SOME EXPERIMENTS WITH AN ORANGE.

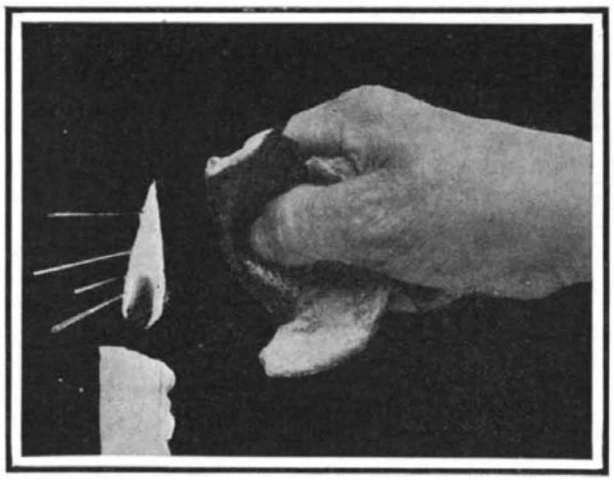
BY PROF. GUSTAVE MICHAUD, COSTA RICA STATE COLLEGE.

Experimenters in need of chemicals may sometimes do without the druggist. The soil, plants, animals, are but chemical laboratories; in one orange, chemicals are found in such a number and of such a nature as to enable anyone to perform several curious experiments. Most of the readers of the Scientific American probably have read about or used the sympathetic ink which is obtained by merely dipping a pen into the juice of the fruit. The sudden apparition, on the heated paper, of the hitherto invisible script is one of the pretty experiments which can be made with orange juice. Those which the writer is about to describe have more to do with the physiological than with the strictly chemical properties of the fruit.

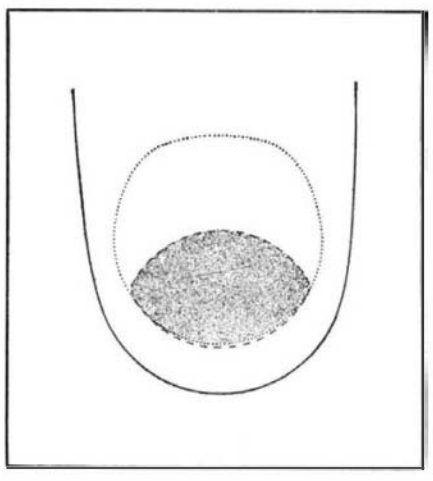
Sugar and a considerable amount of citric acid are found in a ripe orange. Besides the taste, a good proof of the presence of a true acid in orange juice can be had by boiling in water a few red cabbage leaves and then letting some orange juice fall into the bluish decoction. The instantaneous change from blue to red reveals the presence of acids even when taste fails. It may be a matter of surprise to many to learn that the strong sugar and acid flavor of orange juice cannot be perceived by a considerable region of our gustative organ. The middle anterior part of our tongue is as insensible to these two flavors as the *punctum cæcum* of our retina is insensible to light. The fact was ascertained for the first time, I believe, by the scientist Schreiber, who carefully fixed the boundaries of the insensible regions of the tongue for many substances, among which were sugar and citric acid. The accompanying drawing shows that the unresponsive area corresponding to sugar does not coincide everywhere with the area of insensibility for citric acid, but it shows at the same time the existence of a large territory common to both. Cut a small piece of peeled orange. Express it slightly, so as to avoid the dropping and running of the juice over the tongue. Place it in contact with your tongue at nearly one inch from the tip. You will find the orange absolutely tasteless. Bring forward the same piece of orange on to the tip of the tongue, and the strong sugar and acid flavor instantaneously reappears.

It cannot be said that a part only of our gustative organ is insensible to the taste of the essential oil contained in the orange peel, for it is the whole tongue and mouth which do *not* perceive it. To say this while everyone knows the powerful aromatic taste of orange peel seems foolish enough, yet it is true. That particular taste is not a taste but a smell, perceived with the nose only, and many other sensations called tastes have not the slightest right to such a title. Yet the statement that such condiments as vanilla or peppermint are tasteless, is sure to arouse considerable opposition if you make it after dinner in a company of laymen. Ask the most determined of your contradictors to leave the room for a moment, and meanwhile cut into small pieces some of the outer, yellow peel of an orange, which you place into a spoon. Your opponent is then requested to close hermetically his nose, and to enter the room. When he is near the table, you ask him moreover to close his eyes, and to eat and name the spoonful of food you place into his mouth. As long as his fingers press his nostrils, no amount of chewing or swallowing will enable him to comply with the latter request.

Yet it is not probable that any part of any plant is much richer in essential oil than the yellow epicarp of the orange. It is so loaded with the odoriferous liquid, that any change in its shape will produce tiny jets which spring in every direction. To observe these, light a candle and bring near it a piece of orange peel held between thumb and forefinger. Double and press the peel, the yellow side facing the candle, as shown in the photograph. Pretty streaks of fire will be seen to start from the candle up to several inches away from it. They are produced by the ignited jets of essential oil.



Streaks of fire drawn from an orange peel.



Some blind spots of the tongue.

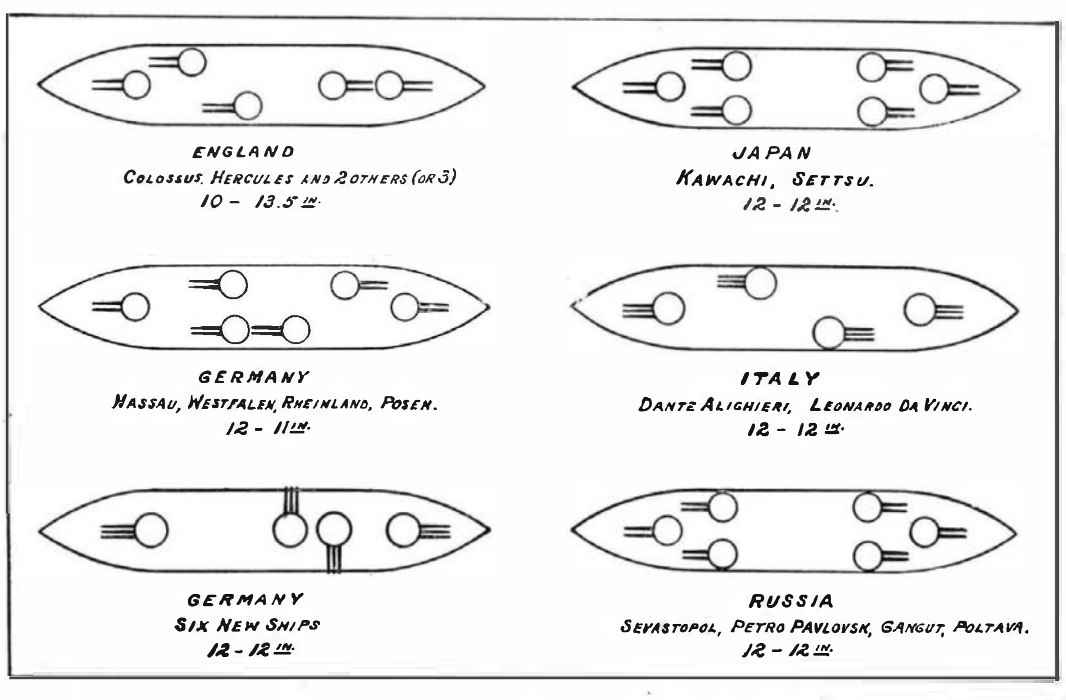
Dots define region insensible to taste of sugar; dashes, region insensible to citric acid, and shaded region that insensible to orange.

To prevent the drying out of gum Arabic, it is only necessary to place a small piece of camphor in the solution. The gum is not thereby impaired but remains adhesive to the last drop. Another method is to add a small addition of glycerine.

SOME NEW WARSHIPS AND THEIR EQUIPMENT.

BY PERCIVAL A. HISLAM.

During the past two months a good deal of information has become available concerning the naval construction of various foreign powers, and this it is proposed to summarize in the following brief paper. The British Admiralty is still very reticent as to the armament of the "Neptune" (laid down in January) and of the four battleships of the current year's programme, but it is generally understood that these five battleships will all be armed with the new 13.5-inch gun with which experiments have been made during the last twelve months. In some quarters it is doubted whether the gun will be in a sufficiently forward state to allow of its being mounted in the "Neptune," but its adoption in the four 1909 ships is regarded as certain. None of the ballistics of this gun has been allowed to become public, but its shell will weigh 1,250 pounds, or 400 pounds heavier than the shell of the 12-inch gun which now forms the main armament of most battleships. Ten of these guns will be mounted, their disposition being shown in the accompanying plan.



LATEST "DREADNOUGHT" DESIGNS OF THE NAVAL POWERS.

Much uncertainty still exists as to the armament of most of the German ships of the "Dreadnought" type, of which ten are now under construction. The British Admiralty last year stated that the first four would carry twelve 11-inch and twelve 6.7-inch. This year an official (British) statement places the main armament at the same figure, but gives twelve 6-inch guns as the secondary armament.

This has recently been confirmed by the German government. Much uncertainty, however, still exists as to the armament of the six later German "Dreadnoughts." Fighting Ships, a usually reliable naval annual, states that they will have twelve 12-inch guns divided between four turrets. It should be noted, however, that although this plan is stated to have been obtained from an official model, the remark is added that "it is not impossible that one of the middle turrets may be suppressed, and the ships carry only nine 12-inch, or even only eight." Sketch plans of the "Rheinland" and "Posen" (sisters to the "Nassau" and "Westfalen") and of the later ships, are given in the accompanying plan.

It is now certain that the armored cruiser "Blucher" will carry twelve 8.2-inch guns (242-pound shell), and the British Admiralty credits her with a secondary armament of eight 5.9-inch. It is impossible to obtain any confirmation of the secondary armament, and those who have seen the vessel say that there is no provision for the mounting of such weapons. Twenty 24-pounders are given as the alternative. She will have a six-inch belt and a speed of 23.5 knots, with triple-expansion engines of 35,000 horse-power. The "Von der Tann," the first of the real German "Dreadnought" cruisers, which will be completed this year, will carry either eight or ten 11-inch guns. The "G" and "H" of later programmes, will carry ten guns of this caliber disposed as in the "Dreadnought." Their main belt is 7 inches thick, and their speed with Parsons turbines of 45,000 horse-power, 25 knots.

The new scout-cruisers building for the German navy will be of 3,800 tons and will carry fourteen 4.1-inch guns, the speed being 26 knots.

The Japanese battleships "Aki" and "Satsuma," which were laid down in 1905, will not be completed before 1910. They are the first battleships to be built in Japanese yards, and the experience, although doubtless of great value, will have been dearly bought. The "Satsuma" is of 19,350 tons and is armed with four 12-inch, twelve 10-inch, and twelve 4.7-inch guns, while the "Aki," 450 tons larger, will have eight 6-inch instead of the 4.7's. Two new ships have just been laid down, the "Kawachie" at Kure on January 18th and the "Settsu" at Yokosuka on April 1st. On a displacement of 20,800 tons they will carry twelve 12-inch, ten 6-inch, and twelve 4.7-inch guns. The "Jiji Shimpo," a Japanese paper, gives only ten 12-inch, but the heavier armament is fully confirmed. Fighting Ships gave these vessels fourteen 12-inch, the end turrets containing three guns apiece, but the design, although produced, was abandoned. The armored cruiser "Kasuga," by the way, has had her single 10-inch gun replaced by two 8-inch, and now is similar in all respects to the "Nisshin." The new 1,150-ton destroyer "Umikaze," built at Maidzuru, has completed her trials successfully, easily maintaining the desired speed of 35 knots. Her engines are of 20,500 horse-power (turbines).

No new vessels have been commenced for the French navy since July of last year. Italy, however, has ordered two battleships of approximately 20,000 tons, their names being "Dante Alighieri" and "Leonardo da Vinci." They will have turbine engines of 30,000 horse-power and a speed of 22 to 23 knots, while their armament will consist of twelve 12-inch guns mounted in four turrets and disposed as shown in the illustration. The secondary battery comprises eighteen 4.7's. Two other battleships are shortly to be ordered, and while their armament may follow that of the earlier vessels it is also rumored that, in accordance with the proposals of Col. Vittorio Cuniberti, the distinguished naval constructor, they may carry eight 14-inch guns of a new type. This burst of activity on the part of Italy is due to the fact that the Austrian government has recently embarked on a four-"Dreadnought" programme, the vessels to carry ten 12-inch guns and to steam 23 knots with engines of 30,000 horse-power.

The reconstruction of the Russian navy has at last

(*Concluded on page 59.*)

take away 8 of them, this suggestion seems as unthinkable as the suggestion of a fourth dimension. But when men chose to represent by —3 the result of subtracting 8 from 5, instead of simply saying it was impossible, then the foundation was laid for the enormously useful science of Algebra.

The assumption of a fourth dimension has not as yet led to any noteworthy useful results, but it is by no means impossible that the science of four-dimensional geometry may come to have useful applications. It has been suggested by Prof. Karl Pearson that an atom may be a place where ether is flowing into our space from a space of four dimensions. It can be shown mathematically that this would explain many of the phenomena of matter. At the present stage, the suggestion is regarded, even by its author, as merely fanciful, though it is not as fanciful as the proposition of the German spiritualists who regard the fourth dimension as the abode of their disembodied spirits.

SOME NEW WARSHIPS AND THEIR EQUIPMENT.

(*Concluded from page 56.*)

been entered upon seriously, and four battleships were laid down simultaneously in Baltic yards on June 16th. The "Sevastopol" and "Petropavlovsk" are building at the Baltic works and the "Poltava" and "Gangut" at the new Admiralty yard, the English firm of John Brown & Co. being in charge of the work. On a displacement of 23,000 tons they will carry twelve 12-inch guns, arranged as shown, as well as sixteen 4.7's and four torpedo tubes. The speed will be 24 knots and the horse-power 42,000, which is very high for battleships. Meanwhile four other battleships which were laid down in 1903—the "Imperator Pavel" and the "Andrei Pervozvanni" in the Baltic and the "Ioann Zlatoust" and "Evstafi" in the Black Sea—are still incomplete.

It is only four years since the first all-big-gun ship was laid down; but the following table will show how completely the idea has seized upon the naval powers. It shows the number of battleships of this type completed, under construction, or to be laid down this year:

TABLE SHOWING TOTAL GUN POWER OF "DREADNOUGHTS."

	Great Britain.	Germany.	United States.	Austria.	Italy.	Russia.	Brazil.	Spain.	China.	Japan.	Chili.	Argentine.
Eight 14-in...	.....	...	.....	....	2 or 0		..	....	....	....	..	...
Ten 13.5-in...	4 or 5	..	....	..	....	.	...	....	..	...	...	....
Twelve 12-in.	0	6 ?	2	...	2 or 4	4	3	0	...	2	..	...
Twelve 11-in.	....	7 or 6	...	..	..		....	.	....	....	...	..
Ten 12-in.....	8 or 7	.	4	4	..	..	....	....	....	....	2 ?	2
Ten 11-in....	..	0 or 1	...	....			...	..	....	....	....	...
Eight 12-in...	4		2				.	3	3 ?	..		.
Tot'l in ships of this type	152	156 or 154	80	40	48 or 40	48	36	24	24	24	20	20

We also present a table which analyzes these vessels according to their main armament. It will be seen that, but for her four ships of this year's programme, British designs would "put up a poor show."

	Battleships.	Cruisers.
Great Britain..........................	12*	4
Germany..............................	10	3
United States........................	8	0
Austria	4	0
Italy................................	4	0
Russia	4	0
Brazil	3	0
Spain	3†	0
China................................	3‡ (projected)	0
Japan................................	2	0
Chili................................	2 (projected)	0
Argentine............................	2	0
	57	7

* Besides four "provisional" ships. †Eight 12-inch. ‡15,000 tons. Query "Dreadnought" type.

OPENING OF THE DOWN-TOWN HUDSON TUNNELS.

(*Concluded from page 57.*)

ing the eye, must afford a contrast generally garish and out of harmony with the otherwise excellent and subdued decoration.

This is doubtless a considerable source of income, difficult to forego in these commercial days; but considering the dignity and lack of ostentation with which the Hudson Companies have carried out both delicate negotiations and difficult engineering feats, considering also the immense profits likely to accrue from their undertakings, one might have hoped that they would omit this rather cheapening feature.

Stairways lead down from the concourse to the five platforms below, at each of which in rotation, separated by only 1½ minutes during "rush" hours, trains arrive by the southern and depart by the northern tube, there being no switching, and everything tending to the most rapid handling of traffic. Each train discharges its passengers upon the platform on one side of it and receives its new load from the platform at the other side, an arrangement which entirely separates incoming from outgoing passengers.

Again, below the rail level are extensive baggage and store rooms, and a subsidiary power station, making the Hudson Terminal Building a veritable city in itself, with clubs at the top, multitudinous business offices in between, a post office, telegraph office, and numerous shops below, and a railway station and power station in the basement, all inclosed within four walls.

THE SCIENTIFIC WORK OF THE LATE PROF. SIMON NEWCOMB.

Prof. Simon Newcomb died on July 11th in Washington at the age of 74. His death has removed not only the most distinguished astronomer that America ever produced, but a man who is honored the world over for his monumental scientific achievements.

All Newcomb's work followed up with rare perseverance has constantly tended to this ideal end: First, to arrive at a more exact knowledge of the magnitudes serving as points of reference and then to establish the theory not only of all the planets but also of their satellites on a system of constants as precise as modern observations permit.

Shortly after he graduated from the Lawrence Scientific School at Cambridge, he began the first important problem with which his name is associated, namely, the motions and orbits of the asteroids which revolve about the sun between Mars and Jupiter. It was once thought that perhaps these numerous bodies might be fragments of a large planet which had been shattered by explosion or collision. Were this true, the orbits would pass through the point at which the explosion occurred. As more and more asteroids were discovered, the coincidences of orbits became less marked. Still the theory was adhered to, because it was thought possible that the attraction of the larger planets might have caused perturbations. In order to decide for or against the theory, it was necessary to discover general formulæ by which the positions of the orbits could be determined at any time in the past, so that it could be ascertained whether or not the orbits ever did pass through a common point of explosion, in which case it would be possible to give an approximate date for the catastrophe. As a result of Newcomb's painstaking investigation, he concluded that the orbits had never passed through any point of common intersection. Later investigations based on Newcomb's work have shown that the hypothetical cataclysm never occurred, and that the asteroids probably always existed as minor planets. The paper which Newcomb read on the subject at the Springfield meeting of the American Association for the Advancement of Science in 1859 was the first that brought him into prominence—a young man of but twenty-four.

When Newcomb commenced his work at the Naval Observatory in 1861, the problems of the moon's motion had attracted astronomical attention. The most perfect lunar tables at the time were those of Hansen. Hansen had only a single assistant and could not, therefore, make the great number of observations required in the case of a body moving so rapidly as the moon. For a year or two Newcomb's observations showed that the moon seemed to be falling a little behind her predicted motion. This soon ceased, however, and she gradually forged ahead in a most remarkable way. In five or six years it was apparent that this acceleration was becoming permanent. Astronomers were puzzled to account for the phenomenon. For half a century the moon had apparently been running ahead and had then relaxed her speed so far as to fall behind again. Hansen had suggested that the planet Venus might be responsible for these inequalities. He showed that for 130 years the moon would thus be made to run ahead and for 130 years to fall behind. For 100 years the moon seemed to have followed Hansen's theory. Yet Newcomb found that the moon was deviating. To ascertain whether or not Hansen's tables represented the motion of the moon perfectly since 1750, as astronomers supposed, Newcomb undertook an examination of the occultations of the moon with bright stars. It was not until the telescope had been introduced and used for finding the altitude of a heavenly body and not until the pendulum had been invented by Huyghens that the time of an occultation could be fixed with the required exactness—a task first systematically performed by French astronomers of the eighteenth century. Newcomb suspected that some accurate observations had been made before their time, which he might use in checking up Hansen's tables. He found that a few such observations had actually been made between 1660 and 1700 and discovered to his surprise that Hansen's tables were evidently much in error. But to determine the cause of the errors was impossible without more observations. Newcomb planned a thorough search of the old records of Europe. On the occasion of the solar eclipse of 1870, he was sent abroad to observe the phenomenon for the Naval Observatory. He seized the opportunity to go to Paris and consult the old records of the observatory there. After a search he found that the very observations he wanted had been made in great number by the Paris astronomers, both at the observatory and at other points in the city. Three or four years were spent in making calculations on the basis of these Parisian researches, when it was found that seventy-five years were added in a single step to the period during which the history of the moon's motions could be written. Before Newcomb's work this history was supposed to commence with the observations of Bradley at Greenwich, about 1750. Now it was extended back to 1665, and with a less degree of accuracy farther still. Hansen's tables were found to deviate from the truth in 1675 and subsequent years to a surprising extent. But the cause of the deviation is not entirely unfolded even now.

In 1877 Newcomb took charge of the Naval Almanac Office. He thoroughly reorganized the office and placed it upon a more scientific footing. He mapped out a programme of work which involved a discussion of all the observations of value on the positions of the sun, moon, and planets, and incidentally on the bright fixed stars, made at the leading observatories of the world since 1750—a programme which involved a repetition, in the space of ten or fifteen years, of an important part of the world's work in astronomy for more than a century past. It was impossible to carry out this plan in all its completeness, so that Newcomb was obliged to confine himself to a correction of the reductions already made and published. For all that, the task was one which, in magnitude, probably exceeded any ever before attempted by any astronomer. The number of meridians observed on the sun, Mercury, Venus, and Mars alone numbered 62,030. Still other branches of the Nautical Almanac Office work involved the computation of formulæ for the perturbation of the various planets by one another.

Important among the troublesome problems with which Newcomb had to deal while in charge of the Nautical Almanac was that of universal time. There was a day when every railroad had its own meridians by the time of which its trains were run, which had to be changed here and there in the case of the great trunk lines and which seldom agreed with the local time of a place. The passenger was constantly liable to miss a train, a connection, or an engagement by the doubt and confusion thus arising. All this was remedied in 1883 by the adoption of our present system of standard times of four different meridians, the introduction of which was one of the great reforms of our generation with which Newcomb's name is associated. When the change was made, Newcomb was in favor of using Washington time as a standard, instead of Greenwich. But those who were pressing the measure thought it advisable to have a system for the whole world, and for this purpose the meridian of Greenwich was the natural one.

By 1894 Newcomb had succeeded in bringing so much of his work as pertained to the reduction of the observations and determination of the elements of the planets to a conclusion. So far as the general planets were concerned, it remained only to construct the necessary tables which, however, involved several years' work. Before Newcomb's time, the confusion which pervaded the whole system of exact astronomy, arising from the disclosures of the fundamental data employed by the astronomers of the various countries and various institutions in their work, was such that it was rather exceptional to base any astronomical result on entirely homogeneous and consistent data. To remedy this state of things and to start the exact astronomy of the twentieth century on one basis for the whole world, was one of the plans which Newcomb had mapped out for himself when he took charge of the Nautical Almanac Office. Dr. N. W. Downing, superintendent of the British Nautical Almanac, was animated by the same motive. He had especially in view the avoidance of duplicate work which arose from the same computations being made in different countries for the same result. The field of astronomy is so vast and the quantity of work required to be done so far beyond the power of any one nation that a combination to avoid all such waste was extremely desirable. When Newcomb published his preliminary results in 1895, Downing took the initiative in putting the idea into effect by proposing an international conference of the directors of the four leading ephemerides to agree upon a uniform system of data for all computations pertaining to the fixed stars. This conference was held in Paris in May, 1896.

In 1902, when the Carnegie Institution was organized, it made a grant to supply Newcomb with computing assistants and other facilities necessary for the completion of his study of the moon's motions.