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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

OUR SYSTEM OF NAVAL COMPARISON.

In the present series of articles on the Japanese and Russian fleets, we follow the system of classification and comparison which the Scientific American inaugurated at the time of the Spanish-American war. The difficulty of making a really satisfactory comparison is proved by the many different systems that are adopted by naval writers. Some of these, in which the mere number of ships is taken, or the aggregate number of guns and the thickness of the armor, are obviously misleading; for the value of a navy is not to be determined by any one of these features alone, nor, indeed, by any two or three of them. At the same time, a system of comparison that enumerates all the elements of efficiency becomes too elaborate and cumbersome for practical and rapid use. A ship of a given size can only embody a certain amount of the elements of fighting efficiency. She may carry an unusually heavy battery and thick armor, but it will be done at the expense of the speed or the coal endurance, as in the case of the "Indiana" or "Massachusetts." Again, the vessel may be extraordinarily fast and capable of steaming half way round the world without recoaling, like our "Minneapolis" and "Columbia;" but her speed and wide radius of action will be gained at the expense of armor and armament. In other words, it is impossible to get a "quart of efficiency out of a pint of displacement." The science of naval design consists in securing such an apportionment of the total displacement of a ship to the different elements of efficiency, as shall best meet the requirements of the nation in whose service she is to be employed. At the same time there is such a considerable difference in the service required of their ships by the various nations, a difference due to geographical position and general foreign policy, as to render it difficult to institute any hard-and-fast comparison between the navies of the world. The best that can be done is to compare them as to their actual fighting value on a basis of displacement and age.

The leading naval architects of the world are so thoroughly in touch (thanks to that admirable institution the Office of Naval Intelligence, and its like) with each other's work, and with the contemporaneous improvements in war material, that we think it is safe to say that a thousand tons of displacement in a battleship of a certain age is worth about as much as a thousand tons in another battleship of the same age, even though the ships may differ greatly in design. This statement, of course, does not apply to vessels in which glaring defects of design and workmanship are known to exist; but as a general rule a comparison based on displacement and age may be safely followed. In comparing the efficiency of navies, age is the most serious consideration, for the reason that the improvement in designs and in the efficiency of war material is so rapid, that every year added to the age of a warship depreciates its efficiency relatively to the most modern ships of the same class, and, therefore, we think that no vessel over ten years old should be reckoned as a first-class battleship, while those that are ten to twenty years old should fall into the second class, and those older than twenty years be considered as suitable only for coast defense. The armored cruisers being modern vessels are arranged in three classes according as they are above 10,000 tons in displacement, above 7,000 tons and below 7,000 tons; while the protected cruisers are arranged in four classes, the limits of which are 10,000, 7,000, 4,000 and 2,000 tons, all protected or unprotected boats below 2,000 tons being placed under the category of small cruisers and gunboats.

VALUE OF CORRECT PROPELLER DESIGN.

The great importance of providing a steamship with suitable propellers has been illustrated in an experiment, which has been tried recently in the English navy on a large number of cruisers known as the County class. There are fifteen of these vessels, ten of them of 9,800 tons displacement, designed for 23 knots speed, and six of 10,700 tons displacement, designed for a speed of 22¼ knots. When the first of these vessels underwent their steam trials, they failed to come up to their full speed, even when running under full power, the best of them, the "Sussex," making only 22.79 knots, and the "Kent" reaching only 21.7 knots under these conditions. As the designed horse power of 22,000 was reached in these trials, it was considered that the deficiency in speed was probably due to the propellers, which were 16 feet in mean diameter, of 19 feet 6 inches mean pitch, and had a total area on their four blades of 54 square feet. It was decided to increase the surface; which was done by designing new four-bladed propellers, with a diameter of 15 feet 9 inches, a pitch of 20 feet, and a total surface of 80 square feet. On five ships which were tested under the new conditions, there was a most remarkable increase of speed, ranging from a knot to 2¼ knots above the speed of the earlier sister ships. Thus, while the "Kent," with her propellers of small area of surface, made only 21.7 knots under full horse power, the "Berwick" steamed at 23.6 knots, the "Donegal" at 23.56 knots, and the "Lancaster" at 24.01 knots. It was recorded in the Scientific American some months ago that the 14,000-ton armored cruiser "Drake" had a similar experience, a change of propellers raising her speed from 23 to 24 knots per hour. The fact that a similar gain should have been made in a vessel of 50 per cent more displacement and of different lines, renders it pretty certain that the increase in speed was due entirely to the use of propellers of larger surface and coarser pitch. It is, of course, well understood that the designing of propellers is not an empirical problem, although it is a complicated and difficult one. Account has to be taken of a great many elements, such as the form of the vessel, her speed, the flow of the stream lines as the water closes in and sweeps past the stern, etc.; but even when this is admitted, the experience with these British ships certainly affords much food for thought. There is probably no body of men that has had such a wide and varied experience in this particular problem of the relation of propellers to high speed in large vessels as have the naval designers of Great Britain, where for some years they have been turning out warships of speeds that vary from 21 to 23 knots an hour. It must certainly be admitted that the advantages of big surfaces and coarse pitch receive a strong indorsement in the remarkable results above recorded.

PRECAUTIONS AGAINST POISONING THE QUEEN BEE.

The safeguards provided against the administration of poison to the Empress of China are rudimentary, compared with those which stand between queens of the honey bee and such a risk. Curiously enough, this is a phase of the internal economy of the beehive which appears to have escaped observation.

In the British Isles, no poisonous honey is collected. If it exist, the bees have learned to avoid it. Probably there is none, as the honey from at least one dangerous plant—the deadly nightshade—is harmless. Ivy honey would be the most suspicious of any gathered on a large scale, and it only exerts, so far as observation goes, a slightly laxative effect on the digestive organs. Although, in this country, no poisonous honey is known, it is met with in other places, notably in Asiatic Turkey. It was in this region that Xenophon's soldiers were poisoned, 2,300 years ago, by honey from the *Azelia pontica*, a plant which still flourishes in Armenia. Some centuries later a Roman army suffered similarly, but less severely, there being no deaths.

The precaution of compelling the cook to eat a portion of every dish, which is the usual safeguard of despotic rulers, or the still more primitive plan of giving the first helping to a little dog, can be eluded by having only one-half of a bird or pastry poisoned. In a wasp's nest, each forager on returning proceeds directly to the queen, and offers refreshment, consequently the queen is sometimes destroyed by slowly-acting poison. Farther as regards wasps, it is observed that when any larvæ not recently fed perceive the queen receiving food, they become restless. If nearly grown, they wag their heads in a suggestive way which plainly conveys a demand for a share. Each forager after feeding the queen gives the balance of his load direct to the nurses. In the case of the honey bee, one possible reason why no virulently poisonous honey reaches the hive may be that the insect foolish enough to collect any would probably die, as the so-called honey sack is really a stomach in which a preliminary digestive process proceeds. This is proved by the polariscope, which shows that while the nectar of the flowers is pure cane sugar, or levulose, the substance in the hive cells is sacrometrically half dextrose and half cane sugar. Dextrose is invert sugar, a coarse variety of which is the glucose of commerce. Forager bees returning to the beehive place the half-digested product known as honey in their storeroom with other honey. This mixing would have the effect of attenuating a poisoned load, should such be brought in. Foraging bees never feed the queen or young larvæ, but they give a mouthful or two to drones in passing. Just before sealing for the metamorphosis, workers and drones are fed with honey mixed with pollen. Not so the young queens, who only get a farther supply of the redigested milky substance known as chyle, which is the sustenance of all larvæ indiscriminately during the first three days of their existence. During the chrysalis stage there is no feeding. It is the business of a gang, distinct for the time being, to cater for the queen and young. They bring the food from the stores, submit it to the digestive process referred to, after which it is regurgitated to supply the needs of the queen and young larvæ. The attendants are numerous, and each supplies only a minute quantity. The queen bee is so constituted that her digestive system is capable of assimilating only the prepared food, or chyle. She will die in a few hours on a comb containing honey, although kept at the temperature of the hive.

Thus it would appear that the safeguards are:

1. A bee collecting poisonous honey would probably die before reaching the hive.

2. If one succeeded in depositing poisoned honey, the circumstance that it did so would prove the poison to be not virulent, and its mixture with other honey in the storeroom would still farther attenuate the poison and render it harmless. This is the stage at which the product becomes human food. It has, as stated above, occurred that poisoned honey has passed both these lines of defense.

3. Should the honey be still deleterious, the alimentary attendants of the queen would first suffer, and only those bringing wholesome food would reach her, as a struggle for the privilege of feeding Her Majesty is continually in progress.

4. Should the stores pass the three safeguards before mentioned, there is still another, viz., that each one of the queen's attendants feeds her only for a second at a time, and thus she would never get a sufficient quantity to affect her seriously. The queen is always on the move, and the competition to feed her so great that she is continually bringing fresh bees in front of her, from which position alone food can be administered. No worker bee would think of jostling—everyone gives way to—the queen.

Uneasy monarchs and others may find some suggestions in these arrangements for securing their safety. Probably they will decide to take their chances rather than avoid risk by living on food which has previously been digested by subjects, however loyal.

THE EIFFEL TOWER.

In the Scientific American of December 26 it was announced that the famous Eiffel Tower was about to be razed to the ground, for the reason that it displayed a marked toppling tendency. M. Eiffel denies the statement that the famous structure is to be torn down, and refers to the report of M. Mascart, president of the Academy of Sciences, in which it is said that "the tower is in a perfect state of preservation, and that no change of position has been noted either in the foundation or in the framework." So far from having sunk to one side, the tower seems to have preserved its position with all the constancy that could be desired. Every competent commission that has ever studied the tower has advocated the preservation of the structure, and vouched for its scientific utility. The first of these recommendations was given to the public on August 11 last, at the Congress of Angers, by the French Association for the Advancement of Science. The views of this society on the safety of the structure were reiterated by the Society of Civil Engineers. Some fifteen days before this second recommendation, a report was handed in by the supervising commission of the tower, whose president is M. Mascart, a quotation from whose report has already been given. After other considerations, among them the scientific service rendered by the tower, it is stated that the preservation of the structure would be to the interest of the public and of science.

The technical committee of the Prefecture of the Seine received at its meeting of the 6th of November the report of M. Pascal, government architect and member of the Institute, which strongly advocates the preservation of the tower. The report of M. Pascal was adopted. Besides this report may be also mentioned the petitions of various municipal councilors presented to the Municipal Council at Paris in the name of the Seventh and Fifteenth Districts for a preservation of the tower.

The administration, on the recommendation of Chérioux, president and author of the report, adopted the recommendations of the Technical Committee. The Municipal Council followed suit.

A brief history of the tower may not be without interest. Begun in 1887, the structure was completed in 1899, and formed one of the noteworthy features of the Paris Exposition of that year. Its cost was in all 7,799,401.31 francs. The total weight from the substructure to the very top is 9,700 tons. The weight of the metal is 8,564,816 kilogrammes (9,426.7 tons). The vertical pressure, when the wind is calm, varies from 4.1 kilogrammes to 4.5 kilogrammes per square centimeter. The generally accepted hypothesis for the intensity of the wind gives the figures as 300 kilogrammes per square meter exposed, which exposed surface amounts to 8,515 square meters. The corresponding overturning force is 2,554 tons, exerted at a height of 84.9 meters above the level of the substructure. At this level the maximum pressure is received on the girders nearest the center. The pressure is about 723,750 kilogrammes without wind and 1,075,250 kilogrammes with the wind. The total maximum pressure on the soil is received on the north piles under the caisson of the framework. It amounts to about 5.95 kilogrammes per square centimeter.

So far from being unsafe, the tower is pre-eminently secure.

THE FUEL SUPPLY OF THE JAPANESE NAVY.

There are two little seaports on an island off the Asiatic coast which may play a very important part in the Russo-Japanese war, if hostilities are declared. Naval strategists believe that one of the first things Russia will try to do is to cut off the coal supply of the Japanese fleet, if possible, and from the two places referred to comes a very large proportion of the fuel burned on the Mikado's warships. They are both situated on the island of Hokkaido, or Jezo, which adjoins the island of Nippon—the largest of the empire—on the north. Mororan is on the southern coast, on the shore of Volcano Bay, so named from the number of volcanic peaks which overlook it. Otaru, the other port, is on the west coast. These towns are just about large enough to be noted on the map, but are among the largest coal-shipping points in the world, as their harbors are ample to float vessels of deep draft. Jezo is directly east of the Russian possessions in Asia, and a steamship leaving Vladivostok could reach either port easily in two days, as they are not over 500 miles from the mainland.

Naval experts believe that as soon as war is declared, Japan's first act will be to send squadrons to guard these ports, to prevent Russia from landing troops and taking possession of the coal mines, for these are more extensive in proportion by far than any other group in the empire, and the coal is of a very high grade, especially suitable for vessel fuel. Although but little was done to secure the coal before 1890, the output increased from about 300,000 tons in 1893 until it is over 1,000,000 tons at present, one company alone during the past year mining 860,000 tons. This is the Hokkaido Tanko Tetsudo Kaisha, one of the wealthiest corporations in the world. It not only owns coal mines, but railroads, steamship lines, most of the harbor front of the Mororan and Otaru, besides warehouses, coal piers, etc. Its capital is no less than 20,000,000 yen, equal to $10,000,000 in American money, and it has been so prosperous that it has paid annual dividends to its shareholders ranging from 20 to 30 per cent, partly through the contracts which it has to supply the imperial government with fuel.

The mines on the island of Hokkaido are in several great groups, although but a part of the territory of coal-bearing deposits has been examined by geologists and mineral experts. They have estimated that the groups owned by the company referred to alone contain fully 250,000,000 tons of coal, near enough to the surface to be easily secured. The Sarachi group is the largest at present operated, and comprises an area of 5,500 acres, upon which have been found ten veins ranging from 3 feet to 7 feet in thickness; but the greatest producers are the mines of the Yubari group, representing about 4,800 acres, for here have been found veins no less than 25 feet in thickness. Analyses of the coal show it to be a high-grade bituminous, excellent for not only steaming but gas and coke making, so the company has built a large number of coke ovens in connection with the pits. The third group, known as the Purowai mines, is considerably smaller, comprising only about 727 acres, while the fourth covers about 600 acres.

To operate the various collieries, the company in question employs a force of 8,000 people, of whom about 1,500 are women, but all of the mines are equipped with American apparatus on an extensive scale. For instance, compressed-air cutting machinery is used for working the larger veins; mine locomotives, also operated by compressed air, haul the coal to the bottom of the shaft, and the elevating machinery was also built in the United States purposely for the industry. The galleries and shafts are lighted by electricity, and in fact everything connected with the operations is as up-to-date as at any mine of this country. The railroads connecting the mining district with the seacoast are also largely built and equipped with American material. The company owns 212 miles in all, one line extending from Otaru and the other from Mororan. The government has built a system in the interior with which both of the coal railroads form connection, and of this fact the Russians are probably well aware. Consequently, unless they are well guarded, the island could be easily invaded and the mines seized, as they are but a comparatively short distance from the seacoast. The Yubari group, which is the principal producer, is less than 100 miles from either of the shipping ports, and the Sarachi group, which is the farthest from the coast, is but 117 miles distant.

PROGRESS IN THE STUDY OF RADIUM AND RADIOACTIVITY.

MINERAL WATERS AND RADIUM.

At a meeting of the Bath Town Council recently Mr. T. Sturge Cotterell stated that Prof. Dewar had, at the expense of the Royal Society, and with their concurrence, collected the gases that arose in the largest and perhaps the best known of their hot mineral springs, the King's Bath. The analysis of the gases revealed the fact that the rare element helium existed in the waters. The presence of helium led to the belief that something more of scientific interest might be found in the deposits that collected in the tanks and pipes at the three springs. A few weeks ago a quantity of the deposit from the new Royal spring was obtained and sent to the Hon. R. J. Strutt, son of Lord Rayleigh. "My experiments have," he says, "led to some conclusions which may, I hope, interest the [Baths] committee. I have found that the deposit contains radium in appreciable quantities, though I am sorry to say not enough to pay for extraction. It will be remembered that the gas which bubbles up from the springs contains a small proportion of helium. Sir William Ramsay has recently made the most important discovery that radium slowly evolves helium by a spontaneous change. I think there can be but little doubt that the helium of Bath owes its origin to large quantities of radium at a great depth below the earth's surface. A little of this radium is carried up by the rush of hot water and is found in the deposit. My experiments promise further interesting developments, which I shall have much pleasure in bringing to the notice of the committee in due course." Mr. Cotterell said it would be noticed that Mr. Strutt stated that radium existed in "appreciable quantities," and as this appeared to require further explanation he wrote to him and received a reply. Mr. Strutt said: "When I speak of 'appreciable quantities' of radium, I mean quantities such that its presence may pretty easily be detected. But the percentage of radium in the deposit is very much less than that in the ores which are at present used to obtain it from. The reason why the presence of radium is so easily detected, in spite of the smallness of the proportion present, is that the tests are exceedingly sensitive; indeed, the only reason why so small a proportion of radium could be detected was the unique and extraordinary properties of that substance."

In connection with the experiments on the waters of Bath, Prof. Henry A. Bumstead's work in an allied field is of interest. Prof. Bumstead, and his assistant Prof. Wheeler, have been experimenting with the radium found in the surface water and the ground around New Haven, and have published in the American Journal of Science a detailed account of their work. As a result of his many months' investigations, Prof. Bumstead draws three conclusions of greatest interest to investigators. In regard to the presence of a radio-active gas in the ground and surface water near the city Prof. Bumstead says first:

"The radio-active gas found in the ground and in the surface water near New Haven is apparently identical with the emanation from radium. If any other radio-active constituent is present it can only be in a very small proportion."

The second conclusion deals with the density of the radium emanation and is as follows:

"The density of the radium emanation, as determined by its rate of diffusion, is about four times that of carbon dioxide, which gives it a molecular weight of 180."

In closing his experiments with the gas Prof. Bumstead attempted to determine the properties of the active gas recently obtained by Strutt from metallic mercury, and in regard to this he says:

"We were unable to obtain the radio-active gas from mercury recently described by Strutt, and are therefore inclined to attribute his results to an impurity in the mercury used."

THE X-RAYS AND RADIUM IN THE TREATMENT OF CANCER.

The Annus Medicus of the Lancet refers especially to the therapeutics of cancer, quoting from a paper published in the first volume of the "Archives of the Middlesex Hospital," by C. R. C. Lyster, the medical officer in charge of the electrical department of that institution. In writing of the effect which the X-rays have upon cancerous growths, the author says "that a very large number of cases have been relieved of pain, and that in a certain number the growth has undergone a definite retrogression; of all the new growths the rodent ulcers have been by far the most satisfactory to treat. The cases that have been under treatment have varied from those exhibiting small recent spots to the most extensive and old-standing lesions. They have all shown a great tendency to improve; the more recent ulcers have quickly healed, leaving a healthy scar, and there had been no recurrence up to the time of publishing the report. In cases of rodent ulcer of long standing, and with considerable loss of tissue the tendency to heal has been remarkable, but after a time, recurrence is not unusual, and this seems to be more difficult to deal with than is the original ulcer. Of other growths, experiments so far seem to show that the best results are obtained in cases of mammary carcinoma, especially in the recurrent forms. Sarcomata are not so amenable to treatment as are carcinomata. The cases which are apparently the least benefited are the epitheliomata, and this is more especially the case after secondary infection of the lymphatic glands has occurred. With regard to the use of high-frequency currents in malignant disease, it is believed that the good results claimed for this therapeutic measure are due more to the tonic action of the rays than to any direct action on the growth itself. Cases of rodent ulcer and epithelioma were submitted to the action of radium and also to pitchblende, the application of the latter substance being of particular interest, as it is far more easy to obtain than radium; the results of the treatment have not yet been published."

The Lancet, in reference to radium in the treatment of cancer, says: "Full of theoretical interest as the discovery of radium is, its remarkable property of radio-activity has already met with practical application in the treatment of disease, but its real value in this regard, as in the treatment of cancer and lupus, cannot yet be determined. The radio emanations are undoubtedly powerful to produce chemical change, but it remains to be seen whether they will be effective in checking the advance of a morbid process, or of destroying, or of restoring to a healthy state, diseased tissue."

The Vienna correspondent of the British Medical Journal states that Exner and Hozknecht have used radium in the treatment of carcinoma and sarcoma with satisfactory results. The conclusions reached by these investigators are as follows: "Radium rays irritate the cells of the skin less vehemently than cells of cancer and sarcoma. The last named are brought to necrosis before the other tissues suffer severely from the effects. The radium dermatitis is very similar to the Röntgen rays dermatitis." The experience then of the majority of medical men who have used X-rays in the treatment of cancer is that in some forms of the disease they have proved decidedly beneficial. As to radium, its use has been too limited and the period in which treatment has been effected by its means has been too short to warrant the passing of a definite opinion with regard to its efficacy as a therapeutic agent in cancerous growths.

THE CURRENT SUPPLEMENT

A splendid picture of the great electrical power plant of the city of Berlin will be found on the front page of the current SUPPLEMENT, No. 1467. The article which accompanies the picture describes the mechanical and electrical novelties of the station. Other electrical articles of interest are those entitled "The Electric Furnace in Metallurgy," "Prof. Slaby's Experiments in Wireless Telegraphy," and "Contemporary Electrical Science." Prof. S. P. Langley concludes his scholarly biography of James Smithson, founder of the Smithsonian Institution. The problem of increasing the fertility of the soil is one that is of especial importance. An exceedingly valuable and instructive contribution to the literature on the subject is George T. Moore's paper on "Bacteria and the Nitrogen Problem," published in this week's SUPPLEMENT. The many inquiries received by the Editor for information pertaining to the caoutchouc-yielding Landolphia of the French Congo will find their answer in an exhaustive discussion of the subject by M. Aug. Chevalier.

THE HYDROSCOPE AND ITS SUCCESS.

Cavaliere Pino is the inventor of a machine called the hydroscope, to which reference has already been made in these columns. The instrument consists of a long tube carrying an optical instrument at the end. Objects at the bottom of the sea are reflected upward, where they may be readily studied from the deck of a steamer. By means of the hydroscope, Pino succeeded in bringing up objects from the sea that have been concealed for two thousand years. These were found off the Grecian coast, and include some valuable art objects—creations of ancient Greek art.

The flooding of the Kansas River last May resulted in some very curious changes in the river bed. At one of the curves in the river cut-offs were formed, which caused the water to flow for a distance of two miles through the old bed, but in an opposite direction to the old current. A complete description and discussion of the peculiar conditions produced by this flood may be found in the current SUPPLEMENT, No. 1467.