Uncle Sam Develops the World's Greatest Phosphate Mines

Government Figures Show Deposits in Florida Contain 52 Per Cent. of Known Supply and 80 Per Cent. of That Found in This Country

Invaluable Peace Time Asset in Resources Brought to Attention by War Needs—Vast Holdings Near Tampa Taken Over From German Control

TAKING account of stock is now one of the principal and vital occupations of the entire world. On every hand, in every land, merchants and manufacturers are preparing for the after the war demands for their goods.

Back of this Governments themselves are figuring on their natural resources. Largely upon these resources rests the continued prosperity of any nation.

Restrictions on international commerce during the war threw every nation on its own resources to a very great extent and focused attention on these resources considerably more than was necessary in times of peace. In this country some very interesting "discoveries" were made when we came to the stock taking of our natural resources, discoveries which were in more than one case of a surprising nature.

Take an instance in Florida. Every one of course is aware that this far Southern State produces most of the fresh vegetables utilized in the Northern and Eastern States during the winter and early spring months. We have also come to look upon the country discovered by Ponce de Leon when in search of the fountain of perpetual youth as the great restorer of the "youth" of the nation to-day as our great winter playground. But there are few Americans who have ever looked upon Florida as a mining State of importance.

World Demands Phosphate.

So to many it will come as a surprise to learn that in one mining product, phosphate, Florida to-day produces about 52 per cent. of the entire world's supply and about 82 per cent. of the supply of the United States; and the war has shown how exceedingly important and valuable a product this is both in time of war and in peace. Incidentally these phosphate beds underlaying to a greater or less extent almost the entire surface of the State are one of the great reasons for the wonderful productivity of Florida soil.

Although they have been known to some and worked for years it was not until 1917 that Uncle Sam really turned his attention seriously to the Florida mines as one of his greatest natural assets.

At that time a very general effort was being made to increase the production of phosphate rock owing to the conviction that the people of the United States must greatly increase their production of foodstuffs. Besides supplying food for ourselves we were more and more importantly required to make large shipments to our allies. But there was a tremendous difficulty in the way which every practical farmer in the United States realized—the shortage of fertilizer. A great increase in the production of foodstuffs or intensive agriculture implies a much greater use of fertilizer. To get this fertilizer meant a more energetic mining of phosphate rock. It was then that eyes were turned toward Florida, and despite many handicaps (the shortage of ships, railroad cars, congestion of freight and scarcity of labor) Florida phosphate miners did their bit.

Not Only Cigars in Tampa.

Many have heard the slogan "Tampa without a chimney makes the whole world smoke," because the south Florida city for years has maintained the world's lead in the manufacture of clear Havana cigars, but few people know that in the vicinity of Tampa there are in the ground and yet to be mined the greatest and richest beds of phosphate to be found in the entire world.

To keep our farmers supplied with their badly needed fertilizer the war quickly gave Tampa the distinction, which she is likely to hold indefinitely, of being the largest shipper of phosphate rock in the world. The facilities at the port of Tampa were developed until they are now the finest in the world for the loading of this product, and the port has the distinction of having the world's fastest phosphate loading elevator. It is possible for large vessels to arrive, take their full cargo and depart in the same day.

With her present facilities Tampa can ship through her port alone something over 1,000,000 tons of phosphate a year. In normal times most of the rock is carried to the markets of the world by boat because of the cheaper rate than by rail and a number of boats were engaged regularly in this traffic. When the war broke out the Government commandeered some of these craft, but when the importance of the phosphate industry to the Government and to our farmers was pointed out the boats were allowed to continue in the trade.

We had not been in the world's conflict long before it was discovered that Germany, with her wonderful trade forsight, had control of some of the best of the phosphate mines in the vicinity of Tampa. The Custodian of Alien Enemy Property, however, quickly was on the job.

Much Used in Munitions.

Every one knows the importance of phosphorus in the making of explosives and war munitions. Now a charge of phosphate rock, coke and sand, upon being heated in an electric furnace, yields about 86 per cent. of crude phosphorus. This crude phosphorus is purified by filtration through porous tile, chamois skin or canvas, the operation being carried on under lukewarm water, which keeps the phosphorus liquid.

Phosphorus usually is marketed in the form of sticks, which are made by conducting the phosphorus from the melting pot through a pipe surrounded by water. It solidifies in the pipe and can be removed as a continuous rod.

Perfectly pure phosphorus is a white, transparent, waxy solid, but commercial phosphorus is generally yellowish, owing to its content of allotropic red phosphorus. Almost every time we strike a match, we burn some red phosphorus, as it is employed very extensively in the manufacture of matches. It usually is made by heating yellow phosphorus in iron pots provided with air tight lids, which, however, bear a long pipe open to the air. A small quantity of the phosphorus combines with the oxygen in the vessel, and the operation then is practically conducted in an atmosphere of nitrogen, which affords additional safety from explosion. The product is ground under water and any unchanged yellow phosphorus it may contain is eliminated by boiling it with caustic soda. The product is then washed and dried and finally packed in tin boxes.

But this is by no means the whole story of the importance of the Florida phosphate mines, as there are various valuable medicinal preparations of phosphorus. Owing to its remarkable influence on the growth of bone in young animals, it has been used in the treatment of rickets and osteomalacia. Its most effective use, however, is as a nerve tonic in paralysis agitans, locomotor ataxia and nervous exhaustion. It also is a remedy for skin diseases. The hypophosphites have been recommended as a remedy for pulmonary affections, in which they are said to act as free phosphorus without being irritant and the glycerophosphates are useful to stimulate metabolism. Dilute phosphoric acid is used as a gastric stimulant.

Bronze manufacturers have long been aware that their product is greatly improved in quality and strength when fluxed with phosphorus. The alloys prepared in this way, known as phosphor bronze, may contain only about 1 per cent. of phosphorus in the ingot, which may be reduced to a mere trace after castings, but the phosphorus nevertheless enhances their value for use in making implements which require a hard, strong metal, such as pump plungers, valves and the bushes of bearings.

Smoke Screens of Phosphorus.

One of the most important constituents of the material used in distress signals at sea is phosphorus in the form of calcium phosphide. As various phosphorus compounds make a very dense smoke, this fact was utilized in a most curious way during the war, when clouds of phosphorus smoke were constantly employed to conceal vessels in danger of submarine attack, and many valuable cargoes and craft were saved in this manner.

Acid phosphate, for years one of our most popular soft drinks, could not be manufactured or served at the soda counter if it were not for the output of the Florida mines.

The methods of phosphate mining in Florida are entirely different from all other mining operations and very varied and interesting. There are several natural variations of phosphate, known principally as hard rock, soft and pebble, and they are all frequently found in close conjunction, but they require different mining and handling.

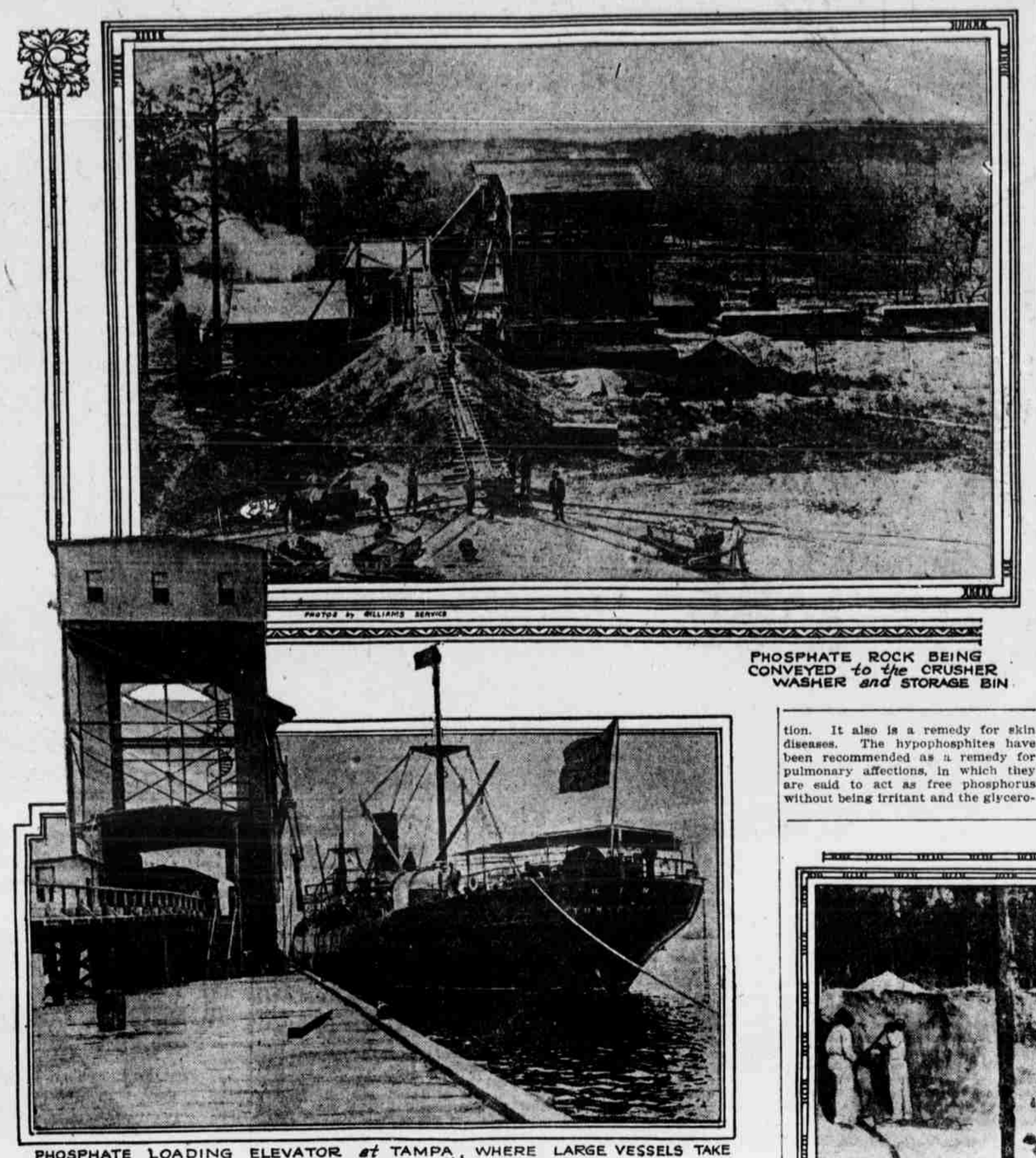
Literally speaking the phosphate mines are properly open pits dug down for many feet below the surface of the earth. Almost all the work in the mines is done by negro labor. In some cases phosphate rock as it is loosened by the laborers in the pits is shoveled into buckets attached on a derrick boom, by which means they are lifted with their contents to the surface. As a rule a pick and shovel are the tools used by the miners, but in other instances the surface first is stripped with horse scrapers and then the miners dig the phosphate carefully out by hand from between limestone cones.

What is known as pebble phosphate is mined principally by hydraulic power. This pebble phosphate is raised from the pits by electric driven pumps and forced through ten inch pipes to washers on the surface.

When the soft phosphate is brought to the surface it is conveyed to a rotary kiln, where it is dried. It is then taken to crushers and pulverizers in a house above the kiln. When pulverized the product is conveyed by air through pipes and by cars in covered trestles to the storage and sacking house, after which, it is ready for shipment.

Hard rock phosphate is dried in sheds especially constructed for the purpose. The rock is then piled on wood, which is set on fire. After this process has been completed the phosphate is ready for pulverizing and sacking.

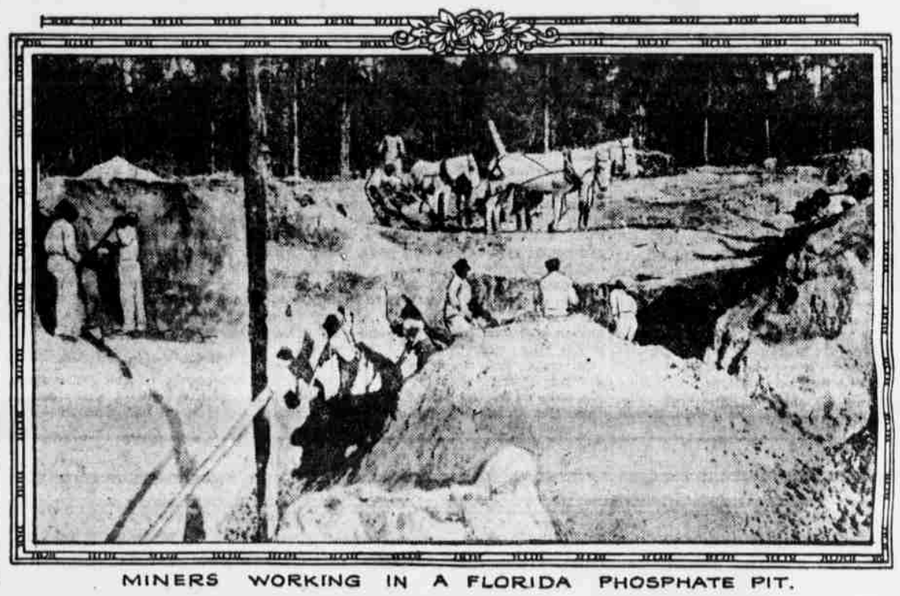
In some cases the hard rock phosphate mines are flooded and the pits are worked by floating dipper dredges, which lift in huge scoops the dripping rock to small mine cars, in which, by means of cables, the product is conveyed along trestled railroads to the plants above, where the phosphate is dried and prepared for shipment.



PHOTOS by WILLIAMS SERVICE

PHOSPHATE ROCK BEING CONVEYED *to the* CRUSHER WASHER *and* STORAGE BIN

PHOSPHATE LOADING ELEVATOR *at* TAMPA, WHERE LARGE VESSELS TAKE FULL CARGO AND DEPART *the* SAME DAY.



MINERS WORKING IN A FLORIDA PHOSPHATE PIT.

Nature's Greatest Secret, the Might of the Atom, Stirs Scientists

Continued from First Page.

as Mars would be from Venus in our own solar system. Prof. Harkins, however, draws attention to the space arrangement of the electrons, that is their third dimension distribution, for they are not on a plane as are the planets. Thus each nucleus, depending upon the nature of the substance, may have from one to ninety-two electrons. He says that the helium atom would in the last analysis be the most difficult to disintegrate.

The tempest in the atom is well described by James Allen Crowther of St. John's College, Cambridge University, England, who made a series of experiments in the Cavendish Laboratory, where he was associated with Prof. Sir J. J. Thomson. He describes, for instance, the manner in which the radium atom breaks up. "Its energy content," he writes, "becomes too small for its mass, and a small fragment of it which we must regard as having been whirling round in the atom with great velocity is projected like a stone from a sling, or rather like one of the fragments of a bursting flywheel. This atom is always an atom of helium—why we do not know. The residue of the atom, its atomic weight now reduced to four, forms a new substance, which in this case happens to be gaseous.

"The emanation itself is very far from being stable. It is half decomposed in a little less than four days, the new decomposition product being in this case a solid. Thus we may give at a glance the interesting but pitiful story from the break up of the original uranium atom to that of polonium, the last member of the chain to be definitely identified."

Crowther declares that although there is not yet formal proof there is evidence that all kinds of matter are radioactive. He raises the question: "Is the atom born to grow old, decay and die?"

He would know if new atoms are being formed in the secret places in the universe to take the place of those which have passed from material ken. He declares that here man is brought face to face with one of those facts which science has not yet illuminated.

If the light is not very strong, there are at least glimmerings which help show the outlines of fact. The genius of Rutherford has informed us much about the disintegration of the atom. Surely the strong and active emanations from radium, which can scorch and heal, are indices of the mighty power which is locked up in this atom battered out of its place at the periodic table and cast into outer darkness.

The investigations of such distinguished physical chemists as Dr. W. A. Noyes of the University of Illinois, who last Friday received the award of the Willard Gibbs medal for his work on valences and kindred subjects, have thrown much light upon the nature of the atom.

"Radium," said Dr. Noyes, "and other radioactive elements disintegrate spontaneously and continuously with the formation of other elements. During the process heat is generated and the quantity of heat is immensely greater than that which can be obtained by the chemical interaction of any other forms of matter. It seems certain, therefore, that the atoms of radioactive elements are storehouses of tremendous quantities of either moving or potential energy. We have very strong reasons for thinking that the atoms of other elements also contain large amounts of energy. If some method of unlocking this energy and of making it available can be discovered the prophecy of Sir Oliver Lodge will come true. At present we have no means by which we can use this source of energy in a practical way and no hint as to the direction in which we should search. While any discovery or invention of this sort seems now very improbable, scientific men would not be inclined to say that it is impossible."

The technical and scientific world is discussing these days with keen zest the remarkable paper of Dr. Irving Langmuir of the General Electric Company of Schenectady, N. Y., who is a practical and research physicist of high standing. Observations in the brilliant review of them by Elwood Hendrick, the president of the Chemists Club of this city, indicate that they should have a most important bearing upon the development of chemistry. Dr. Langmuir, whose subject was "Arrangement of Electrons in Atoms and Molecules," traces the relationships of the elements in new ways and by diagrams illustrates many forms of atomic structure. His postulates are regarded as epoch-making in physical chemistry. They account for the conditions in the world of atoms in a way which will be an important aid to scientists who have to deal with this newest study of matter.

"The properties of the atoms," to quote from the seventh postulate of Langmuir, "are determined by the electrons in the outside layer and the ease with which they are able to revert to more stable forms by their giving up and taking on electrons or by their sharing outside electrons with atoms with which they combine."

Throughout the entire paper are many references to the forces of the atomic realm, both magnetic and hydrostatic.

"The utilization of the force of the atom," said Dr. Langmuir in response to a request from THE SUN for his views of the forecast of Sir Oliver Lodge, "has been in the minds of scientists for several years. I have often thought of it myself. It has been pretty generally recognized that all matter contains enormous amounts of stored energy, which is present in the form of what we may call atomic energy. Since you are more or less familiar with my recent publications on the structure of atoms, I may say that this enormous store of atomic energy resides within the nuclei of the atoms. These nuclei are extremely small, having a diameter which is probably somewhere near one one-millionth of that of the atom itself, or having a volume which is a billion billion times less than that of the atom.

"According to the 'relativity theory' (which is a very abstruse theory, understood well only by relatively few scientists, but which is generally accepted by them) each unit of weight (as for example a gram or a pound) of matter contains exactly the same amount of energy. In fact, each gram about the decomposition of these nuclei we shall undoubtedly be able to of matter, no matter what its composition may be, contains about thirty million kilowatt hours, i. e., if we could get the energy out of a single gram of matter we might theoretically be able to utilize this to run a 5,000 horse-power engine for about a year.

"For a good many years I have known of these facts, and I have been much interested in speculating as to how such energy could be rendered available.

"The more I learn about atoms, however, the more difficult the problem seems. You see the difficulty is that this energy is contained within the excessively small nucleus, and this nucleus is surrounded by an enormously strong field of force. We have, therefore, no 'tools' by which we can act on this small nucleus in any effective way. Chemical reactions, even of the most violent kind, only cause disturbances in the outside portions of the atom, and seem to have no effect whatever on the inner portions of the atom surrounding the nucleus.

"A couple of months ago Sir Ernest Rutherford published a series of papers in the *Philosophical Magazine* (of London), in which he described experiments where by the use of radium he was apparently able to bring about (to a very small degree) the decomposition of some of the nuclei of atoms of certain gases. This is the first step that I know of in which it appears that man has been able to control processes involving the decomposition of nuclei.

"It is, perhaps, not yet certain that this result was accomplished by Sir Ernest Rutherford, and further confirmation of these experiments is needed before we can be sure, but I think it is highly probable that within the next few years we will learn a great deal more about the structure of the nucleus of atoms, and perhaps discover more effective means by which changes in the nucleus can be brought about. One thing is certain, and that is that the nucleus of most atoms is a complex structure consisting of many smaller units, and if we can bring derive energy from the resulting changes.

"As I have pointed out, however, the problem is an extraordinarily difficult one, and although I consider it probable that this source of energy will ultimately be utilized by man, probably to the exclusion of most other sources of power utilization, I do not feel that it will be a long time before this is accomplished; probably many decades, if not centuries.

"I agree with Sir Oliver Lodge to the extent that I would consider that it would have been very unfortunate to the world as a whole if, for example, the Germans had had available the sources of energy that may some day be derived from atomic energy."

With all the thought which has been bestowed on the subject of atomic force in the last few months, no one has as yet devised a means of utilizing it. Where is the atomic engine of which Wells so eloquently writes?

Very likely the development of the harnessing of atomic energy will come along much the same lines as did wireless telegraphy, to which Sir Oliver Lodge referred in his centenary address. After what has been done in a few years by the transmission of the Hertzian waves through the air and their adaptation to a system of signalling there need be no one who will declare that the age of miracles is past. The adaptation of the force of the atom to the uses of man is no more chimerical now than was the proposal years ago to make the earth a great whispering gallery without the use of wires.

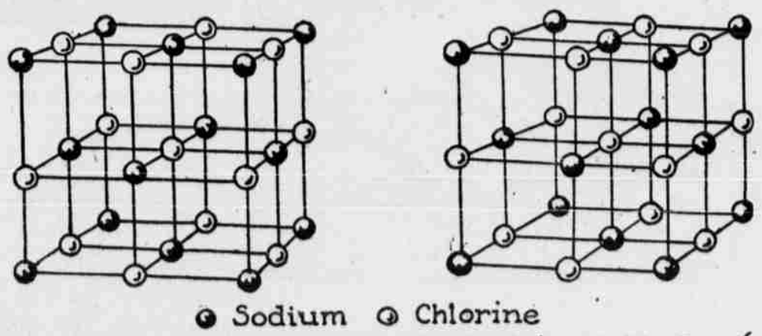
The velocity of atoms may be considered as approaching that of molecules or particles; that is about one-fifteenth of the velocity of light, which would enable them to make from the earth to the sun in about two hours.

Prof. George B. Pegram, the head of the department of physics at Columbia University, said the other day that he point raised by Sir Oliver Lodge as to the moral fitness of the human race to take upon itself the responsibility for the handling of the atomic forces was worthy of the most thoughtful consideration.

Whether or not all combinations of atoms would yield this new energy is a matter for the scientist to estimate according to his set rules. In some of the elements the atomic forces are undoubtedly much weaker than they are in others.

Dr. Whitlock whose investigations have been mainly along the lines of the study of crystals expressed much interest in the atomic energy, although he said that at this time it was most difficult for any one to foresee what progress would be made in bringing it under the control of the race.

What with the molecular forces nearing exhaustion, such as is shown in the gradual failing of the coal measures, the disappearing of the forests and the scant and uneven water power that exists in many localities, there are strong reasons for the extension of research into the development of the force atomic. When that is done many a pet theory of chemistry and physics will have to go by the board. Whatever happens, the day of the atom is nigh, for modern science despises not the day of small things and if it come men will indeed have read a riddle of the universe and made themselves like the demigods of old.



● Sodium ● Chlorine

STEREOSCOPE CARD SHOWING ACTIONS *in* MOLECULE *of* COMMON SALT. THE READER CAN CUT IT OUT *and* PUT IT IN A STEREOSCOPE *and* THUS SEE *the* DIMENSIONS *and* SUSPENSION *by* ATOMIC FORCE

Facts About the Life of Guns.

THE life of a gun depends upon the progress of erosion, which sooner or later is certain to impair the accuracy of fire. Erosion is caused by the action of the explosive gases at high temperature and pressure. The hot gases cause a thin film of steel to absorb heat. The film expands and becomes set. Upon the release of the pressure it contracts, which action causes minute cracks that grow larger with every discharge. As they increase in size they form passageways for more hot gas, and that tends to enlarge them still further. The inner surface thus becomes roughened and the bands begin to corrode.

Finally the bore becomes so enlarged that it allows the gases to escape. The shell does not then acquire its proper rotation, and its flight becomes erratic. All guns except small ones are now constructed with linings in the tube, which, when the bore is worn out, are removed and replaced by new ones. The cost of relining a gun is approximately 30 per cent. of the cost of the gun. There appears to be no limit to the number of times that a gun can be relined.

The small arms used by the United States Army are considered to be worn out after 5,000 to 7,500 rounds have been fired. Small naval guns can be fired about 1,000 times before they are regarded as worn out. Large twelve inch and fourteen inch naval guns are considered to have a life, on one lining, of from 150 to 200 rounds. Low velocity guns, such as howitzers and mortars, have correspondingly longer lives than high velocity guns of the same calibre, because of the pressures they develop, and hence the lower temperatures.

Wealthy Fliers in Japan.

WEALTHY men in Japan have turned to airplaning as a sport. Many of those who made fortunes during the war in manufacturing munitions and building ships are neglecting their motor cars to devote time to skimming through the air. The Japanese Government is encouraging the inpovation in every way, for it is realized that the more persons who indulge in the pastime the greater will be the prospects of progress in aviation in the Island Kingdom.

Japanese have a natural leaning toward aviation, for, like the Chinese, they are great kite fliers, young and old indulging in the sport. Large kite-flying tournaments are held and contests take place in which the fliers compete for prizes awarded by judges by a point system that is hard for an Occidental to understand.

In aviation most of the machines used have been of foreign make, but it is expected that the home production will equal soon both the government demand and that for recreational purposes.

Tsunetaro Oguri, a civil aviator, was delegated by the Mitsubishi firm to come to the United States to study the latest military airplanes. The company is having an extensive aviation factory designed under the direction of Dr. Ito and it has bought a foreign patent for flying motors. Twenty operatives were sent to France and Italy by the firm to look into all latest improvements in the aviation line. The company expects to devote most of its energies in supplying planes to the Japanese army.

The Kawasaki Shipbuilding Company will establish a factory for flying machines near Kobe, its output to be designed mainly for the Mikado's navy. Lieut. Himasu was sent to France to glean pointers for the project.

Wars Then and Now.

IN times past when the country was in danger and wars had to be fought the United States Army was recruited almost entirely from volunteers. The brave and the patriotic rushed to the colors to do whatever task was needed for the defence of the flag and then go home. The American Revolution was successfully fought by volunteers who went back to the farms for their spring ploughing. These soldiers had dropped their occupations only when their own firesides were threatened, but it took the United States eight years to win the American Revolution.

This war was fought on a different basis. The people of the United States decided to organize to win the war in the shortest possible time. Through Congress and the President the people of the United States established the draft and universal military service for the duration of the war. An army of four million men was mobilized by the Government, trained and equipped and sent to France. We won the war sooner than we expected—about three years sooner.

And now that the great army is being demobilized at the rate of 200,000 to 300,000 a month the soldiers cannot be left to drift back into jobs. The work of getting jobs for the soldiers and sailors who have lately served the United States has been organized. The United States Government is guiding this work. Under the guidance of Col. Arthur Woods, former Police Commissioner of the city of New York and now assistant to the Secretary of War, all the Federal departments, the Governors of all the States and the Mayors of the principal cities are cooperating to give soldierless jobs to the jobless soldiers.