

planes, of which several are in service at Putzig near Danzig. One was recently sold to the Norwegian government and is at the present time stationed in Horton, Norway:

DIRIGIBLE AIRSHIPS.

The best known German dirigible airships are the Zeppelin, Schutte-Lanz, Parseval, Siemens-Schuckert and Gross. These five types differ markedly from each other in construction. The two first named, Zeppelin and Schutte-Lanz, have rigid balloon bodies. Zeppelin uses aluminium and Schutte-Lanz wood for the material of the frame. Both types of construction have so far proved good, but it may be that the Zeppelin is the better. The Zeppelin has often remained very long aloft in test flights; thus, a short time ago it accomplished a 36-hour voyage without any accident or stop whatsoever. These ships are built so that they can land on water and they are, therefore, purchased by our naval administration. The motors are very reliable and are manufactured by a sister company of the Zeppelin shipbuilding concern (Maybach motors). Herr Maybach was formerly an engineer with the

Daimler (Mercedes) Motor Company. The Daimler Motor Company, besides Maybach, makes airship motors. They are of 100 horse-power and 200 horse-power. The products are of about equal value, but it may be that Maybach has had the greater experience with airship motors. The other German airship motors cannot be counted as first-class.

The rigid ships maneuver very well in the air, but good hangars are necessary. Turntable hangars are the best. There is one in Germany. The long trips made by the rigid type are made possible principally by the minimal gas loss which characterizes this system. In the rigid ships the gas is not contained at large in the balloon body, but in ballonettes which are confined within the main balloon body. The ballonettes are very impervious to gas. Recently they have been made out of gold beater's skin (gold beater's skin is the outer skin of the blind gut of the beef). The ballonettes are furthermore surrounded by the air inside the balloon body and by the balloon covering itself, which hinder the invasion of the sun's rays. It is a great advantage of the rigid type that the outer shape

of the body cannot be altered by temperature changes. The chief difference between the Schutte-Lanz and the Zeppelin airship lies in the material of which they are built and in the outer shape. Neither factory takes orders for export.

The Parseval dirigibles are the most widely used in Germany. They have the great advantage over the rigid types, that they can be emptied anywhere and packed for transportation. The Parseval patents have been purchased by the Luftfahrzueg-Gesellschaft m. b. h. in Bitterfeld, and orders for export are taken by the company.

The Siemens-Schuckert airship is of very large dimensions and possesses a high load-carrying power. It differs from the Parseval ship only in the details of construction. A half-rigid dirigible exclusively for military use is manufactured by Major Gross, but it has been supplanted by the types mentioned above.

The speed of a Zeppelin airship equipped with a 500 horse-power engine reaches some 70 kilometers (43.5 miles) an hour. A Zeppelin can carry more than thirty persons.

The Increased Cost of Warships

THE correspondence which has taken place between the First Lord of the British Admiralty and the Prime Minister of the Dominion of Canada, incidentally indicates the great advance that has taken place within recent years in the cost of ships. The main theme of the letters is concerned primarily with the possibility of building warships in the Dominion, and Mr. Churchill enumerates the very extensive and costly appliances necessary for manufacturing all the elements which go to make up a modern battleship. He arrives at the conclusion that the cost of laying down the plant alone would, at a rough estimate, be approximately \$75,000,000, and that four years would be occupied in the process. He indicates that the new shipyard which Sir W. G. Armstrong, Whitworth & Co. have constructed below the swing-bridge on the Tyne, in order to enable them to build ships of greater beam, has cost approximately \$3,750,000, and that two years have been occupied in its preparation. It is further stated that the Japanese have taken twenty years to work up their warship building, and now take over three years to build a battleship; although anxious to build all ships in their own country, they still find it necessary to have some of them built in Great Britain. The figures given by Mr. Churchill show that a battle-cruiser of the "Australia" type, ordered in Great Britain in 1909-10, would cost, according to the prices then current, \$11,468,300, whereas to-day the price would be \$13,260,500. Again, the cost of three "Town" cruisers has gone up from \$5,561,550 to \$6,174,500; six torpedo-boat destroyers from \$3,335,575 to \$4,215,000; three submarines from \$1,374,375 to \$1,825,000; and stores and fuel for these from \$296,400 to \$322,000. Mr. Churchill takes the view that the facts prove that it is impracticable to proceed with the building of capital ships in Canada at the present time. He does not attempt to give in actual figures the cost now of the ships to form a Canadian fleet unit corresponding to that of Australia, but he adds that the increase in cost for ships built in Canada would amount to 25 or 30 per cent over the present prices quoted in Great Britain. The interesting point is that now Canada, for such a fleet unit as Australia has built, would have to pay, even in Britain, \$25,797,000, instead of \$22,035,755 three years ago, as compared with seven millions for three battleships of the latest type. The First Lord points to the higher cost of maintaining these ships in Canada, owing to the economic conditions prevailing there, and estimates that, at Canadian rates, the cost of maintenance would be \$2,906,250 per annum, against \$2,060,960 under prevailing conditions here. On the whole question of manning Mr. Churchill points out that our resources are now strained to their utmost limits, more especially as regards lieutenants, specialist officers (gunners, torpedo, and navigation), and the numerous skilled professional ratings which cannot be improvised or obtained except by years of careful training. His arguments undoubtedly force one to the conclusion that the most practical and economic course for Canada to pursue—at the present time, at all events—is to make a contribution in ships, leaving the manning and other provisions to the Imperial authorities. But, of course, the home country cannot dictate to any of the Dominions over the seas the policy they should pursue in this matter.—*Engineering*.

Human and Other Population of the United States

It is interesting to compare with the total human population the total heads of cattle and other domestic animals which we find it necessary to maintain to furnish us with our supplies for domestic consumption and for export. According to the Abstract of the Thirtieth Census of the United States (1910) the human population amounted to 91,972,266 souls. The total

number of cattle on farms was about two thirds of this, 61,803,866. Of these 20,625,432 were cows kept for milk; 12,023,682 were cows not kept for milk. The number of horses was 19,833,113. Pigs numbered 58,185,676. There were 52,447,861 sheep, and about three million goats.

Floral Blue*

By P. Q. Keegan

THE origin of a coloring matter is technically termed chromogen, i. e., the precursor thereof, or the special chemical constituent, whose presence in the corolla is necessary for its production. Most vegetable colorations are derivatives of what is called the aromatic series of organic bodies, and it is known that as certain members of this series produce the magnificent aniline dyes, whose spectacular effects are familiar in theaters, and so on, so also other members of the same series form the origin of the beautiful tints and hues which clothe the flowers of the field and garden. The floral structures (corolla, sepal, and so on) are built up out of a number of chemical constituents, e. g., cellulose, wax, oil, tannin, mucilage, salts, and so on, which may be withdrawn therefrom and separated by chemical methods. The question arises, a most interesting one to the inquiring mind, what is the particular component of this structure to which is due the outcome of that most enchanting adornment, the blue, red, or yellow floral coloration? We must, by diligent analysis and with inexhaustible patience, turn over every clue; we must test and examine all the constituents, until we find some particular one which unquestionably betrays its relationship to the aromatic series of hydrocarbons aforesaid; for we are assured that therein will lie the true spring and fountain of all this floral glory.

We commence the research naturally by studying specimens of plants which bear really true blue flowers, taking care, of course, that we do not mistake a violet or purple corolla for a really blue one. An astute chemist, who is well versed in the analysis of tannic materials, can foretell where such a subject is sure to be found. He knows that such and such orders of plants, for instance, the Rosaceae or the Leguminosae, do not produce blue flowers, and he can assign a reason therefor. On the other hand, he is quite convinced that certain other orders, such as the Campanulaceae or the Gentianaceae, can assuredly do so, inasmuch as that particular constituent called tannin is of a similar kind in each of the latter two orders, but is widely different from that in either of the two former orders. Which is as much as to say, that a kind of chromogen exists in roses and sweet peas which does not exist in gentians or bell flowers, and *vice versa*. True blues exist in veronicas, salvias, verbenas, basil, solanum, penstemon, nemophila, convolvulus, borage, hound's tongue, and in all the orders allied to Gentianaceae and Compositae; but not in lupins, vetches, peas, vetchlings, geraniums, hollyhocks, primulas, balsams, flax, and so on. In the blue flowers just mentioned there is a chromogen, i. e., a tannin common to all as detected by chemical analysis, whereas in the non-blues this special substance does not occur. A noteworthy fact or peculiarity is that while one series or order of plants containing this special color-producing body may exhibit red or blue flowers only in certain species or even in one and the same plant, another series or species with the same chromogen evolves nothing but red or yellow adornments. In fact, in some cases, as, for instance, in begonias, a genus may be quite capable of displaying an azure appanage, but its powers are confined to that of red.

However, to come to details, it may be mentioned that the parent substance of the blue flower is called caffetannin and is imbibed in every cup of coffee we drink, whereas when we drink tea we merely absorb

something concerned in the production of red camellias for example. The chemist will inform you that caffetannin exists in somewhat different forms, and has a different composition, perhaps, in different plants. Some say it is a glucoside; others deny that; and some others again assert that it is a mere mixture of organic acids and other substances. What is beyond question is that it contains in its composition (molecule) more of what are called hydroxyl groups than perhaps any other tannic compound known; that is to say, that where an atom of hydrogen might be found, an atom of oxygen takes its place. Oxygen is an element essential to the support of animal life, but it is also a supporter of coloration, yellow for less of it and blue for more of it. Moreover, we can artificially produce a blue compound from caffetannin; but from any other kind of tannin save one, this cannot be done. We have only to leave a solution of caffetannin freely exposed to the air with a little chalk added, when we see the latter gradually turn green, and then on pouring off the liquid and adding some acid, a red solution is obtained very like the tint of the foxglove corolla, and so on, and which, like it also, may by a certain treatment be changed into a brilliant blue. By a careful application of dilute solutions of an iron and a sodium salt the dilute colorless solution of the same tannin can be induced to yield a beautiful and persistent azure liquid.

In fact, the complete analysis of any plant that contains this tannin reveals in many ways that we are dealing with a powerful color-evolving substance. Then, again, we observe similar phenomena repeated when other plants, perhaps belonging to widely different classes or orders, are taken in hand. But however wide these taxonomic differences, we find invariably one common feature, viz., the capacity to produce a true blue flower. Moreover, this most remarkable feature is absolutely independent of the status of the organism, of the organic perfection or degradation of the species. The gentians, for instance, with their feeble powers of assimilation and their mycorrhiza infestation; the Compositae deprived of one at least of the chief factors of organic perfection; the Labiates more perfected than the borages or the solanums; the Ranunculaceae, Liliaceae, and so on, with types representative of a special kind of organic debasement, all these and more rise to the same high level of floral glory when they unfold and hang out to sun and shower the "soft eye-music" of the flaunting blue.

In fact, the blue corolla is caused by the comparative strength and completeness of the process of de-assimilation occurring there, and this, no doubt, is also the cause why in some plants a certain kind of tannic chromogen is produced, and not so in others. The protoplasm, in order to eliminate from its molecule a tannin containing six HO groups, would de-assimilate or oxygenize more completely than if it produced a tannin with only four or five HO groups. Also, in Gentianaceae with very numerous ovules, blue flowers of the most brilliant description are frequently exhibited; in Compositae with only one ovule they are comparatively rare and never so effective. In the latter case, the de-assimilation is not complete, various volatile oils, resins, and tannoids being a common outcome of the process. It may occur, of course, that the plant itself may produce in its green organs a large quantity of caffetannin, for example, the common yarrow, while the flowers are white or pale pink; but this apparently does not occur in plants with vigorous powers of reproduction (e. g., gentians) wherein tannoids only appear in stem, leaf, and root, the more complete and final products being found exclusively in the floral parts. Therefore, in accordance with this report herein set forth, let gardeners cease from troubling to "evolute" a pure blue flower on a plant incapable of constructing a tannic chromogen containing less than a certain number of hydroxyl groups.

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