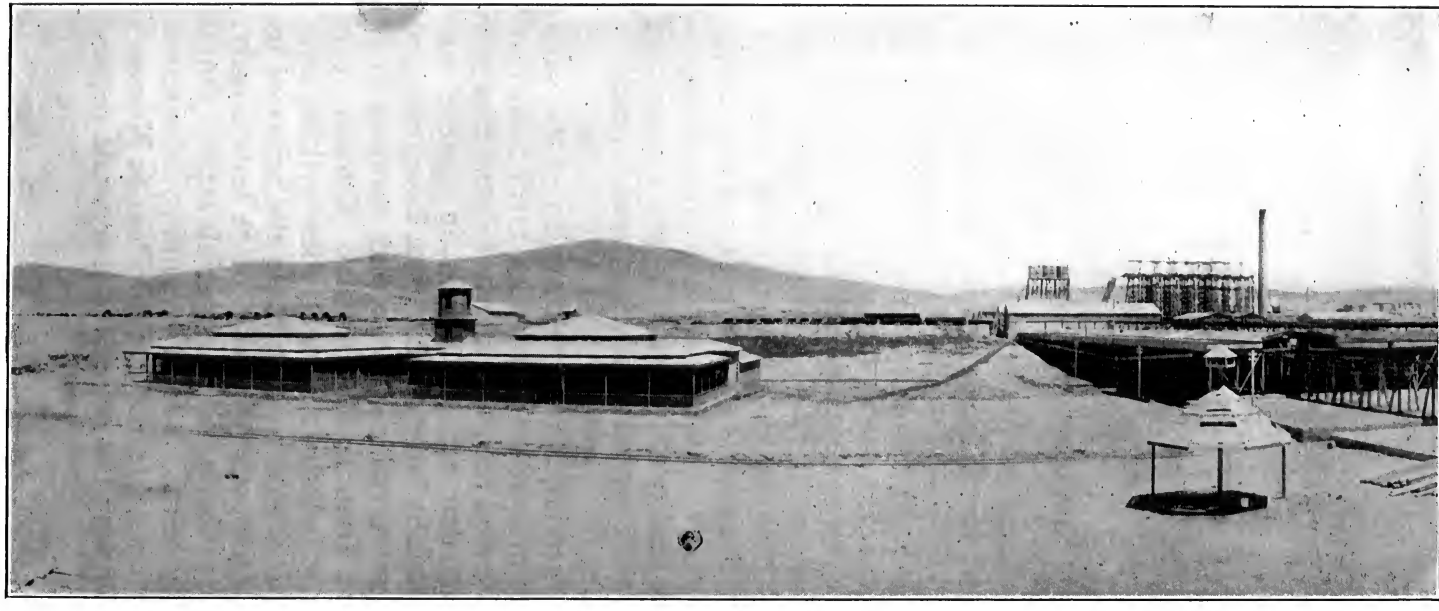
with their live stock, had also taken advantage of these refuges. On one mound of little more than half an acre in extent were found ten people, about twenty head of cattle, one hundred or more chickens, and twenty-five wild deer. Mrs. F. G. Arthur, who was on this mound, told the rescuing party she had found seventy-five deer at one time. Many of them were wounded and few of these will survive. Hundreds that had been drowned were found floating in the river. In certain sections the natives fell upon the animals as they came from the water too weak to escape and slaughtered them in wholesale numbers. The Association supplied funds and made arrangements with local sportsmen to furnish feed for as many of the starving animals as possible, but unless wise protective measures are enforced for some years to come in the flooded districts the last remnants of wild life will disappear from what has been one of the country's most favored hunting grounds."

XV

DEVELOPMENT WORK

IT is sometimes assumed that only the "ultimate consumer," so called, has to meet the problem of high living costs. Perhaps he is the greatest sufferer, but the problem is by no means solely his. In the business of manufacturing important and necessary products the same set of questions has to be met. The manufacturer is sorely pressed at times to sell his finished product at prices to which customers have long been accustomed and yet be able to secure his raw materials at sufficiently low prices to maintain both the quality of his specialty and a reasonable return upon the capital which has been invested in his business.

Without entering into any discussion of the various questions of combinations, trusts, tariff and so on, it is an undisputed fact, well known to great numbers of observers, that many products in general use which are made by large combinations have remained as stable or more stable in price than many of those which come from small factories. Certain it is that the large industry of which these articles treat has constantly sought to keep down the prices of its products. Prompted primarily, or at least largely, by the desire to obtain its raw materials at low enough cost to permit of their quality remaining unimpaired and their prices stable, the E. I. du Pont de Nemours Powder Company has organized a separate depart-



This picture gives a good idea of the Administration House, which is the flat looking building on the left. On the right you can see what is left of the old Maquina. Just in front of the Maquina is the Bateas where the nitrate crystallizes. In front of the Bateas is the Cancha with the small tracks running out over it on trestles. The nitrate is shoveled out of the Bateas into cars which are to be seen on one or two of the tracks and is run out on the trestlework over the Cancha and dumped. The little octagonal sunshade in the foreground is a hitching post for horses.

PANORAMA OF PAMPA AND OFICINA "DELAWARE" FROM THE EAST.

This picture gives a very good idea of the general appearance of this country and the Oficina complete. On the right are seen the long, low rows of workmen's houses called the "Camp." Note the many rocks lying about. In some places the broken rocks are much more numerous than appear in this picture.

ment, the Development Department, to search the world over to get an ample supply of raw materials at the lowest possible cost.

Now the problem of getting raw materials for the manufacture of explosives is a serious one. How critical, nay even vital, it may become in time of war was shown in these articles in the account of Lammot du Pont's services to the Union cause during the Civil War, when he secured a supply of saltpeter in England. Perhaps the most important ingredient of the explosives industry is nitrate of soda, and only in Chile is this to be found in a natural state. If for any reason a sufficient supply could not be found there, or bought from brokers or dealers, those who require this ingredient would be in a sad plight.

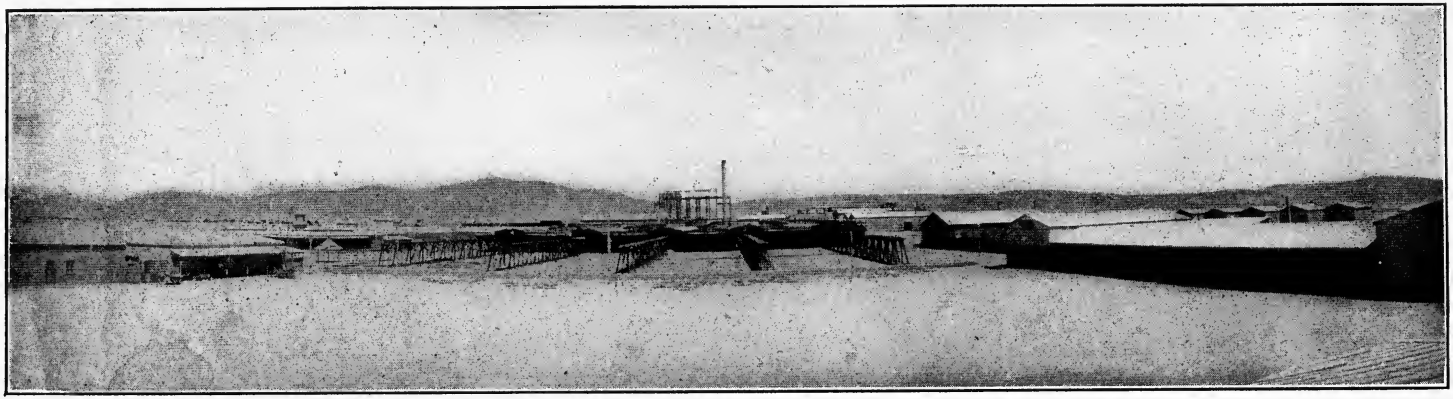
Just this sort of investigation was one of the principal reasons for the organization of the Department.

For the past nine years the study of securing nitrate of soda at the least possible cost has been carried on, and at a tremendous expense. In 1910 it bore fruit when the company purchased a large tract of nitrate-bearing land, thus introducing into the Chilean nitrate fields, for the first time, American capital for the operation of a plant with an all-American staff of engineers.

When operating at full capacity this plant will turn out 50,000 tons of nitrate of soda per year.

This demonstrates in part the duties of this Department as to treatment of many investigations, purchase of lands, erection of plant, and lastly, turning over the operation to the Operating Department.

For two years the Department has been at work developing a new process for the production of ethyl alcohol from wood refuse. While the invention is an old one, every attempt to make it a commercial success has been a failure.



This picture shows particularly the Cancha, Bateas and Maquina. The little piles of what appear to be rocks just in front of the Cancha are small piles of caliche, being the remnants of a shipment made to the States. The building on the left at the edge of the picture is one end of the Pulperia (Grocery); next to it is the Bodega (Supply House). The offices are in the same building. That part of the building which is half cut off on the right hand side of the picture is what is called the "Philharmonica," where club meetings, etc., are held. At the other end of that same building is the sack bodega, and the houses in between are living quarters for the head foremen. The five small houses in between are also quarters for the foremen. The building next in line is the electric power house and next to that the machine shop.

Rights to the use of recent new patents were contracted for, a plant erected at Georgetown, South

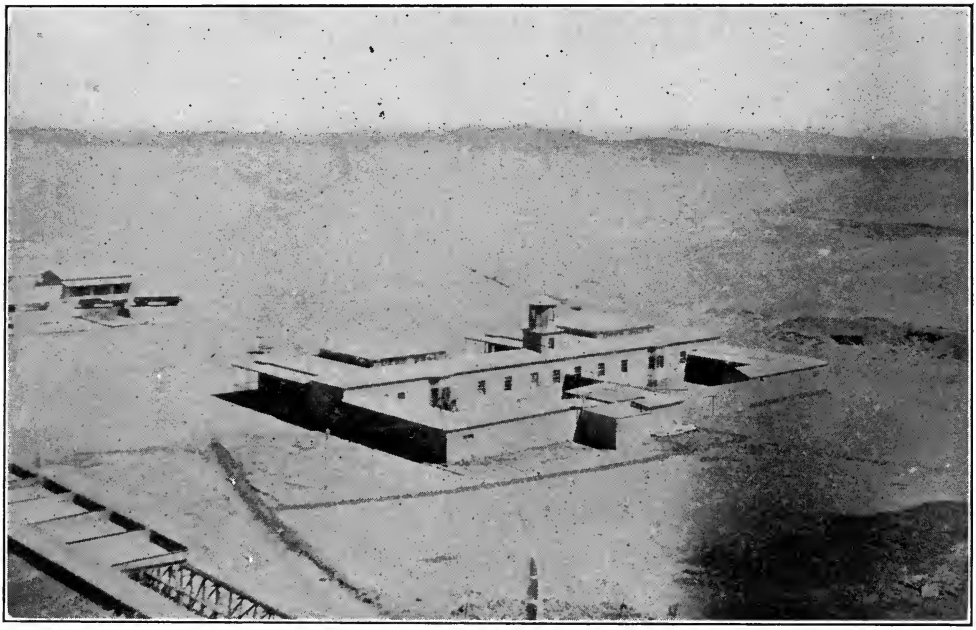
NITRATE OF SODA IN UNDEVELOPED STAGE IN CAROLINA.

Carolina, and work on perfecting the process along commercial lines has been started.

Other examples of their work along these lines might be cited but the above give a good idea of the work the Company is doing through its Development Department in order to keep its selling prices on a

fair and equitable basis, by controlling the cost of necessary raw materials.

But the work of this Department is not exactly one of research along scientific lines. It is chiefly the



ADMINISTRATION HOUSE OFICINA "DELAWARE" VIEWED FROM TOP OF OLD MAQUINA.

work of initiation and originality. It is scientific, but in an aggressive, businesslike way. This department does most of the negotiating with outside parties for the acquisition of new processes and patents. Its twenty-six active men, who are in all parts of the world, must possess a technical training, but they most need business ability and must have imagination, good judgment and that peculiar quality of tact and manner which in the jargon of the day is known as being "good mixers." For the Department is a stepping stone between the company and

the outside world. Its members attend meetings and conventions of engineers and scientists. It is their duty to keep in touch with the world and be on the alert for new things.

Among the subjects which are investigated is the advisability of going into new lines of business that are analogous to the explosive industry. For example, the company manufactures a great quantity of nitro-cellulose, for use in various explosives. But it was found that artificial leather could be made from nitro-cellulose, and so the company went into its manufacture. In other words the Development Department is always on the lookout to discover uses for the company's by-products. In connection with nitro-cellulose the Department designed and built the cotton-purification plant which is now of great value to the company.

But the activities of the Development staff extend beyond the question of materials and by-products. As men of initiative and originality they are seeking better ways of packing and transporting explosives. They have endeavored for ten years to discover a package in which to place black powder which would be absolutely safe. The present steel case is the most perfect package which has yet been used, but the du Pont Company wants something better. Again, the Development staff is studying the advisability of transporting explosives in the large cities in automobiles instead of wagons. It would be necessary in such case to have a specially designed truck. If the right truck can be designed there would be increased safety as well as a greater economy.

From this account it is clear that the men of the Development Department are scouts who seek at many points improved materials and improved meth-

ods. They employ every science, but their chief value lies in their perception of what is of business advantage and in their ability to strike out upon new and original lines.

XVI

THE PRESENT COMBINATION

IN every age and generation there are popular topics of conversation and discussion, themes of which men never tire. In the middle ages warfare was perhaps the most popular theme. To-day men are most wont to discuss business or industrial topics, "Big Business," we say. It is certain that few persons, even those engaged in classical or philosophical pursuits, fail to warm to the subject of combinations and trusts. Their opinions vary as opinions always vary in regard to engrossing matters, but the point is that here is the universal topic to which men respond.

Perhaps the very latest phase of this subject has to do with the controversy over the relative efficiency in business conducted on a very large or on a small moderate scale. No doubt the movement toward combination has been overdone in certain directions, and after history has had a chance to clear away the misconceptions that always cling to any subject when it is under hot dispute, it will be found that all the great combinations of this country have not been based upon the sound principles their promoters fondly argued for them. Certain combinations have been thrown together, as it were, partly for purposes of stock market exploitation, or at least to further the financial ambitions of men no more trained to that particular business than to a score of others. There have been great combinations which owe their

success largely to a domination of transportation facilities, and then again there have been many combinations which have not been successful at all.

It is apparent to any one who has read thus far that the E. I. du Pont de Nemours Powder Company has not reached its present size and degree of success as the result of any mania for combination or "trust" making. An industry which has been managed by one family for one hundred and ten years can hardly be accused of being the child of a brief era which gave birth to combinations on a wholesale scale. During the one hundred and ten years the industry has been managed by men trained to the powder business and not to the stock market. By far the greater part of the company's history antedates stock market and financial exploitation on the present big scale. And since the day of large corporations set in there has been no speculative activity in the securities of the E. I. du Pont de Nemours Powder Company, although its size and the intrinsic value of these securities would have warranted a high degree of speculative activity, if its managers had been inclined to permit it.

Certain it is that the growth of the business has been steady and conservative. The record of progress tells the same story whether measured by output or by financial returns to the owners. The growth of the business from 1802 to 1910 was at the average rate of 6 2-3 per cent a year, the assets in 1810 being $109,227.72 as against $81,099,908.55 on December 31, 1910. This steady rate of growth is further shown by the fact that from 1902, the year before the business assumed its present corporate form, to 1912 the average rate of increase in business done was slightly in excess of 6 per cent per annum.

In as far as these articles have been strictly historical in nature they have carried the narrative down to and including the period of General Henry du Pont, who was president from 1850 to 1889. He was followed by Eugene du Pont, who was president until his death in 1902. Up to 1899 the business had been conducted as a partnership bearing the name of E. I. du Pont de Nemours & Company, and the first corporation took the same name.

For many years E. I. du Pont de Nemours & Co., first as a partnership and then as corporation, organized and became interested in many different companies doing a similar business in various parts of the country. In numerous cases it had been joined with local interests in building plants. In other cases it had been alone in building them. In almost every instance separate corporations were formed and E. I. du Pont de Nemours & Company would generally control these separate companies, although often in conjunction with outsiders.

In 1902 Eugene du Pont died and the next generation of the family was called upon to conduct the business, T. Coleman and Pierre S. du Pont becoming associated with Alfred I. du Pont, who was already in the management. This new management on May 19, 1903, formed a new corporation under the laws of New Jersey, whose existence was to be perpetual, E. I. du Pont de Nemours Powder Co., for the purpose of consolidating into one corporation the numerous interests of E. I. du Pont de Nemours & Company. As stated by the new company in its application to list an issue of bonds on the New York Stock Exchange, "E. I. du Pont de Nemours & Company had acquired a very large property, which, through lack of organization, had become unwieldy and expensive of operation."

The du Pont interests had previously been in a peculiar position. If orders for explosives were received it was not infrequently an embarrassing matter to decide how in fairness to distribute them because the percentage of ownership varied in different plants. It was, therefore, considered much fairer to consolidate into one unit these many companies (at one time numbering some 108) which the du Ponts had been so instrumental in building up. Their affairs had previously been largely directed through one head, but as there were 108 separate corporations the method of directing them had been expensive, cumbersome and indirect.

This direct method of consolidation has been too little employed in American industrial life, for it is clearly one which makes for efficiency and responsibility. The average stockholder is bewildered by a multiplicity of corporations and those who manage these complex units have many opportunities if they desire of obtaining extra fees, commissions and salaries at the expense of the stockholder. This is aside from the simplification of management which goes with a single company.

While the separate corporations originally owned by the company were dissolved, the distribution of their plants throughout the various states remained. In 1910 there were sixty plants owned and operated by the company in the states of Alabama, California, Colorado, Connecticut, Delaware, Illinois, Indiana, Iowa, Kansas, Maine, Michigan, Missouri, New Jersey, New York, Ohio, Oklahoma, Pennsylvania, South Carolina, Tennessee, Washington, West Virginia and Wisconsin. This distribution of plants through twenty-two states afforded tremendous economy in the matter of haulage and freight rates, ob-

viated the danger of haulage, and also placed the company in a position to take advantage of all favorable local conditions. Under such conditions orders received could be filled by the plant nearest the ultimate destination of the purchase and thus make for safety and economy.

The foregoing statements are of great importance in considering the success which has attended the present management of the company, which is composed of the following board of directors: H. M. Barksdale, F. L. Connable, Alexis I. du Pont, Alfred du Pont, Eugene du Pont, H. F. du Pont (Winterthur, Del.), Irénée du Pont, P. S. du Pont, T. C. du Pont, A. J. Moxham, J. A. Haskell (Red Bank, N. J.), Henry Belin, Jr. (Scranton, Pa.), Charles L. Patterson, Francis I. du Pont, E. G. Buckner (Wilmington, Del.). The following Executive Committee: T. C. du Pont, Chairman, H. M. Barksdale, Alfred I. du Pont, Pierre S. du Pont, J. A. Haskell, A. J. Moxham and Charles L. Patterson; and the following officers: T. C. du Pont, president, chairman of Board of Directors and chairman of Executive Committee; H. H. Barksdale, E. G. Buckner, Alfred I. du Pont, J. A. Haskell, A. J. Moxham, Charles L. Patterson, vice-presidents; Pierre S. du Pont, treasurer; Alexis I. du Pont, secretary.

The degree of success attained by the company can perhaps be measured best by the fact that the explosives manufactured by it have been lower in price in the last few years than at any other time in the history of this country, regardless of the extent to which prices of raw material and other products have risen. The policy of the company has been to sell at prices only enough above the cost to net a fair return upon the capital actually invested. In a previous article

mention was made of the work which the development department does in the direction of securing raw materials at the lowest possible cost. The company through its established agencies abroad and through foreign banking connections has been able to take advantage of market conditions for raw material such as a less perfected organization would be unable to do. As stated in the annual report for 1911, the policy adopted by the directors is to give to customers a considerable measure of the increased profits through reductions in prices.

The fact that prices of the company's products are low is very largely due to the opportunities to eliminate waste which the bringing together of more than one hundred entities into one entity has made possible. The large expenditure of capital in the production of raw materials and other means employed to keep down the cost of manufacture would never have been possible without highly centralized organization.

Nor must it be supposed that the E. I. du Pont de Nemours Powder Co. has attained its present position without facing strong competition. The competition existing in the explosive industry at the present time is so great that it would be possible for the black powder manufacturers of the country which compete with the du Pont Company to supply every keg of powder used in the country by employing their full capacity. And if the du Pont mills, one and all, were to close to-day it would be possible for the competing manufacturers of high explosives by working a little overtime to supply the entire high explosive requirements of the United States without importing one pound from abroad. It needs no further statement to show that the success of the du Pont Company has not been due to any sole or undisputed occupancy of its field.

1810-1910

One Hundred Years Ago		A Century's Development
	ASSETS	
$ 66,477.72	Cash, Accounts Receivable, Materials, Finished Product	$22,947,529.74
0	Investment Securities	4,208,200.50
21,100.00	Real Estate	844,601.28
21,650.00	Permanent Investment in Manufacture	53,099,577.03
$109,227.72	Total Assets	$81,099,908.55
	LIABILITIES	
$ 27,887.36	Accounts and Bills Payable	$ 1,434,425.57
0	Miscellaneous Deferred Liabilities	1,527.21
1,091.05	Funded Debt	16,548,000.00
36,000.00	Capital Stock—Preferred	15,893,248.41
0	Capital Stock—Common	29,426,548.45
0	Contingent Liabilities	2,645,132.75
44,249.31	Profit & Loss	15,151,026.16
$109,227.72	Total Liabilities	$81,099,908.55

E. I. DU PONT DE NEMOURS POWDER COMPANY

COMPARATIVE STATEMENT OF EARNINGS — NINE MONTHS ENDING SEPT. 30

	1911	1912	Decreases	Increases
Gross Receipts	$17,987,364.88	$17,152,766.04	$834,598.84	
Net Earnings	$ 3,438,331.42	$ 3,301,729.63	$136,601.79	
After deducting all expenses incident to operations, including those for ordinary and extraordinary repairs, maintenance of plants, accidents, depreciation, etc.				
Non-Operative Items	$ 67,296.31*	$ 38,390.19*		$28,906.12
Resulting from sale of real estate, securities and other transactions not due to current operations.				
Accrued Interest on Bonds to date	378,006.25	377,185.24	$ 821.01	
Accrued Dividends on Preferred Stock to date	395,779.45	373,294.05	22,485.40	
Total Deductions from Net Earnings	$ 706,489.39	$ 712,089.10		$ 5,599.71
Balance Applicable to Dividends on Common Stock	$ 2,731,842.03	$ 2,589,640.53	$142,201.50	
Common Stock as per balance sheet	$29,426,386.03	$29,426,548.45		$ 162.42
Percentage Earned on Common Stock	9.28%	8.80%		
Percentage Earned on Com. Stk. Equivalent to Annual Rate of	18.56%	17.60%		
Net Earnings Equal Annual Income on Gross Investment of	8.09%	8.00%		

* Indicates Profit.

XVII

FINANCIAL AND INVESTMENT POSITION

IN the previous chapter the fact was commented upon that securities of the E. I. du Pont de Nemours Powder Company have never been made the football of speculation. But the success of this company has been measured not only by the growth of its business but also by the increasing financial returns to its owners and the quiet but steady appreciation in the investment value of its securities. One may say that the du Ponts as a family have desired that other owners should share their prosperity. They have taken more pride in the fact that others have shared in increasing financial returns than in their own pecuniary success. This attitude is the more commendable because it has not been forced upon the du Ponts. They have always been in control of the management, and it has been a sense of justice rather than a sense of possible dethronement which has impelled them.

When the present company was formed the many separate organizations controlled by the du Pont family and their associates were taken over. It will be recalled that local interests in many parts of the country had often shared in the building and ownership of these many separated plants, and the new company, therefore, proposed to them that they exchange their holdings in the many small subsidiary companies for stock in the large company upon pre-

cisely the same basis as the du Pont interests had exchanged their holdings. The fairness of this offer to the minority interests is best reflected in the fact that all accepted except in two or three cases where legal entanglement in estates prevented.

The same fair policy has marked the financial administration of the company in more recent years. In October, 1907, an offering of $2,500,000 common stock was made to the stockholders, and, while this issue was underwritten by T. Coleman, Pierre S. and Alfred I. du Pont, every other stockholder was given the privilege of joining the underwriting arrangement. He could join to the extent of 10 per cent of his holdings in stock, by agreeing to pay cash for the quota of stock not taken in the regular way, in return for which service the company was to pay him 10 per cent in cash of the par value of all stock thus taken up by him. As a matter of fact the underwriters were not obliged to "make good" on their agreement because this offering of stock as well as every other offering of securities made by the company was fully taken by the stockholders themselves.

The company has made three public offerings of securities since its formation. One was an offering of bonds through the New York banking firm of Harvey Fisk & Sons. These bonds were largely taken by investors generally. The other offerings were of stock and were made only to shareholders. All offerings have been oversubscribed, and those who have purchased the securities have benefited because they have steadily risen in value. In August, 1910, common stock was sold at $140 a share and its price now ranges around $200. Preferred stock was offered in 1910 at 80 and its price is now about 98½. The bonds, which bear interest at the rate of 4½ per

cent, were offered by Harvey Fisk & Sons on March 26, 1910, at 88½ and are now selling at about 91. The appreciation in prices has been in response to growing values and has had nothing sudden or speculative about it.

Mention has been made in an earlier installment of the sharing of the du Pont employés in their company's prosperity. It is apparent that stockholders have also shared in this prosperity. Regular dividends of 5 per cent a year have been paid on the preferred stock since the company was organized in 1903, and the following dividends have been paid upon the common stock:

1904	½%
1905	3½%
1906	6½%
1907	7 %
1908	7 %
1909	7¾%
1910	12 %
1911	12 %

Despite this highly profitable record the ownership of the company has not remained closely concentrated. In 1907 there were 809 stockholders and by 1911 the number had increased to 2,163.

The company early adopted an enlightened policy of publicity regarding its affairs. It was one of the first of the large industrial corporations to publish a quarterly statement of earnings. These statements are given wide publicity and keep the stockholders fully informed of the financial condition of this company. In addition, a full annual report is issued. The quarterly statements are comparative and thus are more intelligible than many which are issued.

The company has adopted the policy of making a full and regular depreciation charge and it does not reduce this charge in times of slack business as so many corporations do. A depreciation fund has been established which cares for the writing off of antiquated plants and machinery, and likewise renewals and repairs are taken care of. In general it may be said without reserve that the company's reports are among the best issued by industrial corporations.

It should be noted that from August 1, 1903, to December 31, 1911, the new money invested in the company amounted to $25,269,795.87. This new capital may be summarized as follows:

From sale of bonds	$ 1,088,800.
From sale of preferred stock	2,120,887.98
From sale of common stock	5,397,352.48
Accumulated earnings carried to surplus account	16,662,755.41

The plants of the company are so widely scattered that the danger of really serious loss through destruction is reduced to a negligible quantity. The company carries its own insurance, and the fund set apart for this use has proved more than adequate to offset all losses sustained through explosions, fires and accidents of every kind, and after the payment of all such losses had grown to $1,651,975 on December 31, 1909.

It may finally be noted that the earnings of the company have been sufficient in recent years to meet more than nine times over the interest on the bond issue, and after that interest had been paid there has remained enough to pay dividends on the preferred stock about six times over. As we have already seen, 12 per cent has been paid on the common stock in the last few years, and after meeting common stock

dividends a sum of upwards of $17,000,000 has been appropriated to surplus account in the course of about eight years. At the present time the only important issues of securities which the company has outstanding are the 4½ per cent bonds, $14,452,200; preferred stock, $15,893,248; and common stock, $29,426,386.

Such then is the history of the du Pont powder industry. It is truly a record of progress and sustained work in many directions. The industry is a great one and it has accomplished great things during its one hundred and ten years of uninterrupted existence. It certainly deserves and will secure a permanent place in the history of this country.