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THE NEW ELEMENTS IN THE AIR.

We are not at all surprised nowadays at scientific discoveries, even when they are of prime importance. We are apt to receive news of them as a matter of course. Within a week we have had the synthetic production of albumen demonstrated before a learned body, and within a month "coronium," which has been supposed to exist only in the sun, has been detected in solfatara gases, and the Italian scientists gravely observe that "there are probably other new elements in these gases." In June last, Prof. Ramsay announced the discovery of "krypton," a new gaseous element existing in the air, and close on its heels come two other elements, also obtained from the atmosphere, which have been named "neon" and "metargon." Krypton was named from the Greek word "krypto," meaning "to hide," and it was well named, for it eluded the vigilance of even the great chemists who have for a long time paid strict attention to the study of gases and the atmosphere, so that Prof. Ramsay scores one more brilliant victory over the unknown, which adds to his triumphs of the discovery of "helium," and jointly with Lord Rayleigh of "argon." For nearly two years, Prof. Ramsay and his assistant Maurice Travers have been searching for gases allied to them. In a brilliant paper read before the Chemical Section of the British Association, he gave his reasons for believing in the existence of an undiscovered gas. This is only another proof of our wonderful advance in science, when the discovery of an element can be predicted with reasonable certainty.

The search for the suspected gas was a long one. It was begun by examining the gases from various minerals and mineral springs and by fractioning helium through porous plates. It was not considered probable that another element would be discovered in the atmosphere, which had so recently furnished argon and helium, but finally mineral gases were discarded and atmospheric air was examined, with the result that "krypton" was discovered in liquid air, which is now fortunately available for physical and chemical purposes. About 750 cubic centimeters of liquid air were reduced by careful evaporation to 10 cubic centimeters, and the residue, if it may be so called, collected. The oxygen was extracted by means of red hot metallic copper, the nitrogen with the electric spark. Finally a mixture of magnesium and pure lime was used to deprive the gas of the oxygen which was left. There then remained a small quantity of gas, which was sealed up for the purpose of experiment in the Pflücker tube. The poles of the tube were now connected with an induction coil, a current was passed through, and the now isolated gas was examined with the spectroscope. It presented a weakly defined spectrum of argon and two strikingly brilliant lines not previously recognized, one corresponding to the yellow of helium and the other to the green line of helium. It has been suggested with some show of reason that the previously accepted lines of helium may have been partly influenced by the slight admixture of this then undiscovered element which we now call "krypton." Prof. Ramsay states that both he and Sir William Huggins are of the opinion that the green line of "krypton" is identical with the green line of the aurora, so that we again have an interesting fact when taken in connection with the finding of terrestrial coronium. The density of the new gas is approximately 22·5. It is an element and is monatomic. It is placed in the periodical table by Sir William Crookes between bromine and rubidium, and has an atomic weight of about 80.

The discovery of "neon" and "metargon" is also very interesting. The experiments were also carried on by Prof. Ramsay and Mr. Travers. A quantity of argon was liquefied, forming a colorless liquid, but a considerable quantity of solid substance was observed to separate and form around the sides of the tube and below the surface of the liquid. A gas also remained, which was at once removed for further examination. The frozen material was also separated for investigation. The gas was found to be the new element "neon" and the frozen substance was the element "metargon," so that in a remarkably short space of time these scientists have succeeded in adding three more to the rapidly lengthening list of elements.

The gas obtained was examined with the spectrum, and it was found to be characterized by a number of bright red lines. The atomic weight was found to be about 22, which would bring it into the neutral position between fluorine and sodium. The spectrum of the frozen substance proved to be very complex. It was totally different from that of argon. It was proved to consist of a single element, and this substance which was separated by freezing out of argon is a distinctly elementary body, though in some cases in close relationship with it, so that its discoverers promptly named it "metargon." In fact, as the investigators observed, "it occupies the same position in regard to argon that nickel does to cobalt, having the same atomic weight, yet different properties;" and Sir William Crookes classes it in an interesting table which he has just prepared, so that it shares the third neutral position with argon, and the atomic weight is about 40.

In the fall of last year Prof. Ramsay read a paper at Toronto on "An Undiscovered Gas," which is published in the SCIENTIFIC AMERICAN SUPPLEMENT, No. 1137, in which he said:

"The subject of my remarks to-day is a new gas. I shall describe to you later its curious properties; but it would be unfair not to put you at once in possession of the knowledge of its most remarkable property—it has not yet been discovered. As it is still unborn, it has not yet been named. The naming of a new element is no easy matter. For there are only twenty-six letters in our alphabet, and there are already over seventy elements. To select a name expressible by a symbol which has not already been claimed for one of the known elements is difficult, and the difficulty is enhanced when it is at the same time required to select a name which shall be descriptive of the properties (or want of properties) of the element. It is now my task to bring before you the evidence for the existence of this undiscovered element." After a lapse of several months Prof. Ramsay seems at last to have discovered the missing link and it is highly probable that "neon" will ultimately prove to be the gas which managed to elude them on the first search. It was a delicate attention when the eminent English chemist closed his now historic address at Toronto, when he said: "The history belongs to the old world. I have endeavored to share passing events with the new."

THE PERCENTAGE OF HITS IN WARFARE.

Foreign military critics at the seat of war have all spoken in high terms of the marksmanship of American gunners, and, in view of the special training which they received in the months preceding the outbreak of hostilities and their subsequent practice in the frequent bombardments of Spanish forts, it may safely be said that the work of our gunners in the naval battle of Santiago represented the best results that can be obtained with modern high-powered rifles.

With this fact in view, it is startling, and, to the enthusiastic admirer of the modern weapon, somewhat discouraging, to observe what a very small percentage of the shots that were fired, even on our side, hit the mark—not more, in fact, than about three per cent. This, apparently, is the best result that can be expected in the heat, smoke and confusion of an artillery duel at sea.

Until a more thorough examination of the Spanish ships has been made, and the full returns of ammunition expended have been published, it will be impossible to determine the exact proportion of hits to misses; but sufficient has been made known by official reports and the observation of trustworthy observers on the spot to show that the figure we have quoted is not very far from the mark.

The number of shot holes counted on the four cruisers as they lay upon the beach immediately after the fight was one hundred and thirty-one, distributed as follows: The "Oquendo," sixty-six; the "Teresa," thirty-three; the "Vizcaya," twenty-four; and the "Christobal Colon," eight. As the vessels were submerged somewhat below their normal draught, it is possible that some hits in the neighborhood of the waterline could not be counted. Waterline hits, however, are not likely to be numerous, and if we suppose that about a score of hits were made that could not be counted, we get a total of say one hundred and fifty for all four vessels. The very low freeboard and shorter length of the destroyers would render them difficult to hit, and they were so speedily sunk as to be only a comparatively short time under fire. We will assume, however, that sixty hits were made upon the two boats. This would bring the total number made on one side up to one hundred and eighty.

As regards the number of shells fired, we are informed by an officer who took part in the fight that the total of all shells, big and little, was six thousand. This agrees very well with the statement in the official report of Captain Evans, of the "Iowa," which credits this ship with having fired 1,473 rounds. Accepting the estimates of 180 hits and 6,000 rounds as correct, we find that the proportion of hits was only three per cent.

The disparity is largely explained by the fact that the dense volumes of smoke, both from our own and the Spanish guns, prevented accurate shooting by obscuring the mark during the greater part of the action.

There is an important lesson to be learned, however, from these figures; for if only three per cent of the shots reach the mark, the heavy 12 and 13-inch guns, which fire only once in three or four minutes, are at a great disadvantage as compared with the smaller quick-firing weapons. On the basis of three successful shots in a hundred, these big weapons are likely to be the better part of an hour at work before they land a successful shell on the enemy. This is actually proved by the fact that apparently only two or three of the biggest shells struck the Spanish ships, although the "Iowa" alone fired thirty-one 12-inch shells with full charges, and the "Oregon," "Indiana," and "Texas" were using their 12 and 13-inch guns throughout the fight.

Furthermore, it is noticed that the number of hits for each type of gun is in proportion to its caliber, the 8-inch doing good execution, the 4 and 5-inch rapid-fire guns even better, and by far the largest number of hits being due to the 6-pounders, of which a very powerful battery was carried by the several ships. The results are a strong indorsement of the rapid-fire gun, and they emphasize the necessity of increasing, by all possible means, the rapidity of fire of the larger guns on our battleships.

It is questionable if the 12-inch gun can be handled much more rapidly than it is in some of the navies of the world, and if we wish to secure greatly increased rapidity of fire, it can only be done by reducing the weight of the larger guns. Germany has apparently already grasped this truth, for her new battleships will carry no guns of a caliber greater than 9·45 inches. The small bore is compensated by the high velocity and energy of the projectile, the penetration of the weapon being nearly 26 inches of steel, or about the same as our 12-inch gun. Yet the German gun weighs only about 22 tons, against 45 tons for the 12-inch rifle, and it is a rapid-fire weapon in addition.

The 10-inch, 30-ton wire gun now being tested by the United States government is a more powerful weapon than the 13-inch, 60-ton gun of the navy, and if it is fitted with the most recent rapid-fire devices both in mounting and breech mechanism, it will be a vastly more efficient weapon and would form an ideal gun for our new 18-knot battleships. There are 8-inch rapid-fire guns afloat that fire four shots a minute to the one shot a minute rate of the 8-inch slow-firers of the "Brooklyn" or "Indiana." We should retain the 8-inch gun, but the 3 per cent results at Santiago teach us that we should make it a rapid-firer. Two such guns on each broadside would deliver twice the number of shells that can be thrown from the eight 8-inch guns on the "Indiana."

With four 10-inch, wire, semi-rapid-firers, four 8-inch rapid-firers, and six 6-inch rapid-firers, our new 18-knot battleships would be the most powerfully armed vessels of their day. But whatever may be the armament, Santiago teaches us that rapidity of fire should be made the supreme consideration.

DISCIPLINE AND DISASTERS AT SEA.

When all the phases of the navigation of the deep are studied, the wonder is not that accidents are so many, but that they are so few. Special and general navigation laws obtain in all countries having any pretense to civilization; but owing to the willfulness of owners, the carelessness of shipmasters or the lack of proper understanding, they are often rendered practically null and void. Man is naturally optimistic, sailors are unusually so, and freedom from accident in the past is too often assumed to insure immunity for the future.

Strenuous efforts have everywhere been made to educate the seafaring classes along higher and continually advancing planes; but, for some unknown reason, these efforts have failed to reach the man in the forecastle of the merchant marine. Notoriously, the forecastle is in many instances the final refuge of the illiterate and broken down. In spite of the earnest attempts which have been made to enforce that discipline and obedience that constitute the superiority of the crews of men-of-war over those of merchant vessels, something appears, continually, to be lacking. Perhaps what is needed is the physical and moral qualification which is demanded in the navies of the world. Discipline is recognized in the navy as not only essential, but imperative; but in the merchant marine it is too often enforced only in a half-measured and slipshod way.

The supreme value of naval discipline in emergency has been proved in cases innumerable. When a British troop ship foundered in the Bay of Biscay, a few years since, the soldiers stood in ranks at "attention," and went down to their death as if on parade, realizing that the boats were only sufficient to save the helpless women and children. Again, on board the battleship "Victoria," after she had been rammed by the "Camper-

down," the crew stood quietly at their respective stations until the order to "jump" was given, and thus, while discipline carried many of those below decks to their doom, it also preserved the lives of many above that certainly would have been lost in a general wild and headlong scramble for safety.

Seamanship, *per se*, in its relation to the safety of passengers, it is not our intention to discuss, but there are other and collateral issues that constantly endanger human life. Those who travel upon the high seas certainly have a right to demand of shipowners, shipmasters, and of their own and other governments, that they be safeguarded by every reasonable precaution that it is within human power to provide.

Is the maximum protection accorded?

We think not! Ships are still overloaded, and "Plimsoll's mark" is not operative, except in craft that fly the British flag. Ships of all kinds still put to sea shorthanded; lifeboats are generally too few, and the means of getting them into the water are often clumsy and antiquated, entailing exasperating and fatal delays; and boat drill is in some vessels practically unknown. Finally, while the schooling of the officer is, perhaps, thorough and complete, and ever improving, that of the man forward has practically no existence. "Steam," declared an eminent naval authority, "has killed the real sailor, the old time tar who was the eyes, ears, and fingers of his superior on the bridge or quarterdeck, and in his place we have the landsman, boy, coal passer, fireman, and stevedore."

With properly built, manned, and loaded ships, and the enforcement of discipline, the number of fatalities of the character of that which overtook the passengers on the "Bourgogne" would be greatly lessened. No complaints are heard as to the character or abilities of the officers of the French liner, but the crew exhibited themselves as a maddened, brutish, and mutinous mob. Whose was the fault—the officers, the owners, or the lax laws that permitted the shipping of such a crew and yet failed to provide for their proper handling? To-day all the great railway corporations are at especial pains to secure employes of an approved type of health and manhood—men quick to act in emergency, and of sound physical and mental condition. Were such men selected for the crew of the "Bourgogne," or are such generally found among the masses who "go down to the sea in ships" as a means of livelihood? Are the dangers of railway travel and transportation greater and more imperative than those constantly accruing to navigation of the broad seas, and are the duties devolving upon railway employes generally such as to require higher mental and physical qualifications? Quite the reverse! The practical knowledge demanded of the able seaman is not to be gained in the course of a month or even a year; but the brakeman can master his duties in thirty days.

What was it that specially marked the differences in the two accidents that respectively sunk the "Victoria" and the "Bourgogne"? Discipline and manhood in the case of the warship as against mob rule and brutal selfishness on the Transatlantic liner. Had the "Victoria" carried women and children, it is safe to say that their safety would have been assured before a single attempt was made by the crew to save themselves.

It has already been remarked that, as regards many merchant craft, there is a woeful lack of boat drill and the experience that, in connection therewith, is had only by continual practice. This fact has frequently been pointed out and commented upon by the general press. On most river, harbor, and lake craft the boats are not only too few, but they are deficient in belongings and appurtenances. Especially is this true of "tramp" ships, and of the craft plying on the Great Lakes. To be sure, the boats required by law are there; but too often they rest in cradles; are tightly housed and lashed over by canvas, that requires from ten to twenty minutes to remove; the falls are not hooked on, but are elaborately wrapped and tied in canvas to keep out water, and boat plugs have not been seen since some annual painting. Life rafts, if they are carried, are often useless through age, and so fastened as to require from a quarter to half an hour of labor to launch. Watertight and collision bulkheads were put in by the builder, but the communications are too seldom closed, and in the hour of emergency they are liable to fail of their purpose.

Summing up: The additions to navigation laws should include examination as to the physical, mental, and moral qualifications of crews; frequent and rigid inspections of boats and crews, and definite knowledge as to efficiency; better quarters and food for men; the withholding of part of the wages until the termination of a definite period of shipment or till the close of the season; introduction of rigid discipline; ready methods of placing boats in the water; constant inspection of life preservers as to character and utility; and, finally, self-closing, interlocking communications between adequate watertight and fire bulkheads. As a protection against fire, the employment of fireproof instead of inflammable paints is worthy of serious consideration.

CONCENTRATION OF POWER.

The close of the present century is marked by a tendency in the engineering world toward concentration of energy and material. A quarter of a century since a craft 200 feet long was almost a rarity on the Great Lakes, and when the locks of the Welland Canal were extended 235 feet it was supposed they would fully meet any demand to be made upon them in the succeeding hundred years. To-day there are more large craft on these waters approaching 400 feet in length than those of 300 feet and less, and many exceed the greater figure—running, some of them, even up to 460 feet.

The same increase and concentration is also witnessed among the railroads. Heavier roadbeds and rails, and more capacious rolling stock, are everywhere observable, and the locomotive has reached a degree of development as regards size, weight, power, and economy little dreamed of a generation ago.

A very striking illustration of this concentration of power was afforded recently by a train hauled over the Pennsylvania Railway between Altoona and Columbia, which consisted of 130 cars, was nearly three-quarters of a mile in length, and that weighed 5,330 tons. It was made up as follows: Locomotive 118 tons, other rolling stock 1,519 tons, freight (coal) 3,693 tons.

THE VALUE OF A NAME.

The general press have taken to speculation and discussion regarding names to be attached to such ships of Cervera's fleet as may be saved to the purposes of the United States navy.

But why should these names be changed? Are not the present titles suitable, marking a notable victory; and will they not illustrate and perpetuate history?

The "Macedonian," captured from Great Britain by the man-of-war "United States"—popularly known in the service as "The Old Wagon"—was for over half a century one of the Naval Academy fleet, and a beautiful type of the old time sailing frigate. She remained the "Macedonian" to the last, and it is to be hoped another "Macedonian" will ere long appear in the Naval Register.

In the English service it has long been a rule to perpetuate the names of ships that are of historical interest, either as captors or captured. The sixth "Royal Sovereign" and eighth "Revenge" are now in commission. The "Victory," "Triumph," and "Revenge" recall the three flagships of the fleet that fought and scattered the Spanish Armada; and the first and last named mark two notable victories over the French and their allies in the days of the First Empire. The "Shannon" keeps alive the fact that a ship of that name battled successfully with the U. S. "Chesapeake." What are the meanings of "Barfleur," "Bonaventure," "Foudroyant," "Hermione," "Imperieuse," "Neptune," "Temeraire," "Sans Pareil," and others that still hold a place in the Admiralty list?

By all means let us have naval designations that possess historical significance, as well as those that perpetuate the names of States, cities, and men. Let us have a new "Guerriere" and "Constitution," the old ones having been sold; a "United States," a "Constellation," a "Java," as well as a "Maria Theresa," "Vizcaya," and "Cristobal Colon," provided these latter can be saved. We already have a "Kearsarge," an "Essex," and an "Atlanta." All these and many others have a place in our history, and are far more calculated to appeal to national pride and patriotism than the names of deceased gods and heroes, such as "Ajax," "Jason," and "Amphitrite." Neither national policy nor the size of our navy suggests a "Terror" or a "Dictator." Let foreign countries keep these latter names with others of the kind. Our list of States, cities, and mountains will supply all needs for a century to come, but the demands of historic titles should not be forgotten or ignored.

PORTO RICO'S COMMERCE.

There is now every prospect of Porto Rico becoming annexed to the United States, and the statistics of her foreign trade show that our new island territory is well worth the heavy price which we have had to pay for it. In 1896 Porto Rico's foreign trade amounted to the very considerable sum of $36,624,120, and, for the first time in more than a decade, the value of exports exceeded that of the imports. There is little doubt that American enterprise would, within a very short time, almost double the value of exports, and our ownership of this beautiful island will enable us to have a greatly increased market for our agricultural products and for our manufactured goods; but even now we come second to Spain as regards trade with Porto Rico.

Its foreign trade is conducted chiefly with Spain, the United States, Germany, Great Britain, and France. Of all the merchandise imported and exported by the island during the four years, 1893 to 1896, fully 85 per cent, measured in value, was exchanged with the six countries named. Naturally Spain received the largest share of the trade, having an average of $9,888,074 a year. The United States ranks second, with the yearly average of $6,845,252. Cuba's trade with Porto Rico averaged $4,606,220; Germany's was $3,050,334; and that of the United Kingdom was $2,863,930, and of France $2,201,687.

Agricultural products make up a large part of the island's imports and nearly all her exports. The value of the agricultural imports in 1895 was $7,171,352, and of the non-agricultural imports $9,664,101. The agricultural exports were valued at $14,573,366, and the non-agricultural at only $617,490. Rice, wheat flour, and hog products are the principal imports, comprising nearly two-thirds of the total agricultural imports. The imports of rice in 1895 were valued at $2,271,819. Wheat flour was imported to the extent of 170,460 barrels, worth $1,023,694. The hog products imported were valued at $1,274,618. Vegetable products played the most important part in the agricultural imports. Breadstuff imports had a total value of $1,144,017, and meat products imported were valued at $1,531,986.

Cotton fabrics lead the non-agricultural imports, their value in 1895 being $2,070,667. The imports of fish amounted to $1,918,107; of wood and its manufactures, $840,511; of leather and its manufactures, $711,417. The imports of tobacco in its manufactured forms amounted to $692,333. Iron and steel and their manufactures, not including machinery and apparatus, were imported to the extent of $658,413; and the imports of machinery and apparatus were valued at $344,879. The value of the imports of the manufactures of hemp, flax, jute, manila, etc., was $408,974. Other important non-agricultural imports were: Soap, $248,571; paper and pasteboard and their manufactures, $196,197; mineral oils, crude and refined, $169,629; cotton yarn and thread, $154,964; woolens, $154,947; paraffin, stearine, wax, spermaceti, and their manufactures, $151,995; glass and glassware, $125,688; coal and coke, $124,536.

Coffee and sugar, the leading products of the island, comprise in value fully 85 per cent of all the merchandise sent to foreign ports. The quantity of coffee shipped in 1895 was 40,243,693 pounds and its value was $9,159,985; the exports of sugar amounted to 132,147,277 pounds, valued at $3,905,741. In addition to the sugar, $539,571 worth of molasses was shipped, making the total value of sugar and molasses exported $4,445,312. Leaf tobacco is the next most important export, the amount in 1895 being 3,665,051 pounds, valued at $673,787. Other important exports were: Cattle, $141,816; maize, $69,410; hides, $53,799; fruits and nuts, $10,880; distilled spirits, $9,466. Guano is the only important non-agricultural export. In 1895 the exports amounted to 15,491,476 pounds, valued at $610,921. The value of all the other non-agricultural exports was only $10,000. Porto Rico's export of coffee has more than doubled in ten years.

Porto Rican coffee is shipped principally to Spain, Cuba, Germany, Italy, and Austria-Hungary, Spain receiving 16,405,900 pounds in 1896, and Cuba 15,577,710 pounds, together more than half the total export. France bought 11,306,689 pounds. To the United Kingdom only 334,119 pounds were shipped, and to this country only 322,591 pounds.

The British East Indies sent Porto Rico 28,865,623 pounds of rice in 1896, Germany sent 26,100,840 pounds, and Spain sent 12,977,220. The import of rice from all other countries was only 2,819,566 pounds. The United States shipped $944,418 worth of flour, leaving only $24,129 worth for Spain, the United Kingdom, and France. This country also shipped $1,342,104 worth of hog products to Porto Rico in 1896, all but $13,337 of the total import.

The United States take more than half the export of sugar and molasses. Of the 122,946,335 pounds of sugar shipped from Porto Rico in 1896, 71,875,614 pounds came here, and 43,600,064 pounds went to Spain. The United States received $331,646 worth of the molasses exported in 1896, and the United Kingdom and the British possessions received the rest, which was worth $161,976. No molasses is exported to Spain or Cuba, but these countries get three-fourths the tobacco. Of the 2,219,907 pounds shipped in 1896, Cuba received 2,160,347 pounds and Spain 1,375,751. Shipments of Porto Rican tobacco to the United States are rare.

Spain's trade with Porto Rico increased in value from $4,929,799 in 1887 to $12,644,955 in 1896. The chief gain was in the increase of Spanish exports to the island from $2,411,216 in 1887 to $7,268,498 in 1896. During the same period the value of the imports from Porto Rico advanced from $2,518,563 to $5,376,457. Coffee and sugar constitute in value about nine-tenths of the total imports, excluding coin and bullion. After coffee and sugar the most important agricultural imports from Porto Rico are leaf tobacco, cacao, hides and skins, and fruits. Spain's non-agricultural imports from Porto Rico amount to less than $100,000 a year, and are principally bags and sacks, tobacco manufactures, and guano.

Spain's exports to Porto Rico are three-fourths non-agricultural products. Cotton fabrics constitute nearly a third of all the merchandise shipped during 1892–96, the annual average valuation being $1,581,706.

It will be observed no account is taken of the growths that afford most valuable woods for cabinet and special purposes, such as mahogany, rosewood, satinwood, grenadille and manzanilla, some of which readily command $100 to $150 per ton.