SCIENTIFIC AMERICAN SUPPLEMENT No 599

Scientific American Supplement, Vol. XXIII., No. 599.
Scientific American, established 1845.

NEW YORK, JUNE 25, 1887.

Scientific American Supplement, $5 a year.
Scientific American and Supplement, $7 a year.

VICTORIA.

THE present Queen of Great Britain and Empress of India, Victoria, celebrates during the present month her jubilee, the fiftieth anniversary of her accession as Queen to the throne of Great Britain. Her record as monarch has been a quiet one. She has, by the gradual increase of parliamentary powers, occupied a position that made her little more than a figurehead for the British government. In its essentials, England is to-day a republic with an aristocracy. But the power of the aristocracy in government is very slight. The House of Lords, which is its representative in the ruling body, long ago was termed "an irresponsible debating society," so slight are its powers and so little its influence. The country is governed from the lower house of Parliament. When a member acquires too much power in that body, no more effectual way of gracefully extinguishing him exists than to transfer him, by the conferment of a proper title of dignity, to a seat in the House of Lords. His voice ceases to be heard, and he is practically extinguished.

The aristocracy, therefore, represent vast financial and territorial interests, and possess the influence wielded by the power of individual riches only. The position of the Queen follows this rule. She and the bulk of the nobles now are the recipients of immense pecuniary emoluments, for which they render little return beyond the conservative influence of such an organization. This service, however, is a real and tangible one. A true and genuine feeling of loyalty to the Queen is nurtured in many a breast that otherwise would be given up to very wayward thoughts, and a powerful barrier is opposed to socialism and other "isms" of the day by the development of this and other feelings.

The aristocracy also represent luxury and wealth and expenditure of money. To sustain their positions, they must spend largely. The French rag-picker told Sir Francis Head that when there was no luxury, times went hard with him. In England the same truth would hold. The rich families receive enormous incomes, but spend enormously and disseminate comfort

VICTORIA, QUEEN OF GREAT BRITAIN AND EMPRESS OF INDIA.

© 1887 SCIENTIFIC AMRICAN, INC.

among their servitors. The ceremonies of court involve the employment of armies of retainers and servants, while the dresses and equipments of those attending represent the expenditure among dressmakers and other tradespeople of large sums of money. Thus though covetousness is made the ground of accusation against her Majesty, yet her indirect influence and her inevitable expenditures do some good in distributing money.

Victoria Alexandrina was born at Kensington Palace, May 24, 1819. She is the daughter of Edward, Duke of Kent, himself the fourth son of George III. Her mother was the Princess Victoria Mary Louisa of Saxe-Coburg-Saalfeld, relict of the Hereditary Prince of Leiningen. Victoria is the only offspring of the union, and her father died while she was in her infancy, on Jan. 23, 1820. Owing to the absence of surviving legitimate issue of George IV. or his brothers, she became heir presumptive to the throne on the accession of William IV. in 1830. She was educated under the charge of the Duchess of Northumberland. On June 20, 1837, her uncle, the reigning king, died. Up to this period, since the establishment of the house of Hanover on the English throne, the same monarch had worn both crowns, but with Victoria's accession they were divided. The Salic law, prohibiting a female monarch, prevailed in Hanover, and Victoria's uncle, the Duke of Cumberland, received the Hanoverian crown, while Victoria was made Queen of England. On June 28, 1838, a year after her succession to the throne, she was crowned at Westminster Abbey. She is the sixth sovereign of the house of Hanover.

In the early part of her reign, she acquired much popular interest and appreciation by her graceful appearance and her predilection for equestrian exercise. Through selecting a milder type, she indulged in this sport much as the Empress of Austria has done. Many of the early portraits and statues represent her as mounted on a steed, "witching the world with noble horsemanship."

Nearly at the same time as Victoria, her future husband first saw the light. Francis Albert Augustus Charles Emmanuel, Prince of Saxe-Coburg-Gotha, was born at Coburg, August 26, 1819. He was educated under his father's auspices and is said to have made a brilliant record in his studies, finishing at the University of Bonn. In June, 1838, he visited England, and at that early age, for both parties, was introduced to his future spouse by Leopold, King of Belgium. The acquaintance deepened apparently into true regard, and in the following year, in November, 1839, Queen Victoria, not yet 21 years of age, announced formally to her privy council that she intended to marry the young Saxe-Coburg-Gotha prince.

A special act of Parliament, naturalizing the young foreigner, was passed on Jan. 21, 1840, and on Feb. 10 the marriage took place. The match, though presenting every appearance of a union founded on genuine regard, does not seem to have been received with great favor by the nation. The index of this is that while an annual allowance of £50,000 was proposed, but only £30,000 was voted.

In every way the Prince Consort, as he was now termed, showed himself an amiable man, and one devoted rather to the quieter range of pursuits than to warlike aspirations of any sort. He became at once invested with many high titles, such as field marshal, knight of the garter, and Chancellor of the University of Cambridge. He devoted himself largely to model farming, to the improvement of domestic animals, and to the amelioration of the condition of the working classes. Despite a certain tendency to impute to him a lack of strong character, his chosen pursuits would be a useful exemplar for many other dignitaries to pursue. His presidency of the Society of Arts gave his æsthetic tastes ample scope. In 1851 the world's fair was opened in the Crystal Palace, near the city of London. This was peculiarly under his auspices, and was the precursor of the long list of such exhibitions that have since occupied the attention of nations.

The domestic relations of Victoria under these auspices were to all appearance of the happiest kind. The morals of the court, which, during the incumbency of the Hanoverian house, had reached a very low ebb, were by their united influence elevated until the court won a very high reputation for purity. Yet a certain substratum of the jealousy against the Prince Consort, already alluded to in the matter of his allowance, every now and then came into view. In 1855, in Parliament, the ministry found it necessary to correct or to deny the truth of certain rumors as to his partiality for foreign interests. Victoria is said to have been wisely advised and counseled by him in many governmental affairs. The title of Prince Consort, with the prefix of "his royal highness," was conferred upon Victoria's husband by letters patent under the great seal, June 25, 1857. The object of this was to entitle him to undisputed possession of the regency in case of the death of Victoria during the minority of the Prince of Wales. But over this apparently phenomenally happy home, for a royal one, a blow was impending in the death of the husband. The Prince Consort died in Windsor Castle, December 14, 1861. This was in the first months of the civil war in the United States. When the position of England during that contest is remembered, it is of interest to note that the feelings of the Prince Consort were said to have been for the Union.

This loss of her husband was, from every external indication, a great blow to Victoria. For years she maintained a rigorous seclusion and mourning. This was made the object of a certain amount of criticism. As has been shown in the opening paragraphs of this article, much of the good done by the royal house of England consists in the maintaining of a court, with its inevitable distribution of money and employment of people of all classes. When Victoria set her private grief before the nation's desires, while every indulgence was awarded her, it was felt that she carried her feelings almost too far in imposing a species of gloom upon the whole nation.

From his death to the present day the memory of the Prince Consort has been a living thing with her. Statues and monuments and memorial institutions bearing his name testify to her regard. In February, 1876, for the first time since his death, she opened Parliament personally. This was in the ministry of Benjamin Disraeli, her favorite prime minister.

The death of the Prince Consort was not her only loss in 1861. On March 16 of the same year, her mother, the Duchess of Kent, expired.

Her life has been a very quiet one, and seclusion has been uniformly sought for by her. Her summers she has generally spent at Balmoral, in Scotland. Through the highlands of the same country she traveled in the quietest possible manner, under the care of her favorite attendant, the somewhat famous John Brown. Her trips in the highlands were described in a book by her, which has not done much for her literary renown.

Her children and descendants now form a numerous body. She has had nine children, five daughters and four sons. The eldest son, named Albert Edward, from his father, was born in 1841, and in 1863 married Alexandra of Denmark. The well known ode to Alexandra by Tennyson was written in honor of this marriage. This prince is the heir presumptive to the throne, and wears the triple plume of the Prince of Wales.

The jubilee week is now in progress. A programme of quiet celebration has been laid out for it. Regret has been expressed that the celebrations were not more extensive and unique in character, yet it seems as if their sober and orderly character is more in consonance with Victoria's nature. As the jubilee is for her personally, it should be guided by her tastes.

On Monday the court moves to London. On Tuesday and Wednesday the Queen holds receptions, and on the latter day the court moves to Windsor. On Thursday 200 volunteer fire companies are to be reviewed at Windsor Park, and a feast of 7,000 children on the north terrace of the castle is to be visited by her. On Friday an investiture of orders is expected.

On May 14, a preliminary to the jubilee took place, in the opening by her of the People's Palace, graphically described in a recent letter by G. W. Sala. Her appearance at this festival is said to have shown that she is ageing, and feels her years more than would seem necessary from their number, for as yet she is not seventy.

Besides the formal programme, outlined above, many other celebrations will mark the jubilee. At Westminster there is to be a grand pageant, with processions through London. The foundations of an imperial institute are to be laid, naval and military reviews are to be held, and in the near future statues are to be erected. Beacon fires are to be lighted along the coast. The lighthouse authorities have even seen fit to warn captains of vessels against mistaking these effusions of loyalty for the regular Trinity House aids to navigation.

Despite her quiet life and home-like characteristics, Victoria not been spared from the assassin's attempts. In June, 1840, and in May and July, 1842, she was assaulted, but without receiving any injury. Clemency was practiced toward the offenders.

A large body of the English, headed by its greatest statesman, Gladstone, would wish to see the jubilee year made a true jubilee by universal amnesty. But the passage on such an occasion of a coercion act, insured and expedited by the introduction of unusual powers of cloture in Parliament, seems a poor accompaniment for the time of presumable joy.

Were the royal head possessed of a little more influence, how gracefully might it be exercised on this occasion by a proclamation of universal peace and amnesty! There the tone of the daily press is unmistakably opposed to the legislation being hurried through Parliament.

Space permits of no review of the events of the reign of this Queen. The successive prime ministers were: Lord Melbourne until 1841; Sir Robert Peel until 1846; Lord John Russell until 1852; Lord Derby until 1853; Lord Palmerston until 1858; Lord Derby until 1859; Lord Palmerston until 1865; Earl Russell until 1866; Lord Derby until 1868, succeeded by Benjamin Disraeli. This was emphatically the Queen's favorite minister. It was by his influence that in 1876 she received the title of Empress of India. Since then the government has been in the hands of Gladstone and others, whose terms are matters of strictly contemporaneous history.

A curious anecdote of her lively memory of the Prince Consort is told. She sent to a commemoration of Disraeli, who was dead, a wreath of primroses. She had it marked with the inscription, "His favorite flower." Every one supposed that the allusion was to the dead prime minister, and this is said to have been the origin of the "Primrose League," organized in memory of Disraeli. But it is stated that the Queen intended by the word "his" the "Prince Consort," that "his" from Victoria always means this, so that the primrose was not Disraeli's favorite flower at all, but was Albert Edward's. The name of the association designed to carry out and perpetuate Disraeli's ideas is therefore a misnomer. From his taste for luxury and artificial life, it seems tolerably certain that the great Israelite would have cared little for the simple flower.

HUMAN LONGEVITY.

THE possibility of long life may easily be corroborated by referring to numerous examples; but the fact that the nobler qualities of human nature are the most efficient promoters of longevity is our most important lesson, and it is illustrated by the superior longevity of women. He is a misanthrope who does not recognize their superior virtue, and he is a poor statesman who does not wish to see that virtue imparted to our political life, and who does not recognize the importance of giving to woman the most perfect intellectual and industrial education, that she may be self-supporting. The British census shows that there are 948,000 more women than men in Great Britain. The *St. James Gazette* says:

"Prof. Humphry, of Cambridge, has prepared a series of tables which contain some interesting information about centenarians. Of 52 persons whom he mentions, at least 11—2 males and 9 females—actually attained the age of 100. Others attained very nearly to the hundred years. Only one of the persons reached 108 years, while one died at the alleged age of 106. Of the 52 persons, 36 were women and 16 men. Out of the 36 women, 26 had been married, and 11 had borne large families. Of the 26 who had been wives, 8 had married before they were 20, 1 at 16, and 2 at 17.

"Twelve of the fifty-two centenarians were discovered to have been the eldest children of their parents. This fa t, adds Dr. Humphry, does not agree with popular notions that first children inherit a feebleness of constitution, nor with the opinion of racing stables, which is decidedly against the idea that 'firstlings' are to be depended on for good performances on the course. The centenarians generally regarded were of spare build. Gout and rheumatism were, as a rule, absent. 'It seems,' says Prof. Humphry, 'that the frame which is destined to great age needs no such prophylactics, and engenders none of the peccant humors for which the finger joints (as in gout) may find a vent.'

"Of the fifty-two aged people, twenty-four only had no teeth, the average number of teeth remaining being four or five. Long hours of sleep were notable among these old people, the period of repose averaging nine hours; while out of door exercise in plenty and early rising are to be noted among the factors of a prolonged life. One of the centenarians 'drank to excess on festive occasions;' another was a 'free beer drinker,' and 'drank like a fish during his whole life. Twelve had been total abstainers for life or nearly so, and mostly all were 'small meat eaters.'"

The oldest woman in Austria at this time is Magdalene Ponza, who is 112. "She was born at Wittingau, Bohemia, in 1775, when Maria Theresa sat on the Austrian throne. George III. had then been but 15 years King of England, Louis XVI., who had ruled a little more than a twelvemonth in France, was still in the heyday of power, the independence of the United States of America had not yet been declared, Napoleon and Arthur Wellesley were as yet but six years old. Magdalene Ponza retains full possession of her mental faculties. Unfortunately, she can only speak the Czech language, and she can neither read nor write. However, she answers questions briskly enough through the youngest of her surviving grandchildren, herself a woman of 60. Magdalene Ponza's age is authenticated by the outdoor relief certificate of the Viennese municipality."

Of American centenarians we have a number, some of whom are still living. Harrisonville, New Jersey, has two, Michael Potter and Bartholomew Coles. Polly Wilcox, of Hope Valley, R. I., celebrated her centennial last year; so did Jane Wilcox, of Edgecomb, Maine, while she had a sister 94 and a daughter 81. Old Aunty Scroggins, of Forsyth Co., Georgia, is now 104 years old, and is still one of the most effective shouters of the Methodist Church, to which she has belonged 94 years.

Miss Phebe Harrod, of Newburyport, Mass., celebrated her centennial last year. She still takes a lively interest in passing events.

Grandmother Sarah Drew, at Halifax, celebrated her centennial a year ago. Her constant companion is an old Bible which has been in the Drew family for 250 years.

Mrs. Triphene Bevans, of Danbury, Mass., held a lively centennial reception in the parlors of the West Street Church, April 14, 1886. Her health, hearing and speech were good, and her step brisk. She attributes her age and good health to good habits and allowing nothing to trouble or worry her. She has always been a strict church member.

William Waterman, of Oshkosh, Wisconsin, is said to be 109 years old. It is said he "is a Methodist, uses liquor and tobacco, and finds no fault with the world."

Joseph O'Neal, of Barnesville, Georgia, might have been living still if he had not been frozen to death last winter, at the age of 107, in a sudden blizzard. He was a negro, and had over 200 descendants.

Mrs. Elizabeth Thomas, of Reading, Penn., who had lived a century, might be still living if she had not been killed last year, while walking on the railroad track.

Of those who overrun the century, we might mention further Simon Harras, who died in Putnam Co., Indiana, last January, aged 109. His memory was good to the last.

Mrs. Elizabeth Small, relict of Dr. Samuel Small, at Lewiston, Maine, had passed her hundredth birthday a few weeks when she died of apoplexy; and Mrs. Susan Phillips, of Wilson Creek, N. C., died last year just as she finished her century.

Nathan, formerly slave of Benj. W. Bodie, died last year, in Mississippi, Talbot Co., aged 107.

Christopher Mann, of Independence, Missouri, died last year, aged 111.

The oldest of all, and probably the oldest minister in the world, is Rev. Thos. Tenant, of Vineyard Township, Arkansas, an itinerant Methodist preacher, born in 1771, now in his 116th year.

Mr. Edward Gentry told a more remarkable story at Indianapolis, last July. He was at the governor's office, and gentlemen were guessing at his age. None supposed him over fifty; but he said he had a son fifty-two years old, and was himself seventy-eight. He added: "My doctor has given me a fifty years' longer lease on my life, barring accidents. My father is 128 and is still living. My mother died at the age of 117, and her mother lived to the same age." Mr. Gentry is of English birth.

Perhaps the best specimen of family health is that of the Atkinson family of Gloucester, Mass. Nine children were born, and all lived. The first death in the family was a few weeks ago, when John Atkinson died, aged eighty-four. When he died, the ages of the nine amounted to 703 years.

Aunt Dinah John, the oldest Indian at the Onondaga reservation, died in May, 1884, aged 109.

About ten years ago, when Governor Seymour was about to make an address at an Indian fair on the Onondaga reservation, Aunt Dinah walked upon the platform and asked to be introduced to him.

Mr. Gardner said, "Governor Seymour, this is Aunt Dinah, who wants to become acquainted with you."

"Oh, no; him get acquainted with me," Aunt Dinah explained. "Me know him before he know anybody. Many years ago me go to Pompey Hill, his father's grocery. Governor's father say: 'My squaw very sick.' I ask, 'What matter?' His father say, 'Go in and see for yourself.' Me go into a room; see a little pappoose about a foot long" Then moving toward Governor Seymour, and pointing her finger at him, she said: "That pappoose was you, Governor Seymour, born that night."

Aunt Dinah called frequently at Mr. Seymour's, and took especial delight in rocking the cradle and showering caresses in her native fashion upon the future governor of the State.

About three years ago she became blind, and has since been kept at her home on the Onondaga reservation. She retained her faculties to the last. Her husband died thirty years ago. Her dying request was

© 1887 SCIENTIFIC AMRICAN, INC.

that the pagan ceremony be first observed, and afterward the Christian ritual.

What are we to reckon, says the *Home Journal*, as the declining period of man's existence? The point at which old age taps us on the shoulder, and says it comes to keep us company, varies with every individual. It depends a great deal on circumstances, which are hardly the same in any two cases. Some writers have said that a man is old at forty-five, others have set down seventy as the normal standard. Dr. John Gardner, who has written on "Longevity," remarks: "Long observation has convinced me that sixty-three is an age at which the majority of persons may be termed old, and as a general rule we may adopt this as the epoch of the commencing decline of life."

Suppose then, we agree to call no man old till he is past sixty-three. Let us set down the names of some of the illustrious people of the world who have prolonged their days of usefulness after that age. We shall make a table of them, and begin it with those who have died at seventy, that is to say, with those in whom the springs of life have not stood still till they have had at least seven years of old age. It will be found, however, to be far from exhaustive, and every reader may find pleasure in adding to it from his own stock of information:

Age at Death.

70—Columbus; Lord Chatham; Petrarch; Copernicus; Spallanzani; Boerhaave; Gall.
71—Linnæus.
72—Charlemagne; Samuel Richardson; Allan Ramsey; John Locke; Necker.
73—Charles Darwin; Thorwaldsen.
74—Handel; Frederick the Great; Dr. Jenner.
75—Haydn; Dugald Stewart.
76—Bossuet.
77—Thomas Telford; Sir Joseph Banks; Lord Beaconsfield.
78—Galileo; Corneille.
79—William Harvey; Robert Stevenson; Henry Cavendish.
80—Plato; Wordsworth; Ralph Waldo Emerson; Kant; Thiers; William Cullen Bryant.
81—Buffon; Edward Young; Sir Edward Coke; Lord Palmerston.
82—Arnauld.
83—Wellington; Goethe; Victor Hugo.
84—Voltaire; Talleyrand; Sir William Herschel.
85—Cato the Wise; Newton; Benj. Franklin; Jeremy Bentham.
86—Earl Russell; Edmund Halley; Carlyle.
88—John Wesley.
89—Michael Angelo.
90—Sophocles.
99—Titian.
100—Fontenelle.

It may be said that they were exceptional in living so long, but if what the best authorities say be true, the exceptions ought to be the people who died young, and not those who prolong their lives and carry on their work till they are old. Few of us may find ourselves, like Lord Palmerston, in our greatest vigor at seventy, or be able, like Thiers, to rule France at eighty, or have any spirit for playing the author, like Goethe and Victor Hugo, when over eighty, or for playing the musician, like Handel and Haydn, when over seventy; but by good management we may do wonders.

The wisest men and the best have been conspicuous for working to the end, not taking the least advantage of the leisure to which one might think they were entitled. They have found their joy in pursuing labors which they believed useful either to themselves or to others. John Locke began a "Fourth Letter on Toleration" only a few weeks before he died, and "the few pages in the posthumous volume, ending in an unfinished sentence, seem to have exhausted his remaining strength." The fire of Galileo's genius burned to the very end. He was engaged in dictating to two of his disciples his latest theories on a favorite subject, when the slow fever seized him that brought him to the grave. Sir Edward Coke spent the last six years of his life in revising and improving the works upon which his fame now rests. John Wesley only the year before he died wrote: "I am now an old man, decayed from head to foot. . . . However, blessed be God! I do not slack my labors. I can preach and write still." Arnauld, one of the greatest of French theologians and philosophers, retained, says Disraeli, "the vigor of his genius and the command of his pen to his last day, and at the age of eighty-two was still the great Arnauld." It was he who, when urged in his old age to rest from his labors, exclaimed, "Rest! Shall we not have the whole of eternity to rest in?"

A healthy old age cannot be reached without the exercise of many virtues. There must have been prudence, self-denial, and temperance at the very least. According to the proverb, he that would be long an old man must begin early to be one, and the beginning early just means taking a great many precautions commonly neglected till it is too late. More people would be found completing their pilgrimage at a late date if it were not that, as a French writer puts it, "Men do not usually die; they kill themselves." It is carelessness about the most ordinary rules of healthy living.

The enjoyment of old age may be looked on then as a reward, and the aged may pride themselves on being heirs to a rich inheritance, assigned to forethought and common sense. Many years are an honor. They are an honor even in the case of the worldly, and a great deal more so when life has been regulated by motives higher than any the world can show. "The hoary head," says Solomon, "is a crown of glory;" but he adds this qualification: "if it be found in the way of righteousness." Old people form a natural aristocracy, and to be ranked among them may be recommended to all who have an ambition to close their lives well up in the world

For a picture of an old man in this enviable state of mind take Cornaro. In his eighty-third year we find him congratulating himself that in all probability he "had still a series of years to live in health and spirits and to enjoy this beautiful world, which is indeed beautiful to those who know how to make it so." Even at ninety-five he wrote of himself as "sound and hearty, contented and cheerful. At this age," he says, "I enjoy at once two lives: one terrestrial, which I possess in fact; the other celestial, which I possess in thought; and this thought is equal to actual enjoyment, when founded on things we are sure to attain, as I am sure to attain that celestial life, through the infinite mercy and goodness of God."

Jeremy Bentham, who lived to be eighty-five, retained to the last the fresh and cheerful temperament of a boy. John Wesley, who died when he was eighty-eight, also had a happy disposition. "I feel and grieve," he says, "but by the grace of God I fret at nothing." Goethe, who reached his eighty-third year, is another good example. Then there is Boerhaave, one of the most celebrated physicians of modern times, who held that decent mirth is the salt of life. Indeed, in the case of most old people, we believe it will be found that cheerfulness is one of their leading characteristics.—*Journal of Man.*

A SUBMERGED MEXICAN VILLAGE.

ONE of the most remarkable of lakes is the Laguna de Tequezquitengo, in the Mexican State of Morelos. It is a beautiful sheet, and has every appearance of being a natural body of water, but, nevertheless, it is artificial and of comparatively recent date. It lies in the depths of a valley about two miles long and a little less in width.

A Mexican gentleman who visited the spot—which is remote from the ordinary lines of travel, in the district of Juarez—has written an account of the place, which has been reproduced in the July collection of monthly reports, issued by the secretary of public works, giving statistics and information about agriculture and industries, including the geographical features of the country.

The writer (Mr. Eugenio De J. Canos) says: "When, in one of the torrid days of May, the traveler who, for the first time, makes the journey from Puente de Ixtla to Jojutla by the Tequezquitengo road feels oppressed by the fiery sun, his sight fatigued by the aridity of the hills, among which the highway describes its tortuous curves, and whose dry, dust-covered vegetation inspires only weariness and discouragement, when he vainly seeks to penetrate the veil with which the hazy air limits the horizon on all sides, and longing for a drop of water to moisten his parched and thirsty lips, how grateful, how limpid, poetic, smiling, and fresh is the aspect when suddenly there appears at his feet, in the depths of that topographical depression, the beautiful artificial lake of Tequezquitengo!

"The crystalline aspect of its limited surface is like that of the clearest mirror. Around the lake all is verdure and freshness. Beyond, the land is dry, hot, dusty, and sad of aspect. The contrast perhaps heightens the beauty of the lake.

"What strange creatures are those, seeking, in the water, a refuge from the burning rays of the sun? They are carabaos, beasts of burden, indigenous to the Philippine Islands and imported by the Senores Morro, former owners of the hacienda de San Jose Vista Hermoso, one of the largest sugar estates in Morelos, within whose limits lies the lake. These carabaos were imported for use on the place. But it appears they were not of the anticipated utility, for they have been abandoned as working animals.

"But there, almost in the midst of the lake, is something which at first glance is seen to be inanimate; it remains motionless, and but for its rigid immobility it might be suspected to be a gigantic aquatic fowl about to spread white and immense wings.

"Descending by the slope of the almost oval basin, in whose depths lies the lake, it is seen that the object penetrates far beneath the surface, that it increases in size, and when one reaches the margin of the liquid element it assumes its correct shape; it is a church! The strange thing which was seen from afar is the cupola of the tower, crowned by a cross. Now may be distinguished perfectly, within the liquid mass, which has a crystalline transparency, the body of the church, its roof, the main portal, the window of the choir, the belfry openings—all as in a phantasmagoric diorama, whose lens is the surface of the serene lake!

"But how is it that it is an artificial lake? our readers will ask. Who made it, and why? How came the church to be there? What is or what was Tequezquitengo? We will proceed to satisfy, as well as we may, their curiosity, by relating the history of the lake as we heard it from the mouth of some friends living in the neighborhood, as we stood on the margin of Tequezquitengo several years ago.

"Forty years have passed since there nestled in the bottom of the valley the pretty village of Tequezquitengo, where bull fights and cocking mains took place on the occasion of the festival annually held in honor of the saint of the place by its natives and their neighbors. Besides the raising of grain and vegetables, the cultivation of fruit and the breeding of cattle, the principal resource of the inhabitants consisted in the collection of tequezquite, as they call an impure sesquicarbonate of soda, produced in abundant efflorescence in the lowest part of the little valley, where the rains, alternately collecting and evaporating, formed a little lagoon. On the margin of this, as it dried, the material was found. The neighboring hacienda of San Jose, a beautiful estate, conducts the water for the irrigation of its sugar cane fields by an aqueduct of six or seven leagues in length. This water is of considerable volume, and it formerly flowed away in the opposite direction to Tequezquitengo, emptying at Puente de Ixtla into the stream formed at that point by the junction of the Tembembe and Chalme.

"For some reason, now unknown, the administrator of San Jose changed the course of this stream into the valley, whence, by reason of its slopes of nearly equal height on all sides, the waters found no exit. The little lagoon began to increase in size. It first invaded the grain fields and gardens, then the first houses of the village, then the church; rising and rising until it finally desolated the entire place. The unhappy inhabitants fled from their native pueblo, which now may be seen like an enchanted memory as it rests in the depths of the lake. Two miserable huts standing near the bank were all that remained when we visited the spot.

"The lake continued to expand and to rise in level year by year, until eight or ten years ago, when it reached its maximum by attaining an equilibrium between the quantity of water entering and that lost by evaporation and infiltration. The shape of the surface is that of an oval, whose length and breadth are something like two miles and one and one-quarter to one and one-half respectively. The maximum depth is said to measure something like eighty meters, which we believe to be correct, for the level of the lake has been fixed, as upon a gigantic and melancholy hydrometric column, at the last cornice of the tower of the temple, which was built upon the higher part of the plain that to-day forms the bottom, leaving nothing unsubmerged except the cupola."—*Boston Herald.*

ANTIQUITY OF BISCUITS.

VERY few consumers of wheaten products are aware of the fact that biscuits are the oldest form of bread. At what period of man's history the lightening of dough by fermentation was first adopted no one, of course, knows. It is, however, certain that cakes made of nothing but meal and water and then baked are very much older. Fragments of unfermented cakes were discovered in the Swiss lake dwellings, which belong to the Neolithic age, an age dating back far beyond the received age of the world. This is the earliest instance of biscuits as yet discovered, for biscuits are merely unfermented bread. Although this rude form of bread was early discarded for the fermented variety, yet in this, as in many other matters, it was found convenient to return to a discarded and apparently valueless process.

Thin, unfermented cakes were found to possess merits for special purposes. They would keep good for a great length of time, and they were convenient to carry, and thus afforded wholesome and nutritious food in a portable and convenient form. The simplicity in which they could be made and baked was also a point in their favor.

Most of the ancient nations ate biscuits under special conditions; chiefly in war, whether naval or military, or on long journeys by sea or land. To the Greeks they were known as *arton dipuron*, that is, "bread twice put to the fire;" while the Romans had their *panis nauticus* or *capta*, chiefly used, as its name implies, for nautical purposes. Indeed, biscuits have been known to all ages, and are now in every land one of the most popular and useful of all forms of food. It is not a little odd that the word "bisquet," or "biscuit"—for with a certain fine freedom from the restraints of etymology it has been spelt in all three ways—embodies the process by which biscuits were made from time immemorial to within the last century, if not, indeed, later. *Bis*, twice, and *coctus*, cooked, shows that they were twice baked; and although the double process has now been discarded, yet the name is retained.—*Analyst.*

TERMS OF CREDIT IN DIFFERENT COUNTRIES.

THE following data regarding the terms of credit allowed in various countries are derived from reports of United States consuls published by the government.

It appears that in Germany the credit system is very widespread, and that the time allowed purchasers to settle their accounts is generally much longer than in France and England. Nearly every commercial and manufacturing branch of business has its own particular terms of credit, and there is no uniformity in this respect.

In England, a payment of the price of the goods delivered is required at the end of three months, dating from the day of shipment.

In France, a four months' acceptance is required to be sent in settlement of the invoice.

In Italy, but little credit business is done, and none without good security being given.

In Spain, four-fifths of the transactions are done on a cash basis, while in Portugal great liberality is shown, and quite a long credit is usually allowed.

In Austria, it is scarcely possible to do business without allowing a very long credit, which is nearly always one of six months.

In Turkey, even objects of prime necessity are sold on credit, and in this country, as well as in Russia, the time allowed is in most cases twelve months.

In Canada, settlements are made at the end of thirty days, with a discount of five per cent. Sometimes a credit of from three to six months is allowed, but in this case there is no discount granted upon payment of the account.

In Mexico, the large commercial houses willingly give a credit of from six to eight months, and in the retail trade long terms are given customers in which to settle their accounts. In Costa Rica, a credit of from six to twelve months is given in case of merchandise imported from Europe, in order that the goods may be easily and quickly disposed of. But since this system of credit has often led to losses, it is now being given up.

In Cuba, the time fixed for payment is generally from four to five months after delivery of the goods.

The Consul-General of the United States at Rio states that one of the greatest drawbacks to commercial intercourse with Brazil resides in the necessity of allowing too long a credit. At Rio Janeiro, as at Buenos Ayres, the minimum credit is six months, and often more.

In the Bermudas, accounts are settled but once a year. The thirtieth of June is the day usually fixed for the payments.

In Asia Minor, a credit of but two or three weeks is in most cases all that is allowed.

In China, it is not customary to give credit. Money is obtained from lenders, who exact an interest of from 8 to 12 per cent. Business is nearly always conducted upon a cash basis.

In Australia, a credit of six months is generally allowed.

TO SILVER SILK RIBBONS.

MAKE a solution of nitrate of silver. and add a little gum to it, so that the liquid will not run. Then, with a camel's hair pencil or a new pen, draw any sort of ornamental figure on the silk. After the drawing is dry, hold the ribbon over a vessel containing water, zinc, and a little sulphuric acid. In a short time, the silver will be reduced and adhere quite strongly to the fabric.

Arabesques, wreaths, etc., executed in this manner have a very pretty appearance.—*Chronique Industrielle.*

© 1887 SCIENTIFIC AMRICAN, INC.

THE APOLLO BELVEDERE, IN THE VATICAN, ROME.

© 1887 SCIENTIFIC AMRICAN, INC.

THE APOLLO BELVEDERE.

OF all the ancient statues of the Græco-Roman period none is more universally admired or more popularly known than the Apollo Belvedere. The illustrious Winckelmann, with artistic emotion, thus describes the figure somewhat in the strains of an ecstatic eulogy: "The statue of Apollo is the highest ideal of art among all the works of antiquity which have escaped destruction. The artist has based his work entirely on the ideal, and has employed only just so much of matter in its construction as was necessary to carry out his design and make it visible. This Apollo surpasses all other images of the god as far as the Apollo of Homer transcends that of succeeding poets. He is exalted above humanity, and his bearing speaks of the grandeur with which he is filled. An eternal spring like that of the blessed Elysian fields embathes his charming manhood of ripe maturity combined with the loveliness of youth, and plays with soft tenderness over the proud structure of his limbs.

"Enter in spirit into the realm of incorporeal beauty, and seek to be the creator of a heavenly nature, to invest the spirit with supernatural charms! For there is nothing mortal here, nothing which human necessities and weaknesses require. No veins or sinews to heat or excite this form; but a heavenly spirit poured out like a gentle stream has filled the sphere in which this figure lives and moves. I forget all else as I gaze on this miracle of art, and myself assume a lofty attitude to contemplate it with becoming dignity." * This rhapsody, possibly, to the student of art in these days may seem overwrought; but the eulogy is an evidence of the utmost influence which a work of art can exercise upon a sensitive, sympathetic, and instructed mind.

The indiscriminating and extravagant praise of its earlier admirers has led in recent times to an equally unwarranted depreciation of this splendid work of art. To judge it properly, the fact should be remembered that the design and style are of different periods. It is the work of one of those genial eclectic copyists of the Renaissance of Greek art in Rome who, having chosen his model from among the older types, was not satisfied with merely reproducing it. He has evidently tried to invest it with the charm of novelty by substituting for its grand simplicity the ultra refinement and polished elegance which suited the taste of his own times. Thus writes Mr. Walter Copland Perry: "The Apollo Belvedere shows a master's hand. The artist was evidently in possession of all the knowledge and all the skill which had been accumulated in past ages. We see Lysippus in the form and Praxiteles in the face. The noble limbs are moulded with the ease and freedom which are the result of perfect mastery, and the proud and beautiful face, from which the Muses drew their inspiration, gleams with expression as he moves along in graceful majesty bathed in the purple light of eternal youth—such an image, if worshiped at all, could only be the favorite divinity of an elegant and sumptuous court."

The *motif* of the statue is, after all, the most interesting subject for inquiry. The earlier opinion rules that the great "god of the silver bow" has just discharged an arrow at the Python (Tityos? or the Niobids?), and is watching the effect of his exploit with satisfaction. Others, again, have urged that he is "the bringer of the plague," shooting at the Greeks before Troy who had dishonored his holy prophet (Hom. Il. I 44). The discovery of the Stroganoff Apollo suggested another interpretation, for the resemblance of this bronze figure to the marble statue is far too marked to be merely accidental, and there can be no doubt that both are copies of the same original work. The drapery folds, the sandals, and other details are identical in the two statues, and where they differ the style of the bronze is simpler and more archaic. The left hand is, however, the most important feature, for it holds not a bow, but an elastic substance, the bottom part of which is broken off, and which Stephani takes to be the ægis.

Preller, basing his argument on this discovery, urges that the Apollo Belvedere might be brought into connection with the defeat of the Gauls at Delphi in 279 B.C., on which occasion several statues were offered in the Temple of Apollo at that place. This is called the Gallic theory, and against it is urged the question how Apollo came by the ægis, which is not his proper attribute. Perry has supplied a precedent even for this in a passage of the Iliad which records how Zeus intrusted his son with the dreaded instrument of his wrath:

"Take thou and wave on high the tasseled shield,
The Grecian warriors daunting."

And again—

"When he [Phœbus] turned its flash
Full on the faces of the astonished Greeks
And shouted loud, their spirits within them quailed."

It was, therefore, quite permissible to the artist to represent Apollo in his character of *Boedromios* (helper), with the ægis of Zeus. The Apollo Belvedere was discovered toward the end of the 15th century at Capo d'Anzo (Antium), the birthplace of Caligula and Nero, the latter of whom loved to pose as the representative of the "fair haired" and "musical" god. Montorsoli, a pupil of Michael Angelo, restored in 1532 the missing left hand and fingers of the right hand with the all-important attributes which they bore. It is still a matter of dispute whether the marble of the statue is Greek or Italian. Our illustration is from a fine photograph taken from the original statue, which is one of the glories of the Vatican.—*Building News.*

ITALIAN MARBLES.

THE Italian marble trade is of considerable importance. It centers in Carrara. It is calculated that there are annually extracted from the quarries in the neighborhood of this town alone something like 200,000 tons of marble, representing a money value of over a million sterling. Upon this the Italian government takes toll to the extent of £20,000 a year, in the shape of a direct tax of 10 centesimi (a penny) on every cubic palm raised. A palm measures in length 9·81 inches, and is to the Italian quarryman what the foot is to the Englishman. Four cubic feet equal rather more than seven cubic palms, the exact equivalent being 1 to 1·81.

The whole range of the Apennines is singularly rich in deposits of marble; but the white marble found at Carrara, and known all over the world, is the most famous. The name Carrara is derived from the Latin *quarrariæ*, whence our English word quarry. The population of the town numbers some 25,000 souls, nearly the whole of whom are engaged in the trade. The people are exclusive; they speak a sort of language or patois of their own, dignified by the name of Carrarese. Human life is not set at so high a value as it might be, stabbing affrays being lamentably frequent; but it is of almost unknown occurrence to hear of mischief to the stranger within the gates. The numerous *studii* and workshops are like so many cellars built on the street level under the dwelling houses. They admirably answer the purpose of being shady and cool to work in, but afford no opportunity for the sculptor to display his handiwork. A small stream runs through the center of the town, and affords the motive power to saw mill after saw mill. In the academy there is a large collection of models and casts from the greatest works in sculpture—ancient and modern. From sixty to seventy pupils, who are taught drawing and modeling, are regularly in attendance.

The marble, when brought from the quarries, is conveyed to the seashore at Avenza, which is about five miles distant from Carrara. It is sent thence to Leghorn in small coasting vessels called "*navicelli.*" From Leghorn it is exported to all parts of the world. A considerable saving would be effected if sea-going ships could load at Avenza itself. At present there is the cost of transportation to another port, and the consequent double handling. It is quite practicable to make a good harbor; but hitherto local enterprise has contented itself with building a pier, from which the small craft are loaded. A railway connects the pier with some of the quarries; but the bulk of the traffic goes the old way by road, and on bullock wagons. The journey down is a slow and terribly toilsome process. A team of bullocks takes a whole day to complete a single journey from the quarries to the seashore; the mountain road is more like the bed of a torrent than a beaten track.

The quarrymen are a prodigiously hard-working race of men. In the summer it is too hot for them to work in the middle of the day; but long before the day breaks they commence their ascent of the mountains, and climb three, five, and some of them six miles before they reach the scene of their labors. When the sun is high enough to force them to retreat, they have done a good day's work, and a long march home in the burning heat is before them. These men earn wages which average some 15s. a week; they are paid fortnightly. Not being a thrifty race, a good portion of the scanty wage goes in liquor and the lottery, and nature is kept going till next pay day on a fare in which a miserable black bread is the principal factor. The men work in gangs. Each gang is under the control of a head man, who agrees with the owner of the quarry to get out the marble at a fixed price per cubic palm. The getting of the marble is dangerous work. The quarries are just so many openings cut in each side of the valleys into the mountains. The blocks are loosened from their beds by the ordinary process of blasting, and are then suffered to slide down by their own weight. As they fall down the mountain side, large fragments are knocked off them right and left, and this rough usage is the cause of many of the flaws and vents which are afterward developed in the working.

On Sundays the market place at Carrara is a sight to be seen. It is filled with quarrymen from the mountains, sculptors from the *studii*, and country people in picturesque attire from the surrounding villages. In this same market place there is a statue said to have been executed by Michael Angelo during one of his visits to the town. The authorship, however, like a great deal ascribed to the great artist, is very doubtful.

The average wages paid to the different classes of workmen are as follows: quarrymen, per day, 2s. 6d.; gangers or foremen, 4s.; masons, 2s. 9d.; sanders, 2s. 9d.

Of sculptors there are all grades, from the ordinary carver, whose services can be obtained for 3s. 6d. a day, to the master in the art—the professor—who has received rewards and decorations from crowned heads, and who is sought after with commissions from every part of the world. The quarries are situated in the ravines or gorges which run up between the lofty peaks of the Apennines. At Carrara these mountains are about 1,500 feet in height, and from their summits a magnificent view can be obtained of the plain below and of the Mediterranean in the distance. The white marbles of Carrara are known to the English market as Sicilian, vein, and statuary. Of these, Sicilian is the most common. The term "Sicilian" is purely English, and is of doubtful origin; it has been asserted that the first cargo brought to England arrived in the good ship Sicilia. More probably, however, the marble is so called because it was formerly shipped to Sicily, and thence to an English port. The Italians call it Bianco Chiaro (clear white). It varies much in color and in texture as it approaches more nearly to the character of vein on the one hand or of dove on the other. The principal quarries are situated in groups known as the quarries of Lorrano, Canal Bianco, Canal Chiosa, La Rattola, and Ravaccione, in the ravine of Ravaccione; of Fantiscritti and Canal Grande, in the ravine known by the latter name, and of Collonata.

The pure appearance of white marble has caused it to be much used in the raising of memorials to the dead. For this purpose Sicilian is chiefly employed. It is, in fact, the only white marble which will bear exposure to the open air. The others are much softer and liable to speedy disintegration if placed out of doors. Very great care is, however, necessary in the selection of Sicilian which will withstand a northern climate. The best is of a slightly bluish tint, of hard and close texture, of uniform color throughout, and free from decided veins. Vein marble is used for decorative purposes in the interior of buildings. It is of much whiter ground than Sicilian, is softer, and becomes more or less valuable as the veining is more or less fine and regular. The principal quarries are those of the groups known as Vara and Canal Piccola, in Canal Grande, and of Gioja, in Collonata.

Statuary needs no description. It is the most beautiful and most sought after of all marbles. The great difficulty about it is that a block can be rarely obtained which is pure. The principal quarries are in Ravaccione, near Carrara. The best is of even, white tone, with a slightly yellowish tint. Some of it is of a sugary whiteness, which takes the eye of the inexperienced, but is quite unfit for sculture. Statuary of this description is soft and easy to work, but is very liable to stains, and rapidly falls into decay. A very beautiful description of statuary is found near Serravezza. It is much whiter than that of Carrara, but is somewhat coarser in grain, and is, perhaps, on the whole, not so well fitted for the sculptor as the latter. Some of the quarries in Canal Grande and Collonata produce a marble of a dark blue tint with veinings, which are little to be distinguished from the ground color. This variety is known in England as dove marble. It is very hard, and is little used.

A marble of similar character, but of much greater beauty, is known as Bardillo or Bardiglio. It is found at Serravezza. It is of a pale dove ground traversed by dark veins; sometimes the veining assumes the appearance of flowers, hence the Italian name for it of "Bardiglio fiorito," or "fiorito di Serravezza."

Pavonazzo marble is raised near Carrara. It is of very rich color; the ground varies from a creamy white to a yellowish brown, marked with deep purple veins, with here and there a greenish tinge. It is much used for panelings to walls. When employed for this purpose and used in large masses, it has a magnificent appearance.

Siena marble is found near the town of that name, the ancient Sena Julia on the Via Clodia. This marble is of a deep, rich yellow tint, with veinings of purple and black. The quarries do not seem to have been properly opened up. They are so many scratches on the side of the mountains, and very few large blocks are produced. In Italy it is usually sold by weight.

The quarries from which black and gold marble is procured are at Porto Venere, near the mouth of the Gulf of Spezia. This marble is sometimes known as "Portor" marble. This is a corruption of the Italian Port d'Oro. The ground is of a rusty black with spots of light brown. The veining is very beautiful, running from white through every shade of yellow to dark brown.

Near the coast between Spezia and Genoa are several quarries of colored marble. At Levanto two varieties are raised—the Rosso and Verde di Levanto. The first is a purplish red marble. In the latter veins of purple, red, and green are mixed and interlaced in a most bewildering manner. At Pietra Lavezzara, near Genoa, the beautiful Genoa green marble is produced. This marble has a very deep green ground. In places it is almost black. It is filled with veining of a lighter green and white. Another very handsome green marble, known as Verde di Pegli, is found near Genoa, along the course of the Varenna torrent.

A very beautiful serpentine, called Verde di Prato, is quarried near Prato, a small town a few miles from Florence. The ground is of a deep green, with dark spots, and veined with white. It polishes well and is cheap, but it cannot be obtained in large blocks, and it is not the most durable of marbles. A great deal of it has been used in buildings at Florence. It is especially to be noticed in the cathedral, the campanile, and the church of S. Maria Novella. In these buildings it has been employed in the exterior walls with alternating courses of white marble and red sandstone. The effect is striking and very beautiful, but much trouble has been caused by the gradual decay of the serpentine. The use of it should be entirely confined to interiors.

There are several quarries of a finely marked white marble in the hills to the north of Verona, the town immortalized by Shakespeare in his story of the loves of Romeo and Juliet and the contests between the Montagues and Capulets.

"Two households, both alike in dignity,
In fair Verona, where we lay our scene."

The tomb of Juliet is one of the attractions of the place, and it is built of the red Verona marble. This is of a pale pink ground, with veins of red and dashes of gray. It sometimes assumes a brecciated aspect. The marble is not very hard, but it takes a good polish. It has been extensively used in the building of Venice. In the palace of the doges it is found in the columns on the south and west sides; and it has also been employed at St. Mark's, in the Accademia delle Belle Arti, and in several of the Venetian churches.

Near Lago Maggiore there are some quarries of a white marble, which was used in the construction of the beautiful cathedral at Milan. In the same neighborhood, at Baveno, on the shores of the lake, there are some large quarries of a very fine granite. This is principally worked upon the spot, very little being sent away in a rough state.

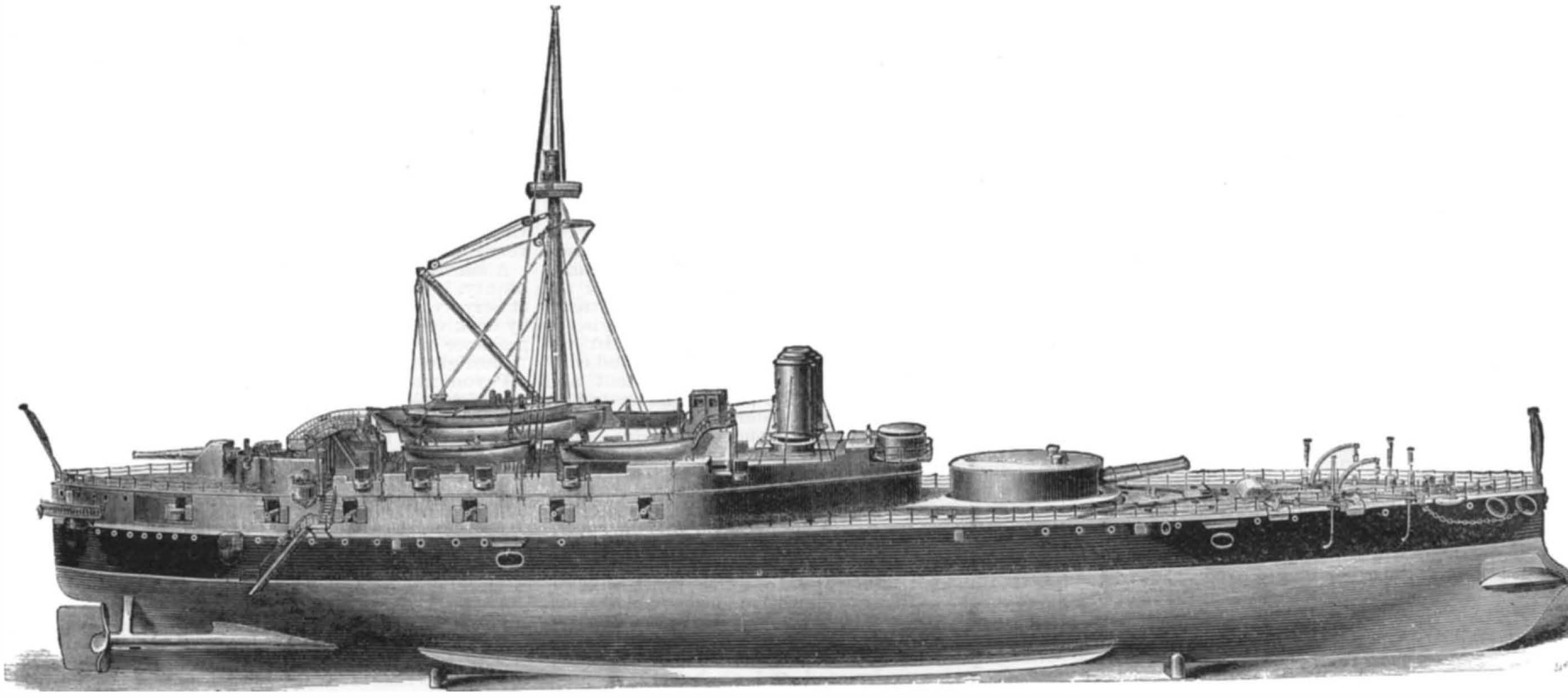
There are several varieties of Italian alabaster. A very beautiful pure statuary is found in the Val di Marmolago, near Castellina. Another, known as agate alabaster, is quarried near Volterra. A fine clouded variety, called Bardiglio, is also found near this town, which is the seat of the Italian alabaster trade. There is an enormous business done in this material. There is hardly a piece of sculpture of which a model can be obtained which has not been reproduced by the sculptors of Volterra. So much of it has been turned out in modern times that its value has been sensibly depreciated. It is somewhat fragile, but the beauty of its appearance and the ease with which it can be worked will always keep it in demand.

The stowage of marble, as practiced at Leghorn, is raised to the dignity of a fine art. Generations of stevedores have inherited and have improved upon the traditions of their fathers. The loading of the large ocean-going vessels from the small *navicelli* is very smartly done. A floating pontoon crane is brought into play, in which the required power is gained by means of a huge wheel. By this means the heaviest blocks are lifted from the small vessels, and are delivered into the holds of the large craft without difficulty. The cargoes are usually made up with light goods, of which pumice stone, hemp, oil, and sumac form the principal part. Of these, neither hemp nor pumice is a source of trouble, but it is necessary to keep oil and sumac from all contact with marble. Sumac is especially dangerous. It is shipped as a fine floury substance, and in sacks which are never too stout. When sumac dust settles on white marble, the result is not immediately apparent; but if it once becomes wet, or even damp, it becomes a powerful purple dye, which penetrates the marble to an extraordinary depth.

Italian marble is usually shipped and freight paid by

* Winckelmann, vol. vi., p. 222, ed. Eiselein.

© 1887 SCIENTIFIC AMRICAN, INC.



H. M. S. VICTORIA.

measurement, and not by dead weight, twenty-five cubic palms, or about thirteen and one third cubic feet, being reckoned to the ton. The principal market is the American. In one year (1882) there were shipped to the United States and Canada 29,940 tons. During the same year the exports to British ports amounted to 15,760 tons. Belgium, France, Russia, and Germany are large importers of Italian marble. Sawn slabs are principally shipped to England; in fact, this is now almost the only country which admits them duty free. As a consequence, the market price of sawn Italian marble is lower in England than in any other part of the world, except in Italy itself, and sometimes not even with that exception.—*Arthur Lee, in Building News.*

H. M. S. SANSPAREIL.

THE latest addition to the British navy, the Sanspareil, was recently launched with perfect success from the yard of the Thames Ironworks and Shipbuilding Company. The launch took place shortly after two P. M. The ceremony was performed by Lady George Hamilton.

The Sanspareil, of which we give a plan, longitudinal and transverse section taken from the models, is a sister ship of the Victoria, recently launched by Messrs. Armstrong, Mitchell & Company, at Newcastle, and we illustrate the latter vessel by the engraving above, prepared from a photograph of a very beautiful and accurate model constructed by Messrs. Armstrong, Mitchell, & Company.

The following are the principal dimensions of the Sanspareil: Length, 340 ft.; breadth, 70 ft.; depth, 37 ft. 6 in.; displacement in tons, 10,470; engines, 7,500 indicated horse power natural draught, and 12,000 indicated horse power with forced draught, by Messrs. Humphrys, Tennant & Company. A speed of 18½ to 19 knots is expected. The armament consists of two 16 in. 111 ton guns, twelve 6 in. 5 ton guns, nine 3 pounder quick firing guns, one 10 in. 29 ton gun, twelve 6 pounder quick firing guns, two 1 in. Nordenfelt guns, eight 14 in. Whitehead torpedo tubes, and four 0·45 in. Nordenfelt guns.

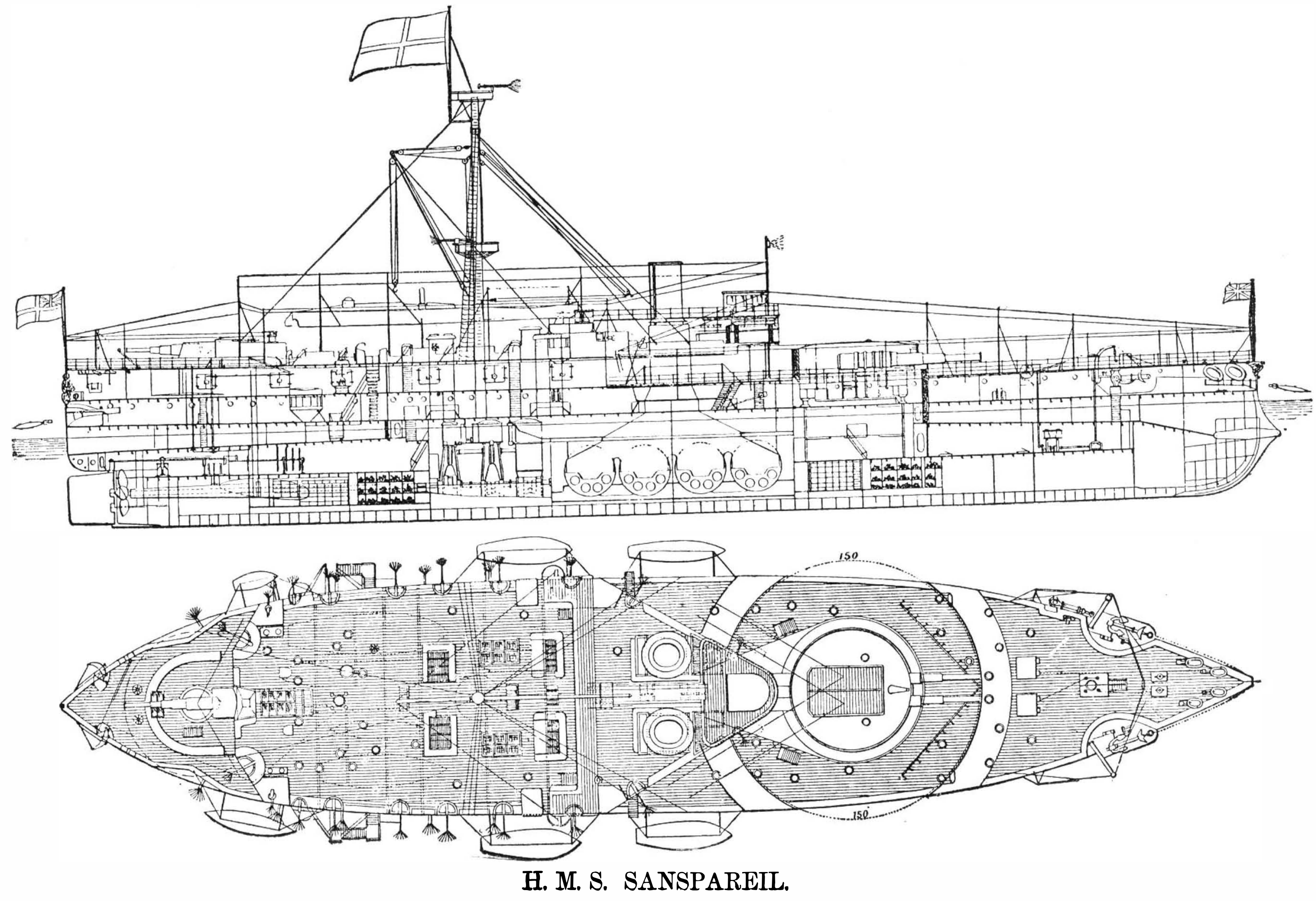
The Sanspareil has 170 watertight compartments, necessitating the introduction of 969 watertight doors, scuttles, and valves, while the steam engines, main and auxiliary, amount to fifty-five in number. The contract for this vessel was taken on April 21, 1885, and the first keel plate was laid on June 26. The dead weight of the Sanspareil is stated to be 6,000 tons. The original contract price was £504,000 for the hull and £97,000 for the propelling machinery, making a total of £601,000. But before any progress was made in the construction of the ship, certain changes were introduced in the plan of the upper works, and the contract now appears as £537 444 for the hull and £111,018 for the propelling machinery, thus raising the total to £648,462. The estimate for the gun mountings and torpedo gear remains unaltered, being £55,636 for the former, and £10,980 for the latter.

Fittings and equipment, in the shape of dockyard work, absorb £40,000 more, making the total estimated cost under the navy vote £755,078. The estimated expenditure for guns and other matters, chargeable to the army votes, is £70,390, making the total cost of the ship, when fully armed and equipped, £825,468. The total estimated cost for the Victoria is £829,979.

The contract was taken while the Benbow was on the stocks, consequently the keel could not be laid until two months after the signing of contract, but the interval gave time for the preparation of a large amount of material ready to be placed on the blocks as soon as they were ready, and on the 26th day of June the first keel plate was laid, and since that time the material has been worked into the vessel at the rate of 260 tons per month. This is not a large amount compared with merchant vessel construction; but when it is remembered that the hull of an armorclad is composed of a multitude of small watertight compartments, with numerous watertight doors, armor decks, armor plates, and backing, all demanding care and skill, occupying time not necessary in merchant vessel construction, the amount is large.

At first the amount that can be worked in is small, but as the framing of the vessel expands, a large number of hands can be set to work, so that in some weeks as much as 100 tons have been put into place. The result is that on the day of the launch upward of 6,000 tons dead weight of steel material, armor plates, teak backing, decks, smithings, etc., were set in motion down the ways into the Thames, the greatest weight launched in this country since the launch of the Great Eastern.

It is now twenty-seven years since this company launched the first armorclad sea-going ship, the Warrior, since which time up to the present these works



H. M. S. SANSPAREIL.

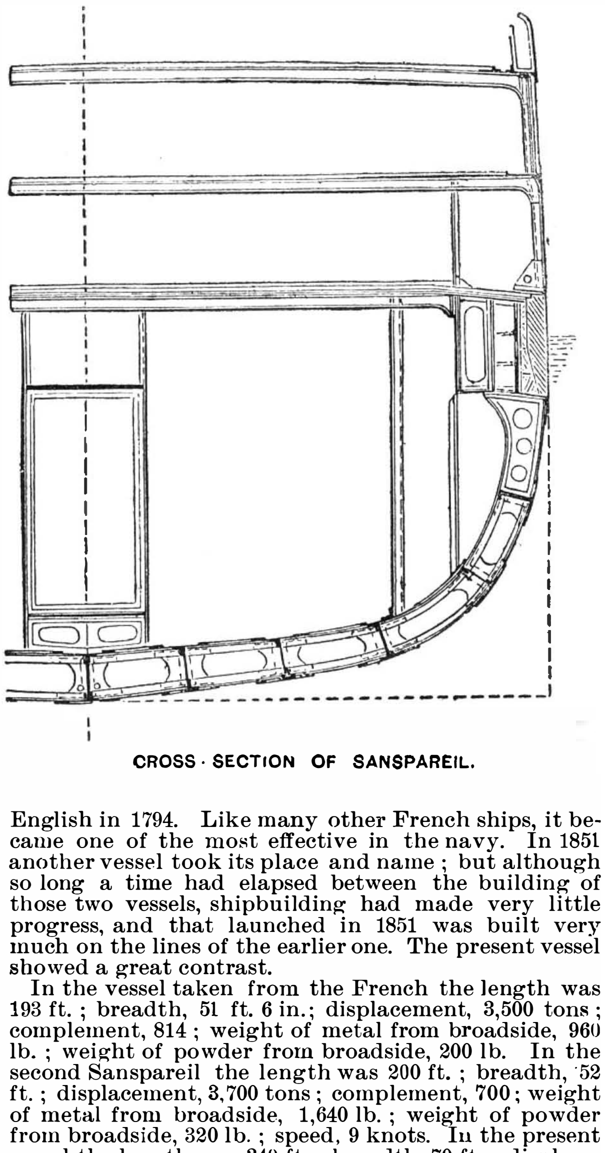
© 1887 SCIENTIFIC AMRICAN, INC.

have turned out in armorclads and fighting ships alone the enormous amount of 127,212 tons displacement tonnage, an amount of work of this class far beyond what any other public or private establishment in the world can show. The armorclads, nineteen in number, average 5,325 displacement tons each, or a total of 101,175 tons, the remaining 26,000 tons comprising cruisers and dispatch vessels. The growth in powers of offense and defense since the construction of the first named vessel, the Warrior, is of great interest; and when we contemplate the specimen plate of the Warrior exhibited on the wharf of these works, 4½ in. thick, with a 68 pounder cast iron shot embedded in the plate, and a second indent to the right of it, and now contrast the 18 in. steel faced material used for the defense of the vital parts, we must admit that the science of shipbuilding has made enormous advances. A comparison here of the Warrior with the Sanspareil may be made.

	H.M.S. Warrior.	H.M.S. Sanspareil.
Length between perpendiculars	380 ft. 0 in.	340 ft. 0 in.
Breadth extreme	58 ft. 0 in.	70 ft. 0 in.
Depth (top of keel)	41 ft. 7 in.	37 ft. 6 in.
Displacement	8227·7 tons	10,500 tons
Draught of water	25 ft. 6 in.	26 ft. 6 in.
Horse power engines	5,469	12,000
Speed ... knots	14·3	18
Armor	4½ in.	18 in.
Backing	18 in.	6 in.
Guns	28, 7 in.—6½ ton guns	2 113 ton guns
"	4, 8 in.—9 ton guns	1 29 ton gun
Original armament.		12 6 in.—5 ton guns
2 100-prs., 2 40-prs., 2 25-prs. upper deck		12 6-prs., 9 3-prs., 2 1 in.
40 68-prs. main deck		4 0·45 machine guns
Weight of broadside for Warrior.		Weight of broadside for Sanspareil.
3,143 lb. shot		4,750 lb. shot.
1,456 lb. powder		3,000 lb. powder.
Coals, 800 tons		Coals, 900 tons.
Radius of action, 1,200 knots at 10 knots per hour		Radius of action, 7,000 knots. at 10 knots per hour.

The Sanspareil has 170 watertight compartments, necessitating the introduction of no less than 969 water tight doors, scuttles, and valves. And the steam engines, main and auxiliary, amount to fifty-five.

After the launch, Lord George Hamilton, in the course of a speech, gave some particulars concerning the history of the ship named. The Sanspareil, he said, was originally a French ship, and was taken by the



CROSS-SECTION OF SANSPAREIL.

English in 1794. Like many other French ships, it became one of the most effective in the navy. In 1851 another vessel took its place and name; but although so long a time had elapsed between the building of those two vessels, shipbuilding had made very little progress, and that launched in 1851 was built very much on the lines of the earlier one. The present vessel showed a great contrast.

In the vessel taken from the French the length was 193 ft.; breadth, 51 ft. 6 in.; displacement, 3,500 tons; complement, 814; weight of metal from broadside, 960 lb.; weight of powder from broadside, 200 lb. In the second Sanspareil the length was 200 ft.; breadth, 52 ft.; displacement, 3,700 tons; complement, 700; weight of metal from broadside, 1,640 lb.; weight of powder from broadside, 320 lb.; speed, 9 knots. In the present vessel the length was 340 ft.; breadth, 70 ft; displacement, 10,470 tons; complement, 550; weight of metal from broadside, 4,750 lb.; weight of powder from broadside, 2,320 lb.; speed about 17 knots. The complement in this vessel was made up of 37 officers and 513 men and boys. About one-fourth of the officers—including engineers, paymasters, etc.—and rather more than one-fifth of the men might be regarded as non-combatant, about 110 men being employed on the engine room staff. This proved that during the past thirty years we had made greater progress in shipbuilding than had been made in the five hundred years preceding.—*The Engineer.*

THE "SLIP" OF SCREW PROPELLERS.

OF the many points to be dealt with in screw propulsion, that of "slip" is one of the most important. The questions as to the proper amount of slip, and the right number of revolutions a screw should have to attain maximum efficiency, are matters for more careful consideration than is usually accorded them in daily practice. Engineers, as a rule, are apt still to regard the absence of slip in screw propellers as a great virtue. This, however, is a mistake. And it has been forcibly pointed out by the late Dr. Froude that, "instead of its being correct to regard a large amount of slip as a proof of waste of power, the opposite conclusion is the true one. To assert that a screw works with unusually little slip, is to give a proof that it is working with a large waste of power."

If the screw worked in an unyielding medium, it would advance a distance equal to its pitch for every revolution; but working, as it does, behind a ship afloat in water, the speed of the screw—*i. e.*, its pitch × revolutions in a unit of time—is greater than the speed of the ship. This difference between the speed of screw and the speed of ship is termed slip, and as such is usually tabulated, being generally expressed as a percentage of speed of screw. It should, however, be called *apparent* slip, as the propeller is working in the wake, which has a forward motion relative to still water; and to determine the *real* slip, the speed of this wake should be a known quantity.

With every propeller the real slip is always, of neces-

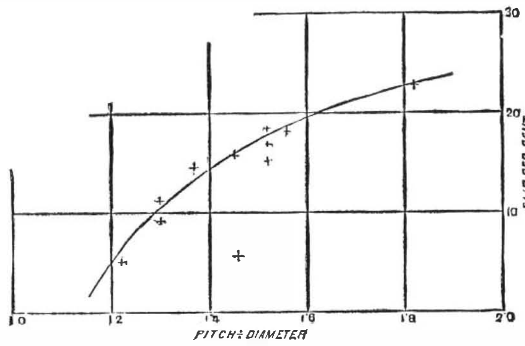


FIG. 1.

sity, greater than the apparent slip, and all screws must have a certain amount of real slip, for any pressure from the screw, however small, will overcome the inertia of the water. Therefore, without real slip, we could get no reaction, no thrust, and consequently no propulsion. And it is only when slip commences that useful work begins. It is evident, in producing slip, we lose speed, or lose power in obtaining a certain speed. But it should be borne in mind that an attempt to reduce slip may introduce other elements, by which considerably more power will be used than is gained by lessening it.

Theoretically speaking, if there were no friction, it would be well to use as large a diameter as possible, consistent with immersion, because we should then have a greater quantity of water acted on; yet, although increasing the diameter reduces slip, the surface friction is considerably augmented thereby.

The diameter remaining the same, slip increases with the resistance of the ship and with revolutions of the

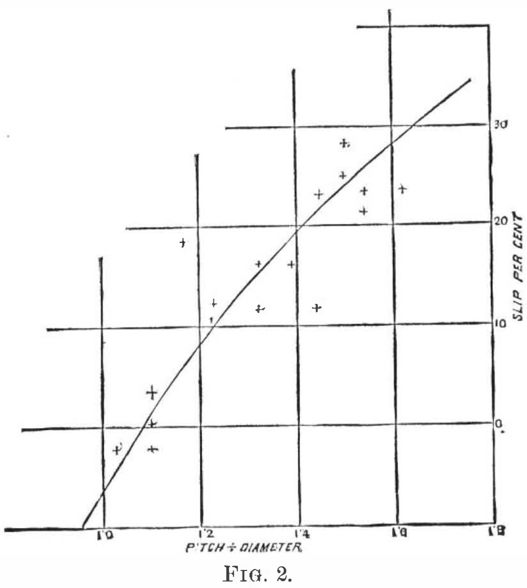


FIG. 2.

propeller, and decreases with increase of blade area, decrease of pitch, and immersion. Slip is also influenced by the wake, and becomes less as the wake increases. The propeller will have its apparent slip increased as its distance from the hull of the ship increases, until the apparent and real slips are equal.

In not a few instances apparent negative slip has been recorded—*i. e.*, where the speed of the ship is greater than the speed of the screw (revolutions × pitch in a unit of time)—a phenomenon which has given rise to much discussion, and many theories to account for its existence.

One popular theory attributes its presence to the false or inaccurate measurement of the effective pitch of the blades; another theory to the fact that the elasticity of the blades alters the pitch, and produces negative slip. A very likely reason traces its occurrence to the upper and lower blades of the screw operating unequally on the wake and dead water at the stern of the ship. The unequal forward motion of the wake at different points throughout the screw disk causes differences in thrust, and, consequently, differences in speed of the propeller, the mean of which speeds would be less than that of the ship.

Negative slip occurs mostly in vessels of very full run, and may be aggravated if the full run be accompanied with a screw of fine pitch. It may be modified, and sometimes entirely removed, by the substitution of a propeller of different form or dimensions. This was the case in the Amazon, where the original Mangin screws of 15 ft. diam. and 12 ft. 6 in. pitch, giving a negative slip of 14 per cent., and a speed of 12·079 knots with 1,940 i.h.p., were replaced by a Griffiths screw of 15 ft. ¾ in. diam. and 13 ft. 9 in. pitch, giving an apparent positive slip of 3·16 per cent. and a speed of 12·396 knots with 1,664 i.h.p.

A study of the diagrams given here will show in a general way, regardless of other conditions, that a decrease of pitch is accompanied by a diminution of slip, and that screws of fine pitch tend to the production of apparent negative slip. It has been found convenient to plot the spots in terms of slip per cent., and pitch ÷ diameter. The curves in each case have been drawn to indicate the general tendency only.

In Fig. 1 the ship is the same throughout. The spots (small crosses) are taken from the trials of the Flying Fish with different propellers, varying in diameter from 11 ft. to 13 ft. 2 in., in pitch from 16 ft. to 20 ft., and in revolutions from 72 to 77.

In Fig. 2 the ships are different. Each spot represents the actual slip obtained for the individual ship at the highest speed on her measured mile trial. The propellers vary in diameter from 11 ft. to 24 ft. 6 in., in pitch from 11 ft. 6 in. to 30 ft. 3 in., and in revolutions from 40·1 to 87·9.—*Industries.*

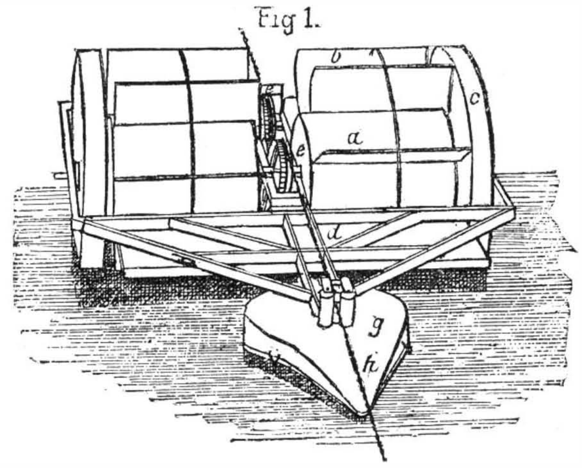
A WATER LOCOMOTIVE.

IN a report addressed February 25, 1886, to the German Central Society of Navigation on canals and rivers, Engineer Wernigh explained a project having in view the utilization of the force of a current for towing boats. The apparatus, which is styled by its inventor a water locomotive, is extremely simple, and is destined to render great services upon watercourses having a certain slope, and on canals that are of too little importance to have the usual methods of towing applied on them.

Currents of water have for a long time been utilized for actuating wheels, such as those of flour mills, for example, and the idea is therefore not absolutely new.

After some experiments performed near Maltsch, on the Oder, in the month of January, 1873, Mr. Wernigh devised a style of boat that was provided on each side with paddle wheels like those of a steamboat. As long as it was a question of proceeding against a current in a straight line, this apparatus gave good results; but when it came to turn, or had to follow a sinuosity in the river that modified the direction of the current, one of the wheels remained immovable and the results were no longer the same. After several successive studies, the inventor reached the definitive type shown in perspective in Fig. 1 and in longitudinal section in Fig. 2.

In these figures, *a* represents an impermeable cylinder to which are affixed plane paddles as in Fig. 2. The spacing of these paddles is so calculated that there shall be no difficulty about the flow of the water. The



general dimensions are determined according to the depth of the water and the needs of navigation. To prevent the breakage of the paddles in case of a lowering of the level of the water, the two cylinders are provided at the extremities with wheels, *c c*, which would then roll over the bed of the river. The different parts of this mechanism are connected by a frame, *f*, in front of which there is a directing plate, *d*, to prevent the water from striking the paddles situated above the axis of the wheels. In front, and acting the part of a rudder, there is a sort of hollow pontoon, *g*, ending in a sharp point. Around each shaft there are three pulleys, *e*. Motion is transmitted to the apparatus by a cable, *h*, which passes over the pulleys and then descends to the bed of the stream, as shown in Fig. 2. In order that sufficient adhesion may be obtained for the cables, the pulleys are provided with a deep channel.

It is well in practice to use three apparatus of this kind, placed one after the other, and separated by a certain interval. These may then be connected through a single platform (Fig. 2).

Three persons are sufficient for the maneuvering, viz., a pilot, a deck hand, and a boy.

It will be understood that the current, in revolving the paddle wheels, will, at the same time, cause the revolution of the pulleys, *e e*, so that, if the chain passing over the latter is fixed upstream, the locomotive will advance in that direction.

The results obtained by means of this apparatus are given by Mr. Wernigh in the *German Shipbuilding Review*. On comparing the motive power due to the force of the water that acts upon the paddles with the effective power registered upon the shafts of these latter,

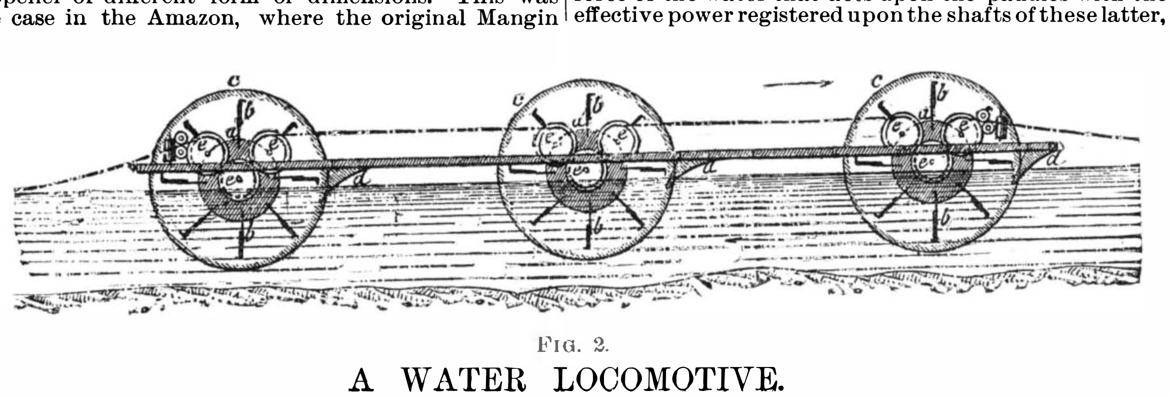


FIG. 2.

A WATER LOCOMOTIVE.

© 1887 SCIENTIFIC AMRICAN, INC.

he concludes that the performance is 35 per cent. Now, upon applying formulas, we find a performance of but from 25 to 30 per cent. in the case of water mill wheels, and it is hence prudent not to reckon over 20 per cent. in the apparatus under consideration. If we grant this latter figure, with an apparatus 18 feet in width, having paddles of 8×1¾ feet, and lateral wheels descending to within 3 feet of the river bed, and composed of three pairs of wheels, as in Fig. 2, it will be possible, at a velocity equal to half that of the current, to tow three lighters of the style of those that run on the Oder, that is to say, three lighters 15 feet in width and drawing 3 feet of water.—*Annales des Travaux Publics.*

THE GREAT MULHOUSE UNIVERSAL LATHE.

THE large house of Heilmann Ducommun & Steinlen, of Mulhouse, has recently finished one of the finest and most powerful tools that has ever been manufactured, and that is a two-carriage, universal break lathe, which is in itself equivalent to an entire stock of mechanical tools. Let us add that this fine machine tool is designed for the national establishment of the French navy of Chaussade at Guerigny. The views of it which we here give will serve to show the colossal size of this machine, which is capable of performing the most varied operations, such as mortising, shaping, boring, and moulding, with the most perfect accuracy and finish.

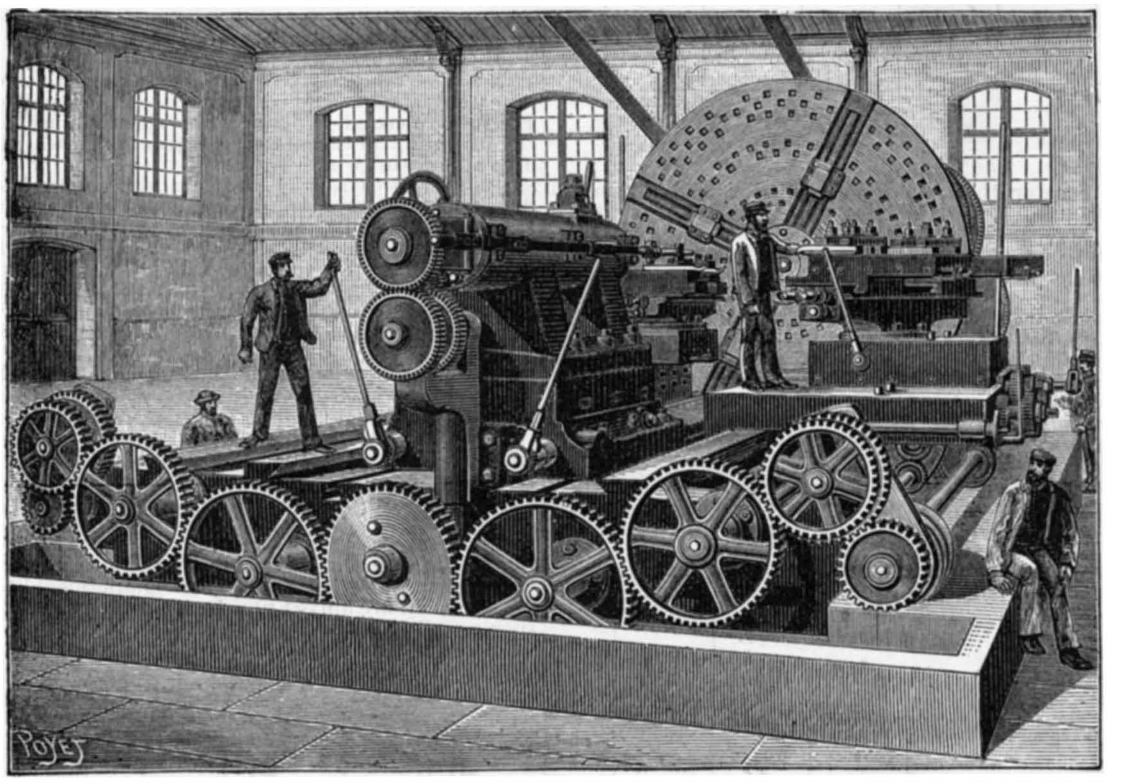


FIG. 1.—THE GREAT MULHOUSE UNIVERSAL LATHE.

The lathe is actuated by a vertical steam engine of 25 h. p. It weighs, with its accessories, 851,640 lb.

To our knowledge, there does not now exist any other so powerful a tool embracing so wide a field of operation. It is a sort of workshop condensed into a minimum of space and containing several machines of large dimensions and weight. These machines, distributed over a wide surface, would, by reason of their specialization, be idle at times; but, combined, they all lend a hand, so to speak, and without any troublesome and costly carriage of material, permit of a reduction of manual labor, a saving of motive power, and a rapidity of execution.

There are just as many valuable features when it is a question of manufacturing, in all haste, those large pieces so varied in form and destination that enter into the construction of a large armor-clad ship of war—for example, into its hull, armament, or engines. There is neither mounting nor dismounting; the work is continuous. The colossal affair traverses the mass of steel in every direction, and leaves the useless portions to the right and left as if it were a small block of wood in the hands of a skillful carpenter. The piece is shaped, roughed up, and finished.

It is curious what destructive and ruinous needs for modern war are created by these great mechanical improvements. The immense supplies that arms of war necessitate, and the exigencies of precision that they occasion, have led our manufacturers to combine these great means of ingenious manufacture that are both so accurate and powerful.

When, through fear or universal opinion, the scythe of the husbandman shall no longer have a menacing aspect and reflect the sword in the shade of history, the great tools of modern industry, created under the inspiration of the menaces of war, will not for all that cease to turn and subjugate metal; but it will be for the civilizing and pacific needs of humanity that they will accomplish their cyclopean operations.

A like mechanical combination, which would, all proportions guarded, have formerly been justly qualified as a masterpiece of its kind, does not rise unawares complete in all its parts. It is the work of time and the sum of the experience acquired. It is especially an evidence of the progress that has been accomplished step by step, and of the conquests of human industry over the difficulties of matter. It is from these standpoints that we are happy to salute the fine execution of this work by the remarkable Mulhouse establishment whose just and wide reputation is perpetuated by Messrs. Heilmann Ducommun & Steinlen.

The lathe had a very humble origin, and it is in the hands of the potter, in the night of time, that we lose the principle of the metallic colossus which is to perform its duties at the great national works of Guerigny.

We have stated that this tool weighs more than 340 tons. Now, about 1860, a lathe of the same kind did honor to French industry and attracted the attention of all our mechanicians. It was constructed by the Calla establishment of Paris, for the arsenal of the port of Toulon. It marked a great progress for its time, weighed 76 tons, and was the subject of a description that may be read with great interest in Armengaud's publication, "Machines Outils et Appareils."

Our imposing Creusot works could not remain in the rear, and at about the same epoch constructed a large lathe, which solved the problem of the construction of the circular pieces of the Brest revolving bridge. The puppet of this lathe rests upon a base of dressed stones. The tool, although very powerful, exhibits hasty and incomplete arrangements from certain points of view, since it was got up to answer a programme of special needs. It lacks, then, the spirit of generalization that we find in its followers.

The Mulhouse works are pursuing their researches and their generalizations in this direction, and are furnishing various large manufactories, as well as the state arsenals, with lathes that are completer than the preceding, and that weigh from 50 to 80 tons. In recent years, they have furnished the gun foundry of the navy, at Ruelle, with several lathes for boring and turning guns, and that weigh from 120 to 150 tons and have a total length of from 130 to 135 feet. Our large naval guns owe much to the use of these colossal machines. Messrs. Varrall, Elwell & Middleton, toward the same epoch, furnished the same foundry with a series of lathes weighing about 150 tons each.

Finally, some weeks ago, a large German establishment of Chemnitz, Saxony, invited by circular such manufacturers as were interested in progress to inspect at its works a lathe 6½ feet in height, 88 feet in length, and weighing about 200 tons.

The Mulhouse lathe designed for the Chaussade establishment is 140 tons ahead of the one that its German competitors invited mechanicians to inspect. It weighs two-thirds more, but the power is much more than proportional to the increase in weight. It will be wonderfully adapted to the delicate and complicated working of pieces for armor-plating turrets, of helix supports, of rudders, of cranked shafts, of pistons, etc.

It should be remarked that with these large objects the manufacturer is obliged to watch with scrupulous care, and must at the same time bring enormous weights into play; and this is a double difficulty. A fraction of a line out of the way will compromise a costly piece of work, and lead not only to great expense, but also to delays whose consequences cannot be estimated. Neither error nor delay can, therefore, be admitted. This is what gives the large lathe under consideration, when we consider the different aspects of it presented by our engravings, the appearance of a gigantic clockwork combination with delicate and innumerable wheels. All this complication is combined with a view to simplicity of execution. Each of its gearings, formed with accuracy, and of great strength, comes into play precisely at the moment desired, when the human mind intervenes, when the hand of the workman executes what foresight has indicated—*mens agitat molem*, according to an old expression.

The great Mulhouse universal lathe is typical in the line of mechanical combinations. It shows how much true economy can be found in the improving of machine tools, outside of the desire to battle with the dearness of manual labor by the forced reduction of its elementary price. A numerous force is, on the whole, just as necessary with these large tools for the accomplishment of given work; but such a force is better employed, and in a manner more conformable to human dignity and to the excellence of the result. By such a use, time is gained, the production is increased, and all the ground that the resistance of matter loses in the contest is gained by intelligence and progress.—*La Nature.*

APPARATUS FOR STUDYING THE EXPANSION OF METALS.

IN 1877, the *Revue Universelle des Mines et de la Metallurgie de Cuyper* published a translation of a note communicated in 1868 to the Russian Imperial Technical Society by Mr. Tschernoff, on the working of steel. In this note it is stated that, for every kind of steel, there exists a point of the thermometric scale, which Mr. Tschernoff calls the *b* point, that when steel is heated above such point its texture becomes amorphous, and that if the grain obtained be then fixed by any process whatever, a metal will be had which will be so much the more homogeneous and finer grained in proportion as the fixation has been effected at a temperature nearer the point, *b*.

It is certainly impossible, through hammering, to succeed in fixing the grain at a sufficiently constant temperature at all points of the piece to obtain a uniform grain, especially with large blocks; but such a result will be obtained with certainty if, after the piece has been forged, the irregular texture be converted into an amorphous one by a heating to the *b* point, and if this texture be afterward fixed by a rapid cooling. It was, therefore, of interest to determine the temperature corresponding to the point, *b*, for the different kinds of metal.

In 1884, Mr. Alfred Evrard, then director of the Firminy steel works, had some researches made with such an object in view. From these researches, made with such measuring instruments as are usually used in forges, it resulted that, as Tschernoff had shown, the position of the point, *b*, on the thermometer scale varied with the nature of the metal; but it was found likewise that the passage to the point, *b*, was characterized by two phenomena: (1) a constant linear expansion in all natures of steel, and equal to 0·0125 meter per meter; and (2) a retardation in the expansion, due to the absorption of heat through the work of molecular transformation.

Starting from this point, Mr. Evrard sought a means of showing the instant at which the retardation of the expansion occurs, and of giving, through the temperature of the metal, the position of its point, *b*, on the scale. He found such a means in the solution of the following problem: To heat together two bars of different natures, but of the same dimensions, in such a way that both shall be at every instant at the same temperature. To have each bar inscribe the curve of expansion as a function of the time and elongations. If, of one of the bars, the curve of expansion as a function of the elongations and temperature is known, it will be possible (since the two bars are constantly subjected to the same heat) to deduce the curve as a

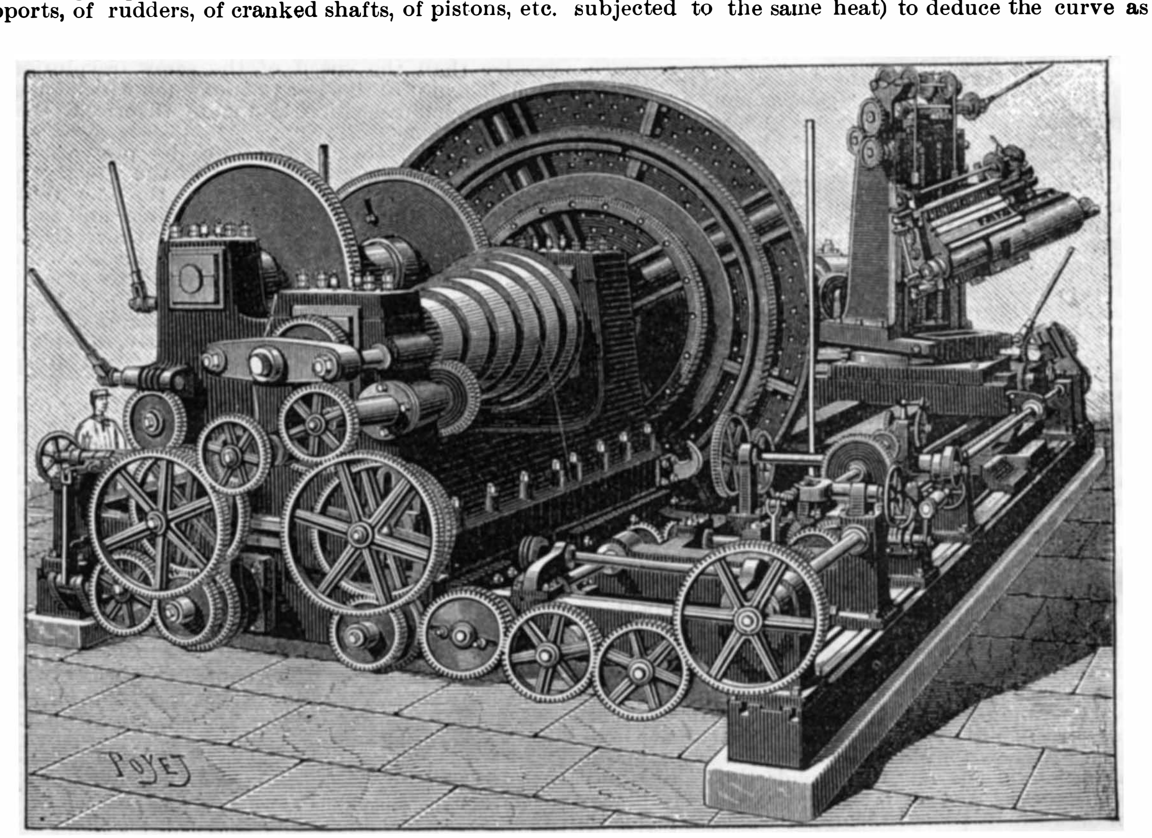


FIG. 2.—THE GREAT MULHOUSE UNIVERSAL LATHE.

© 1887 SCIENTIFIC AMRICAN, INC.

function of the temperature, and of the elongations of the curve as a function of the time and elongations, for the second bar. Upon this curve, the passage to the point, *b*, will be a singular point. The co-ordinates of this point will then give the temperature of the point, *b*, and the corresponding expansion.

Mr. Evrard solved the problem by the aid of the following apparatus (Fig. 1), which was constructed after his plans by Messrs. Dumoulin & Froment.

The apparatus consists of two superposed machines,

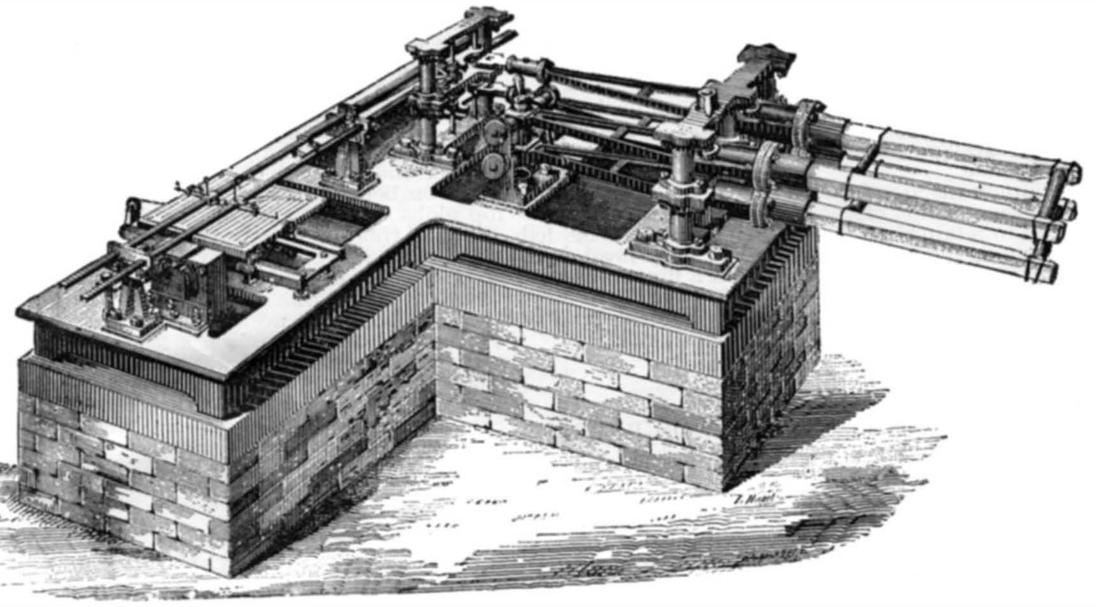
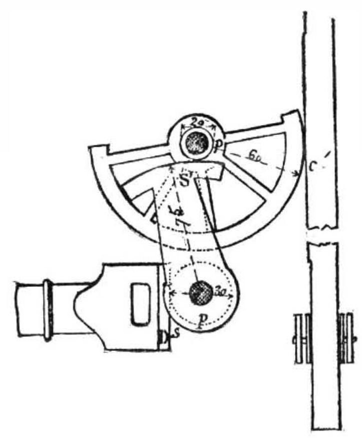


FIG. 1.—APPARATUS FOR STUDYING THE EXPANSION OF METALS.

absolutely identical, but independent of each other. Upon each of these is placed one of the bars to be experimented upon, one of which serves as a standard for the measurement of the temperatures; that is to say, its curve of expansion is known in advance. What we shall say of one of these machines, then, will also apply to the other.

FIG. 2.—DETAILS OF PINIONS.



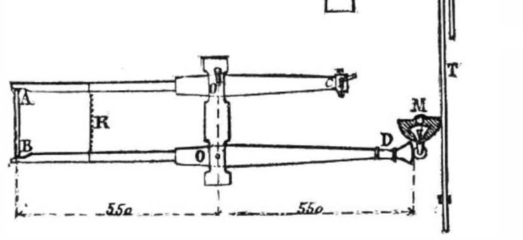


FIG. 3.—DIAGRAM OF THE APPARATUS.

The bar, AB, to be experimented upon (Fig 3) is held between the heads of two levers, AOC, BO'D, which are both movable around vertical axes, O and O'. The bar, AB, is held tightly between the levers by means of a spiral spring, R. As the lever, AOC, is fixed invariably by means of two keys, O and C, every increase in length of the bar, AB, will be shown by a displacement of the head, B, of the lever, BO'D, revolving around the axis, O'. A mechanism, M, of which the details will be given further along, is actuated by the extremity, B, of the lever, and transmits (and amplifies) its displacement to a rod and rack, T, which moves in a vertical plane. This rod carries at its extremity a tracing point, *t*, which inscribes all its motions upon the board, P. This latter is connected with a clockwork movement, H, and moves uni-

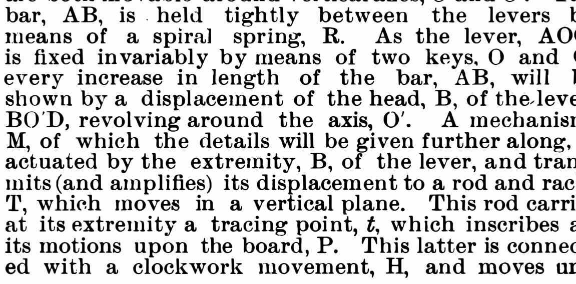


FIG. 4.—CURVE OF THE EXPANSION OF IRON.

formly at right angles with the rack, so that the tracing point inscribes upon the board a curve whose abscisses are times, and the ordinates the amplified displacements of the end, B, of the lever, BO'D. The lever end, B, really describes an arc of a circle whose length is not equal to the elongation of the bar; but if the calculation be made by starting from a bar of 0·2 meter and a lever arm, BO', of 0·55 meter (as is the case in this machine), we find that for an expansion of 0·015 meter per meter, say of 0·003 meter for the bar of 0·2, the difference between the true and indicated elongations is less than $\frac{1}{2000}$ of a millimeter.

When it is desired to make an experiment, the position of the levers, AOC, of the two machines is so fixed by the keys, O and C, that the two tracing points shall both in the beginning be upon the line of the abscisses drawn by moving the boards by hand.

Details of the Machine (Figs. 1 and 2).—The lever arms are of the same dimensions. The extremities to which the bars are fixed, and which consequently are heated, are of porcelain for three-quarters of the length, AO.

The porcelain parts are firmly fixed in plaster in the second part of the levers, which is of cast iron. The cast iron extremity, D, is provided with a toothed sector, S, which gears with a pinion, *p*. Upon the axis of this latter is fixed a second sector, S', which gears with a second pinion, *p'*, upon the axis of which is fixed a semicircular sector, which moves the rack, *c*. The dimensions of these various gearings are such that the rack is given a displacement equal to 30 times that of the end of the lever. All these gearings are of bronze.

The racks are supported by trains of rollers provided with pivots. The rack does not carry the tracing point, but actuates a lateral brass rod supported by rollers and carrying the said point at its extremity. In this way it has been made possible to separate the styles of the two machines from each other, so as to prevent confusion in the two curves traced at the same time.

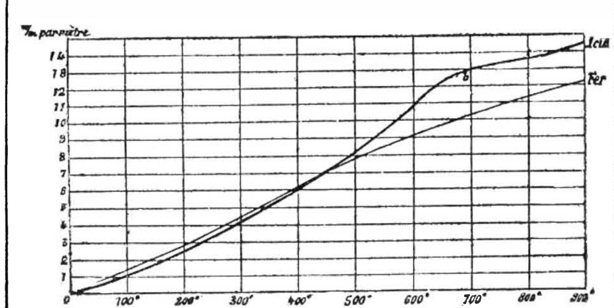


FIG. 5.—CURVE OF THE EXPANSION OF STEEL.

The stress required at the extremities of the levers to carry along the styles is but 250 grammes. Rubber threads are arranged above the racks, and tend to hold the styles back, so as to compensate for the time lost by the gearings.

The motion communicated to the board is 18 centimeters per hour, or nine centimeters only, at the will of the operator.

Finally, the whole is fixed to a cast iron frame. A gas furnace, movable upon rollers, serves for heating, and the temperatures therein are taken by means of a De Saintignon water pyrometer.

First Trials made at the St. Jacques Works, at Montluçon.—These experiments were made upon soft iron used in the manufacture of sheathing. Its analysis gives:

Cc=0·12
Mn=0·25
Ph=0·05
S=0·02

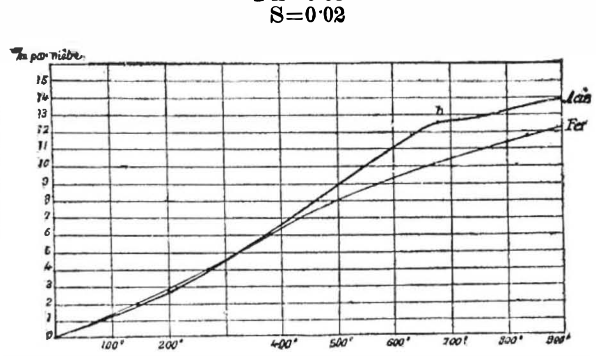


FIG. 6.—CURVE OF THE EXPANSION OF GUN METAL.

In all the tests made with this metal, we obtained a curve that exhibited but a slight inflexion at 400° Up to 400° the expansion increases to a faster degree than the temperature. Above 400° it increases to a less degree up to 900°, the point at which we stopped the heating. The curve given in Fig. 4 is the result obtained on taking the average of a large number of sufficiently concordant curves.

In the following experiments, we always used as a term of comparison bars derived from this same metal, and all belonging to the same piece, and it was by the expansion of these that we determined at every instant the temperature of the metal submitted to experiment.

Metal with 1·13 *per cent. of Carbon* (metal containing but little Si and Mn).—The expansion of the bar increases with the temperature up to 660°. At this temperature, the curve of expansion changes quite abruptly (Fig. 5) in direction, and the elongation increases very slightly with the temperature up to 850°, the point at which the curve rises. For these steels, we shall take 660° as the temperature of the point, *b*.

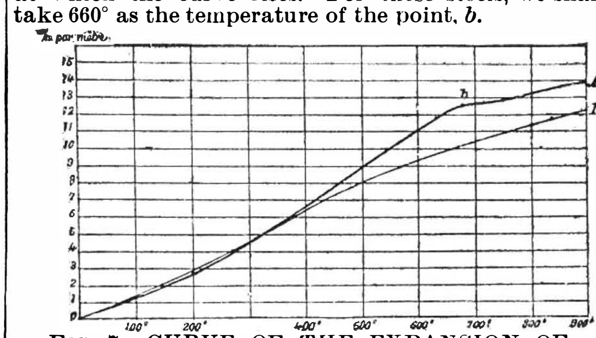


FIG. 7.—CURVE OF THE EXPANSION OF BASIC METAL.

It is above this point, then, say toward 700°, that we shall have to heat the metal for tempering. The expansion of the bar corresponding to this point is 0·0128 meter per meter. In the different curves obtained with this metal, we got figures varying from 0·0124 to 0·013 meter.

Gun Metal (Cc=0·45).—The singular point of the curve (Fig. 6) is much better shown than in the preceding case. There is a very abrupt retardation in the expansion, starting from 680° to 750°. The point, *b*, for this metal is found at 680°, and the corresponding expansion is 0·0126 meter per meter.

Basic Metal with 0·15 *of Cc and* 0·54 *of Mn.*—The singular point of the curve is clearly shown at 725°. The corresponding expansion is 0·0123 meter per meter (Fig. 7).

In addition to those whose curves we have just given, we have studied a certain number of other metals. The general conclusions to be drawn from the results are as follows:

1. The position of the point, *b*, upon the scale is so much lower in proportion as the metal is more carbureted or contains more foreign elements.

2. The expansion corresponding to the passage to the point, *b*, does not appear to us to be constant for all the ferric metals.

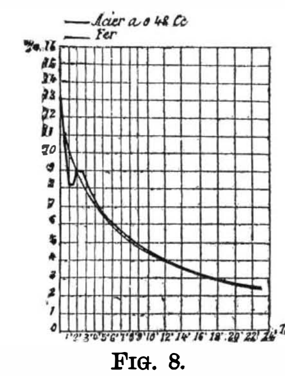


FIG. 8.

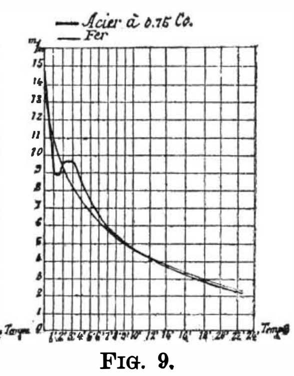


FIG. 9.

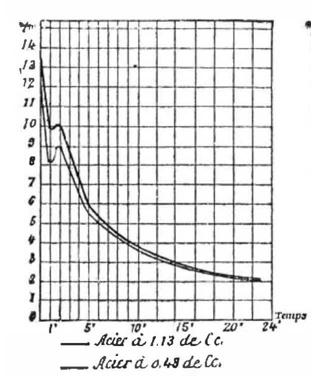


FIG. 10.

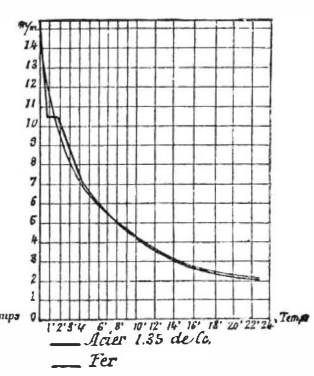


FIG. 11.

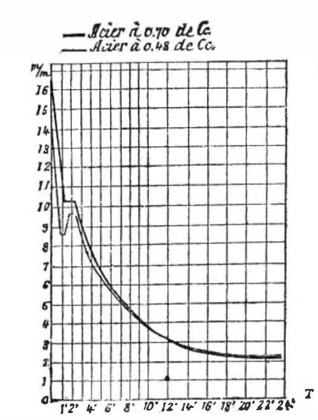


FIG. 12.

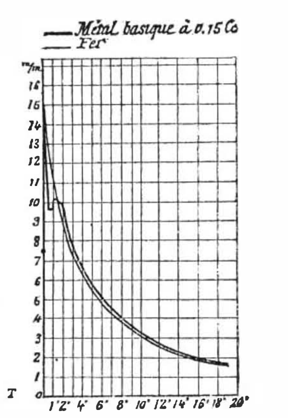


FIG. 13.

FIGS. 8 TO 13.—CURVES OF COOLING.

(Ordinates, expansion in millimeters. Abscisses, times in minutes.)

It is so much the greater in proportion as the metal is harder, and it varies within very narrow limits. We may consider the figure 0·0125 meter, pointed out by Firminy, as giving the mean. In several temperings of metals heated until the expansion reached this figure, or slightly exceeded it, we have obtained excellent results. We have thus been enabled to give a fine

© 1887 SCIENTIFIC AMRICAN, INC.

grain to bars of steel that we had crystallized by heating them very hot.

Curves obtained by Cooling.—We have endeavored to ascertain how a bar would behave on cooling. To this effect, the bars* were heated in a furnace up to within 1,000°, then placed in a machine by slightly stretching the spiral spring, R. The curves given are such as the machine inscribed them as a function of the expansion and the time.

Soft Iron.—Upon cooling, we remark no singular point in the curve (Fig. 8).

Steel with 0·45 *Cc.*—The primitive elongation of 14 millimeters per meter decreases in one minute to 8·2 millimeters. The contraction then ceases for half a minute, then the bar dilates anew to 9 millimeters per meter in the space of half a minute. The curve then exhibits a second stoppage for a minute, then descends regularly toward the axis of the abscisses. The curve of the bar of iron treated at the same time intersects the curve of the steel at the beginning of the second stoppage.

We remark that the singular points of which it has just been a question correspond to a much slighter elongation of the bar than in the curves obtained by reheating. We have not accurate enough instruments to take the temperatures corresponding to these different points. We have oil-tempered the same metal at the instant at which the curve given by such metal was passing to the different singular points, and the

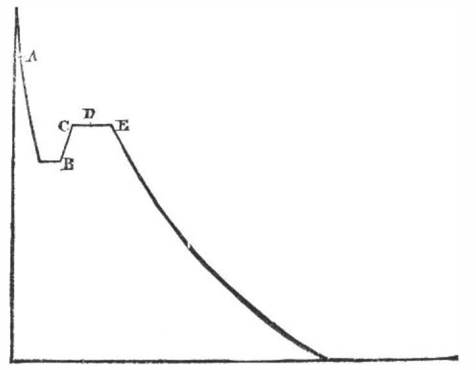


FIG. 14.—POSITION UPON THE CURVE OF COOLING OF THE POINTS AT WHICH SEVERAL BARS WERE TEMPERED.

points at which these temperings were effected are shown at A, B, C, D, E in Fig. 14.

The following are the results obtained :

Bar heated to redness.........		R=54	k.	A=22	p. c.
Bar tempered at the point	A	" 72·5	"	" 14	"
" " " "	B	" 72·1	"	" 15·6	"
" " " "	C	" 57·2	"	" 15·3	"
" " " "	D	" 57·2	"	" 20	"
" " " "	E	" 58	"	" 18	"

From these results, we conclude that tempering has no very perceptible effect, when once the point, B, of the diagram has been exceeded.

On another hand, we have obtained the proportion of the carbon by the Eggerth method at the points, A, B, D, and E, and also through combustion at the points, B and D. The following are the results :

	Eggerth method.	Combustion.
A.........................	Cc 0·32	....
B.........................	0·31	0·48
D.........................	0·43	0 50
E.........................	0·45	....

Between the points, B and D, of the curve, a modification in the state of the carbon has occurred, and this is shown by the turning back of the curve.

Starting from B, the tempering carbon has been converted into annealing carbon.

In the curve, the first stoppage, then, would correspond to a molecular modification of the iron, and the second (as well as the turning back of the curve) to a change in the proportions of tempering and annealing carbon.

From the standpoint of tempering, it results that the operation should always be performed before the point, B, of the diagram is reached.

As with the preceding metal, we have studied the entire carbon series, from metal containing 0·15 up to that containing 1·7.

In Figs. 8 to 13, we give the curves obtained with some of these metals. Up to the proportion of one per cent., all the curves obtained exhibit two stoppages and a turning back of the line. The expansions corresponding to these are so much the greater in proportion as the metal is harder. The distance separating them seems to diminish with the hardness, and with a proportion of 1·13 of carbon the turning back is nearly null, and is entirely so when the proportion is 1·35. In this case, the two stoppages become confounded with each other.

Hereafter, we propose to ascertain the influence of foreign bodies upon the form of the preceding curves, and this time complete the results by a measurement of the temperatures corresponding to the different singular points.—*A. Nouel, in Le Genie Civil.*

* All the experiments were made by treating two different metals at the same time.

INDIAN CORN OIL.

THE horny or flinty portions of Indian corn, when examined in section under the microscope, are found to consist of a large number of hexagonal cells filled with a fixed oil, which has been successfully used for illuminating purposes. Upon this oil depend the popping qualities of the grain ; for when the kernels are heated to a temperature high enough to decompose the oil, a sudden explosion takes place, and every cell is ruptured by the expansion of gaseous matter arising from the decomposition of the oil and the formation of carbureted hydrogen gas, the grain being completely evoluted and folded back, or turned inside out. This property is remarkably strong in the pop-corn, and is common, in a varying degree, to all varieties of corn that abound in oil ; but those kinds, such as Tuscarora, that are destitute of a horny covering, will not pop under any circumstances. This change in corn is one of considerable importance, as regards facility of digestion ; for, after the decomposition or extraction of the oil, it is more readily digested by man, though less fattening to animals.

In some varieties of corn, such as the Golden Sioux, the color of the oil is yellow, while in others, such as the Rhode Island white flint corn, the oil is colorless.

As far as examined, the proportion of oil in corn varies from an entire absence to 11 per cent., according to the variety employed. In the manufacture of whisky, the oil is saved during the fermentation, as it separates and rises to the surface. One hundred bushels of corn yield from 15 to 16 gallons of oil.

Oily corn makes a dry kind of bread, and is not sufficiently adhesive to rise well without being mixed with rye or other flour.

The oil of corn is easily converted into animal fat by a slight change of composition, and consequently serves an excellent purpose for fattening poultry, cattle, and swine.

One important use of the oil in corn is to prevent the rapid decomposition of the kernels when sown in the soil, and to retain a portion of the food until needed by the young plant. It also serves to keep meal from souring, as it has been observed that a flint-corn meal will keep sweet for years, even when put up in large quantities without being kiln-dried, while the meal of the Tuscarora will become sour in a short time.

[AMERICAN CHEMICAL JOURNAL.]

APPARATUS FOR FILLING A BURETTE.

THE difficulty of filling a burette with standard solutions without a material loss of strength from evaporation has suggested to me the following plan : In Fig. 1, A is a glass tube bent as shown, and extending to the bottom of the bottle, C, containing the standard solution ; B is a similar tube extending just beneath the stopper ; both tubes are sealed in the bottle after it is filled. A small rubber tube 30 cm. or 40 cm. long fits at either end on the glass tubes, A and B, and remains in this position when the bottle is not in use. When the burette is to be filled, the rubber tube is detached from B and slipped over the tip of the burette at D, thus leaving B open for the admission of air when the fluid is drawn from the bottle.

In Fig. 2, E is a bent glass tube fitted by means of a stopper to the top of the burette ; it is pierced by a hole, H, in the side, just beneath the lower surface of the stopper, and extends about 2 cm. beyond, being open at each end ; a rubber tube is attached to its outer end for the purpose of making suction with the mouth.

The bottle being attached by means of the rubber tube, M, to the tip of the burette, and the compressor being open, the fluid is drawn by suction on the tube, N, through the tube, A, together with some air, into the burette. If a swimmer is not used, the air bubbles will simply rise to the top and give no further trouble. With a swimmer, however, it will be necessary to remove them by drawing the swimmer forcibly against the bottom of the tube, E (Fig. 2), when they will pass by the swimmer and escape ; if not at the first trial, by allowing the swimmer to recede slightly and repeating the operation, the air will easily pass out. The object of extending E (Fig. 2) beneath the stopper, and of the lateral hole in E, is to prevent the solution from entering the suction tube, N. When the burette is free from bubbles, the fluid may be allowed to recede until the swimmer stands at the mark. The rubber tube, M (Fig. 1), is detached from the burette and restored to its place on the tube, B, thus

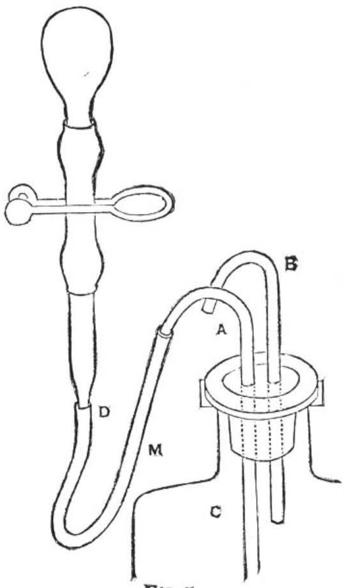


FIG. 1.

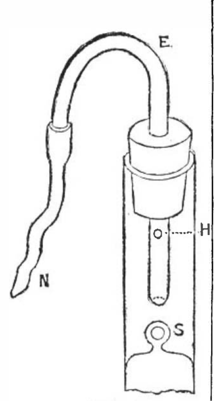


FIG. 2.

sealing the bottle against any possible evaporation. The efficiency of the apparatus in preventing loss of strength is evident ; in practice, I have found this method more speedy than any other I have known.

C. L. PENNY.

State Normal School, Shippensburg, Pa.

[AMERICAN CHEMICAL JOURNAL.]

SOME PIECES OF CHEMICAL APPARATUS.

Simple, Portable, Quick-Filtering Apparatus.—The accompanying cut represents a quick-filtering apparatus devised by the writer some four or five years ago, and which in the absence of a head of water answers fully all the purposes of the Bunsen pump. B is an ordinary hard rubber syringe, 5 inches long, fixed in a block, A (which is a piece of pump stock with a bore to suit the diameter of the syringe, and screwed to the table); and C is a three-way stopcock worked with the left hand while the right hand works the piston of the syringe.

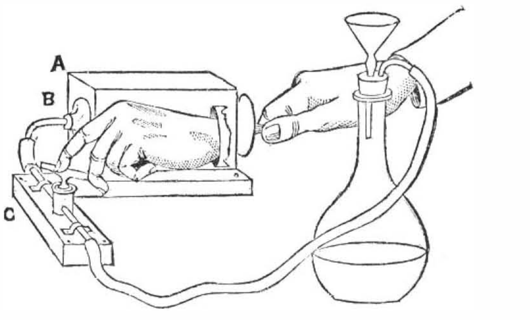
The idea was suggested by the text of Fleischer's volumetric analysis, Muir's translation, pp. 28 and 29, and the translator's note, p. 269, where devices inferior to this are described.

Sulphureted Hydrogen Apparatus without Stray Fumes.—Kipp's apparatus is in every laboratory. When the apparatus is not in use, the acid is above the iron sulphide, and gravity tends to produce leakage. I put ferrous sulphide into the top instead of the middle globe, having filled the stem with broken porcelain. The bottom globe and one half of the middle globe are then filled with dilute acid. To the tubulure of the middle globe (through which the gas is usually evolved) a rubber stopper, tube, and pinchcock are attached. By blowing through the tube the acid is made to ascend to the top globe, where it meets the iron sulphide.

When the gas is no longer needed, the pinchcock is opened and the acid falls. The evolution tube is connected with a wash bottle, and the considerable difference of height renders regurgitation impossible.

Obviously, in the absence of Kipp's apparatus, the same principle can be variously applied. For example, a long bottle, say an inch and a half in diameter, may have its bottom cut off and a one-hole rubber stopper one and a half inches in diameter inserted. This, on being inverted, may take the place of the top globe of Kipp's apparatus, if a one-hole stopper and long tube be attached to the neck, and if another bottle with a two-hole stopper (one of the holes for the blowing tube) be used as the acid reservoir.

Simple Arrangement for Reverse Filtration (Carmichael's Plan).—The neck of an ordinary vial is cut off. The outer end is ground on a lead, copper, or wooden surface with emery and water. Into the other end a one-hole rubber stopper is inserted, and pushed in so as to be flush with the opposite end. On the last mentioned end a pe orated platinum disk and a disk of



moistened filter paper are placed. Into the hole of the rubber stopper a tube is inserted, which is itself connected with the aspirator.

WOODVILLE LATHAM.

University of Miss., January 13, 1887.

NICKEL SALTS USED IN DYEING.

THE use of nickel salts for dyeing and printing woolen goods has recently been carefully studied by L. Liechti and G. Ulrich, in Vienna, and from the results of their experiments with most of the coloring matters in common use, they conclude that there is an opening for the introduction of the nickel salts as mordants. The high price of nickel, and its salts, has limited their use ; but, recently, from improvements in the preparation of the metal, the value of nickel compounds has been considerably reduced, so that they can now be obtained at prices which do not exclude them from use in dyeing and printing. Hitherto, for the reason already stated, nickel salts have not been used for the fixing of coloring matters on a large scale ; but experiments were tried by E. Dollfus, on the fixing of alizarin blue by means of nickel salts, and by L. Stamm, in 1877, when endeavoring to apply nitro-alizarin to steam dyeing. The nickel salts usually met with are those of the lower oxide of nickel, corresponding to the salts of the lower oxide of iron, and in order that they may become available for mordanting, it is necessary that in certain stages of the process some oxidizing agent be employed. The authors of these experiments find that, of the many nickel salts known, the following are those which are best suited for this purpose, viz.: Nickel sulphate $NiSO_4$, nickel chloride $NiCl_2$, the double nickel ammonium chloride $2NiCl_2 NH_4Cl$, nickel nitrate $Ni2NO_3$, nickel chlorate $Ni2ClO_3$, nickel sulphocyanide $Ni(CNS)_2$, and the acetate $Ni(C_2H_3O_2)_2$, and the double salts of the latter with the sulphate and nitrate. All these salts are precipitated as basic nickel carbonate by carbonate of soda, and as the hydrate $Ni(HO)_2$ by caustic soda. Bleaching powder precipitates the hydrate of the higher oxide $Ni_2(HO)_6$, while the phosphate, silicate, and arseniate of soda only partially precipitate the base. Nickel sulphate is the cheapest of the salts of nickel, and will, therefore, be, as a rule, the salt which would be preferred ; but as these salts vary in their solubility, the salt used depends on the strength of solution required. Liechti and Ulrich classify the nickel salts as follows : For dyeing—The double ammonium chloride, nickel chloride, nitrate sulphocyanide, sulphate and double sulphate, and acetate. For printing—the double nitrate and acetate, sulphate and acetate, and acetate.

BLACK DYES.

MR. BREINE, of the Laboratory for Dyeing and Bleaching, established at Bielitz, Austria, has investigated the chemical nature of the so-called "direct black" kaiserschwarz, nigrosaline, etc., which has been used for several years past for dyeing wools. The "direct black" appears to be a mixture of logwood extract and copper and iron sulphates, and is sold in two forms—one black, in amorphous spongy lumps, the other as a reddish brown powder, the latter form containing a small quantity of sumac. From a quantitative analysis, Mr. Breine found in the black compound 22·9 per cent. of green vitriol and 10·2 per cent. of blue vitriol, mixed with 66·9 per cent. of the logwood extract. The powder consists of two parts solid logwood extract, two parts iron sulphate, and one part copper sulphate. When these dyestuffs are dissolved in water, slightly acidulated with vitriol, wool can be dyed directly to a beautiful blue-black color, 100 lb. of wool or woolen fabric requiring from 15 lb. to 20 lb. of the coloring material. The wool should be kept in the bath for one hour to one hour and a half, at a boiling heat. Oxalic acid can be employed instead of vitriol, to render the solution acid, more being used with hard than with soft waters. If a small quantity of fustic be added, the color of the wool will be a dull black, without any shade of blue ; and by varying the quantity of the two materials, blacks of different shades can be

© 1887 SCIENTIFIC AMRICAN, INC.

produced. Bonsor's black appears to be a similar product.

The following are the compositions of two dyes for producing a green and violet shade of black. For green black: Logwood extract, 10 to 12 per cent.; blue vitriol, 4 to 5 per cent.; oxalic acid, 1 to 1·5 per cent. For violet black: Logwood extract, 12 to 15 per cent.; sulphate of iron, 5 per cent.; oxalic acid, 1·5 to 2 per cent.

WARNER'S IMPROVED DRY PLATE HOLDER.

ONE of the most serious annoyances a photographer has to contend with in the present day of lightning dry plates is a leaky plate holder, particularly when the latter is composed of one or more separable parts, since the slightest trace of light entering at some minute crevice will frequently damage a day's work. By its simplicity, solidity, and ease of operating, the holder here shown possesses features very desirable for out of door photography, in that it is perfectly light tight, strong, and compact.

Fig. 1 represents a longitudinal section, in which the upper slide is withdrawn. The body of the holder consists of a light hardwood frame, having a metal or gelatinized fiber septum in the center, upon each side of which are riveted very light flat steel springs, shown clearly in Fig. 2. In the lower half of the holder (Fig. 1) may be seen a plate in position. An angular metal strip is rigidly secured on the left hand end of the inside of each plate compartment, intended to hold one end of the sensitive plate, while at the opposite end is a movable or pivoted angular strip or clamp provided with projecting ends, which, when thrown up, permits the sensitive plate to freely drop down into the holder, resting, as it were, upon a bed of springs.

To insert the plate, the holder is held with its narrow end resting on a support at a slight angle, then the exposing slide is withdrawn, and the plate, film side out toward the operator, is slid over the spring under the left hand angular strip. In this position the other free end of the plate projects slightly above the holder. The right hand clamp is now turned down over the end of the plate, pressing the same down into position. The springs compensate for any variability in the thickness of the glass. Hence the film side of the plate remains always in the same plane and in focus. The exposing slide is next inserted, and the holder is filled ready for use.

The pivoted clamp, it will be noticed, has the pivot located just one side of the center, and as it is turned down over the plate, the latter pushes past the line of the pivot, thus securely locking the plate. The upward pressure of the plate cannot open the clamp. The latter is also held by friction on the sides of the holder.

Special cut-off light valves, consisting of plates with one side bent down, forming an angle, to prevent slipping, and also arranged to fly outward by a miniature spiral spring between them, as the slide is withdrawn, and effectually close the slit, may be seen in Figs. 1 and 4.

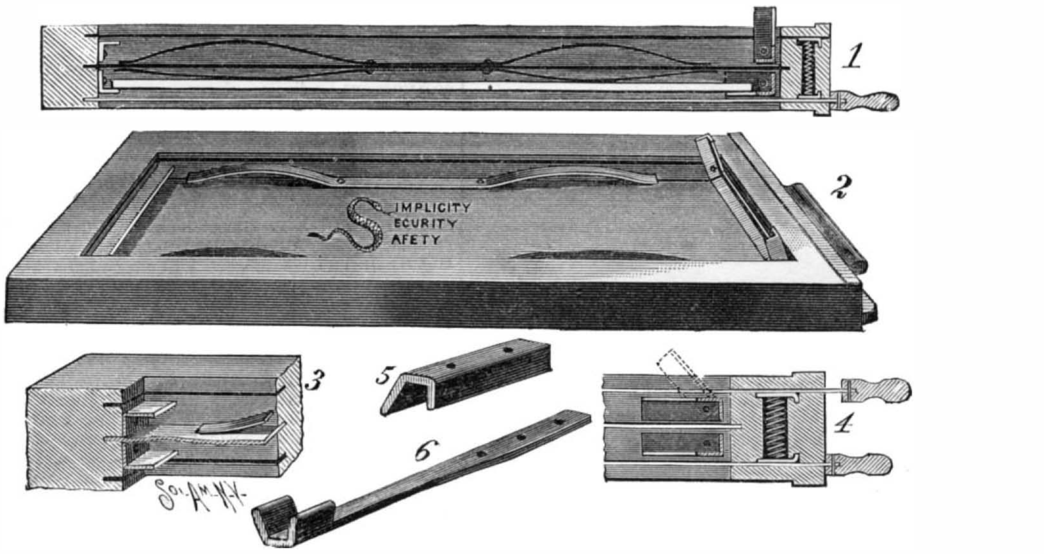
In removing the sensitive plate, the pivoted clamp is first turned up. At once the springs underneath force one end of the plate up and out of the holder, when it is easily caught with the fingers and slipped out. This feature of the holder is quite important, since in ordinary holders the operator is obliged in many cases to dig out, as it were, the plates with the fingers, being very apt to injure or scratch portions of the film. Fig. 3 is an enlarged view of the rigid angular strip. Fig. 4 shows the pivoted clamps down, when holding the plates. The dotted line indicates the position when thrown up.

Fig. 5 represents another form of a rigid angular strip, made in one or two lengths, intended to be substituted for that shown in Fig. 3, with the bevel side downward, and in conjunction with two spring clamps, bent in the shape of a half bow, secured to the inside end of the holder in place of the pivoted clamp. With this latter device the plate is inserted by putting its lower end in the two spring bow forks, then by pressing down on the edge the plate until its upper end slides under and snaps, or pushes up into the rigid beveled lugs in the upper end of the holder. To remove the plate, a knife blade or a thin steel key is passed over the upper edge of the plate. Then by pressing down it is quickly pried out from the rigid lugs. The beveled shape of the latter is intended to compensate for the varying thickness of plates.

The holder being made in one piece is perfectly tight, while the arrangement of the clamps permits uneven and rough-edged plates to be quickly and easily inserted.

It should also be mentioned that the sides of the holder are made of gelatinized fiber, a new material, light and as enduring as steel and not affected by moisture. The surface is slightly roughened and may be written upon, serving as a memorandum of exposures. The inventor claims that by substituting this fiber for metal, together with the other features, he has an extremely light holder, one that, in fact, is without a peer for convenience and safety.

Further particulars may be had from the patentee and manufacturer, Mr. M. P. Warner, 69 Lincoln Street, Holyoke, Mass.



WARNER'S IMPROVED DRY PLATE HOLDER.

DRUM ARMATURE FOR THE HAND POWER DYNAMO.

By GEO. M. HOPKINS.

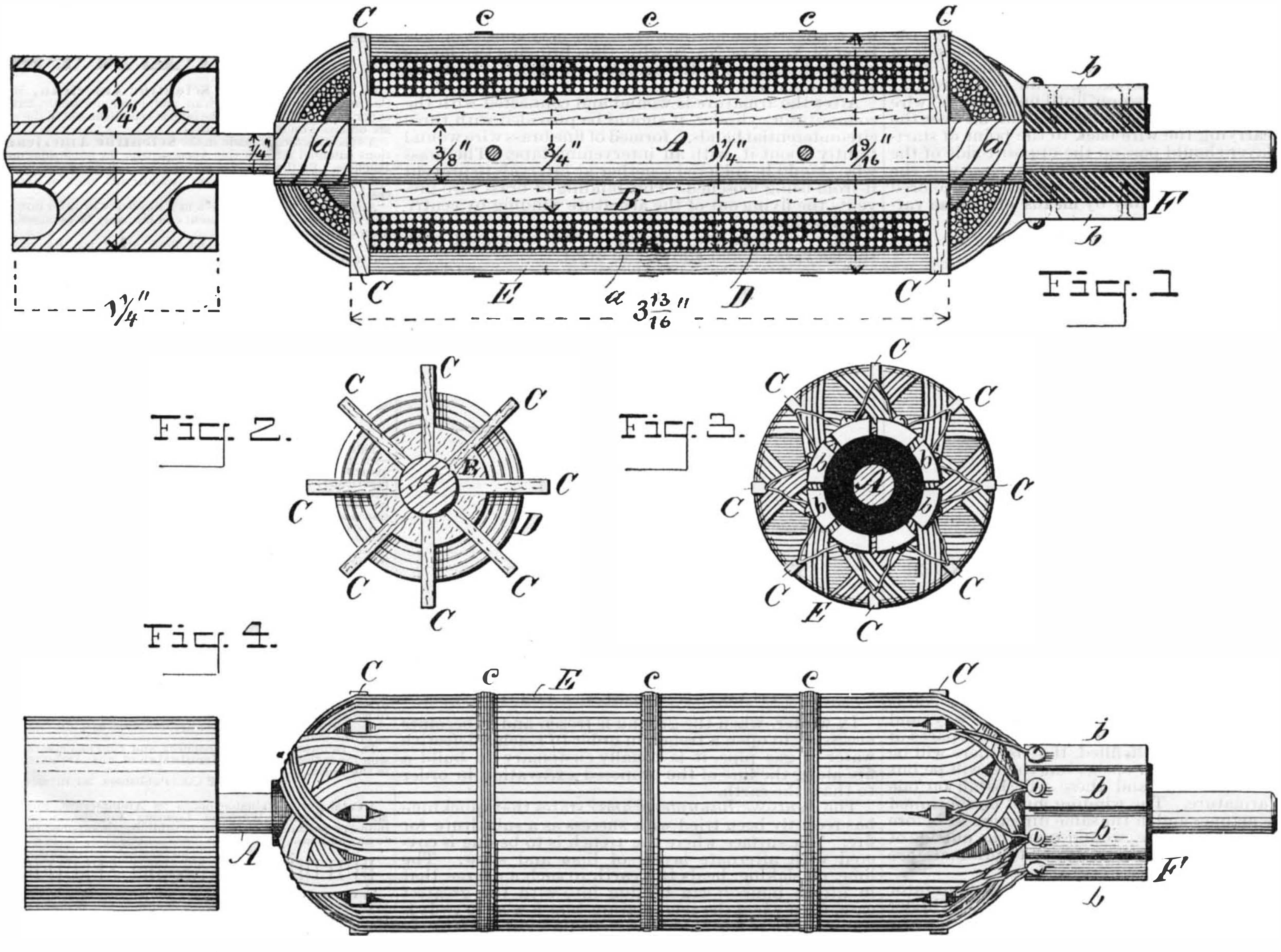
A DESCRIPTION of a hand power dynamo-electric machine was published in SUPPLEMENT 161 in 1879, before electric lighting had been commercially developed. This dynamo was then, and probably is at present, the best adapted for construction by amateurs. For most uses it answers a very good purpose; but recently many of the readers of this journal have manifested a desire to construct drum armatures for their machines, in hope of securing better results. It is for the purpose of replying as far as possible to the many inquiries on the subject that the present paper is published. The writer, however, does not recommend the making of a drum armature on so small a scale, as it involves an amount of labor almost equal to that required in making an armature for a larger machine.

The eight light dynamo recently described in the SCIENTIFIC AMERICAN, and to be presented on a more extended scale in SUPPLEMENT 600, is as small a drum armature machine as one should try to make.

The hand power dynamo forms an efficient motor when provided with a drum armature adapted to the kind of current used. Hints of this will be given further on.

As all of the dimensions are given on the engravings, it will be unnecessary to repeat them here.

To the armature shaft, A, is fitted a wooden cylinder, B, which receives the iron wire forming the core of the cylinder. The wood of which this cylinder is made should be hard and well seasoned. Maple, mahogany, or cherry may be used. Each end of the wooden cylinder is sawed across, so as to divide it into eight equal divisions, and into each saw kerf is inserted a wooden



DRUM ARMATURE FOR THE HAND POWER DYNAMO (FULL SIZE).

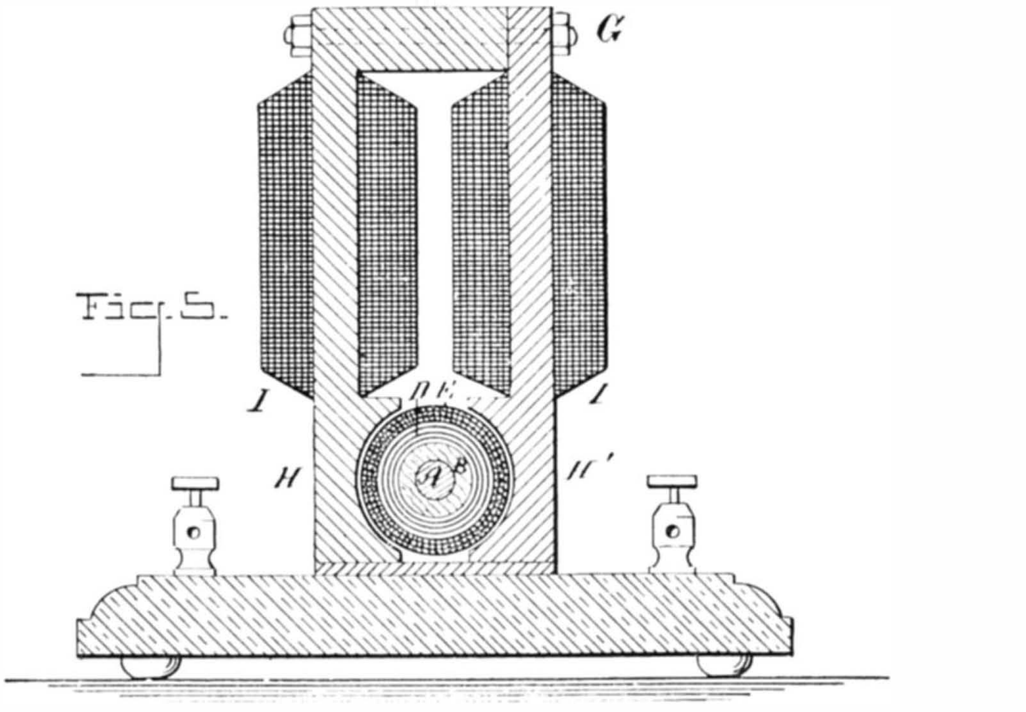
FIG. 1.—Longitudinal Section of Armature. FIG. 2.—End of Armature Core. FIG. 3.—End Elevation of Armature, showing Commutator Cylinder. FIG. 4.—Side Elevation of Armature Complete.

© 1887 SCIENTIFIC AMRICAN, INC.

arm, C. The wood of which these arms are made should be very tough. Hickory or oak will answer. The arms, C, when glued in their places, form together with the cylinder, B, a reel on which supports the armature core, D. The No. 20 annealed iron wire of which the core is formed is varnished with shellac and allowed to dry before it is wound upon the cylinder, B. The iron wire is wound evenly in a lathe, and its outer end is fastened by scraping the adjoining surfaces of wire and soldering them together. The iron core thus formed and the portion of the shaft, A, lying between the wooden cylinder and the shoulders of the shaft are covered with adhesive tape such as is used by wire men in covering the joints of wire conductors, or if this is not at hand, muslin or even stout screw for receiving the terminals of adjacent armature coils.

The coils of the armature are connected with the commutator bars in the following manner: The colored end of the first coil is connected with one of the commutator bars, while the white end of the coil is connected with the next commutator bar along with the colored end of the next coil in advance, and the white end of this second coil is connected with the third commutator bar along with the colored end of the third coil, and so on until two terminals are connected with each commutator bar.*

The commutator brushes used in connection with an armature of this kind are made of thin sheet copper, and should be arranged as shown in Figs. 6 and 7.

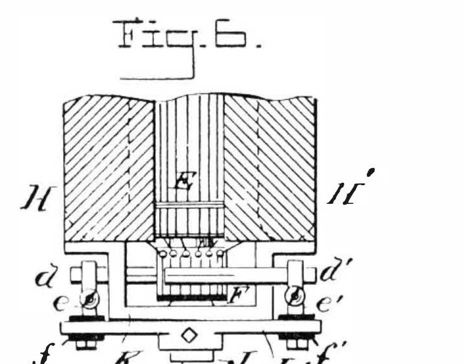


VERTICAL TRANSVERSE SECTION OF SMALL DYNAMO, SHOWING ARMATURE IN SECTION (HALF SIZE).

paper attached by means of shellac varnish may be substituted. This extra insulation is necessary to avoid short-circuiting.

The winding of the armature may be readily done by supporting its shaft between the centers of a lathe, and applying a lathe dog to it, so that the armature can be turned back and forth with the lathe spindle. To secure the required length of wire on the armature, it is necessary to use quite fine wire. The armature shown in the engraving was wound with No. 30 cotton-covered magnet wire. The armature has eight coils, with two layers of wire in each coil. Each coil contains about 60 feet of wire.

The winding is begun by attaching the end of the wire to one of the wooden arms by winding it once or twice around the arm, then carrying it past one space and passing it in the next space endwise over the armature core, across the end of the reel at one side of the shaft, then along the diametrically opposite side of the armature core, then across the end of the reel at one side of the shaft, and so on until one layer of wire is in place. Then the second layer is put on over the first layer, carrying the wire back to the point of starting. This layer should pass on the opposite side of the shaft, at the ends of the reel. The extremity of the wire is now removed from the wooden arm and colored in some manner—preferably by means of shellac var-



PLAN VIEW OF COMMUTATOR CYLINDER AND BRUSHES (HALF SIZE).

nish containing vermilion or some other pigment—to indicate that it is the inner end of the coil. The wire leading from the spool is now severed, and the colored or inner end and the white or outer end of the first coil are twisted together slightly. Another coil is laid on in the next space in exactly the same way, and so on until four coils are wound, when all the spaces of the armature will be half filled, that is, there will be two layers of wire in each space, but there will be but four pairs of terminals, and these will be all on one side of the armature. The winding must be continued in the same manner and in the same direction as before until four more coils are wound upon the outside of the first four, and four more pairs of terminals are brought out.

The winding, E, being complete, the commutator cylinder, F, will next require attention. A cylinder which will answer very well for this machine may be made by mounting a piece of brass tube on a cylinder of vulcanite fitted to the armature shaft, dividing the brass tube into eight parts, fastening each part to the vulcanite with two countersunk brass screws, then separating the parts into segments or bars, *b*, by means of a hack saw. Into one end of each bar, *b*, is inserted a

They should be carried by an adjustable arm, which will allow of their adjustment in any desired position around the periphery of the commutator cylinder.

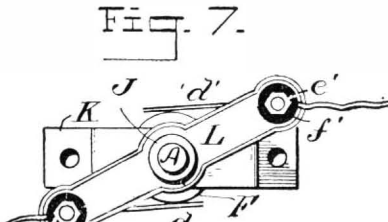
To the frame, K, which supports the armature shaft, is attached a boss, J, concentric with the shaft, and upon this boss is adjustably mounted an arm, L, carrying in its ends studs, *e e'*, which support the commutator brushes, *d d'*. The studs, *e e'*, are electrically separated from the arm, L, by the insulation, *f f'*, and are connected with wires leading to the field magnet and binding posts as shown and described in SUPPLEMENT 161.

The armature may be wound with wire as coarse as No. 28 or No. 26. For a motor to be propelled by a high tension current, wire of No. 30, No. 28, or No. 26 may be used. When it is to be used on a circuit carrying a low tension current, each coil may consist of one layer of No. 18 or No. 20 wire, thus bringing two layers into each division of the armature, instead of four, as above described.

After the armature is wound and connected with the commutator cylinder, it should be provided with three circumferential bands, *e*, formed of fine brass wire wound tightly about it, with an intervening tape. The brass wire should be soldered together at intervals to prevent it from being loosened. This binding of brass wire prevents the flying out of the armature winding by centrifugal action.

After binding, the winding is well saturated with shellac varnish and allowed to dry.

The armature should be driven at a speed of 2,500 or 3,000 revolutions per minute The resistance of the armature when wound with No. 30 wire is eight and one-half ohms.



FRONT ELEVATION (HALF SIZE).

The best results are obtained from this armature when the field magnet is separately excited by a battery or otherwise.

THAWING FROZEN EARTH.

IN winter, when the ground is frozen and it becomes necessary to open a trench in order to reach a defective water or gas pipe, it is usually customary to build a fire along the line of the proposed excavation in order to thaw the earth.

The *Deutsche Banunternehmer* states that quicklime has recently been tried with success as a substitute for fire. The surface where the trench is to be dug is covered with alternate layers of lime and snow. The lime, on slaking, heats the earth to such a degree that in fifteen hours it can be dug into with the greatest ease, even when the temperature is as low as 25°. It is unnecessary to say that if there is no snow; water may be used as a substitute.

The application of this process is of course limited to cases where the delay of a day is of no consequence.

* See description of armature of eight light dynamo in SUPPLEMENT, No. 600.

THE
Scientific American Supplement.
PUBLISHED WEEKLY.

Terms of Subscription, $5 a year.

Sent by mail, postage prepaid, to subscribers in any part of the United States or Canada. Six dollars a year, sent, prepaid, to any foreign country.

All the back numbers of THE SUPPLEMENT, from the commencement, January 1, 1876, can be had. Price, 10 cents each.

All the back volumes of THE SUPPLEMENT can likewise be supplied. Two volumes are issued yearly. Price of each volume, $2.50 stitched in paper, or $3.50 bound in stiff covers.

COMBINED RATES.—One copy of SCIENTIFIC AMERICAN and one copy of SCIENTIFIC AMERICAN SUPPLEMENT, one year, postpaid, $7.00.

A liberal discount to booksellers, news agents, and canvassers.

MUNN & CO., Publishers,
361 Broadway, New York, N. Y.

TABLE OF CONTENTS.

PATENTS.

In connection with the **Scientific American,** Messrs. MUNN & Co. are solicitors of American and Foreign Patents, have had 42 years' experience, and now have the largest establishment in the world. Patents are obtained on the best terms.

A special notice is made in the **Scientific American** of all inventions patented through this Agency, with the name and residence of the Patentee. By the immense circulation thus given, public attention is directed to the merits of the new patent, and sales or introduction often easily effected.

Any person who has made a new discovery or invertion can ascertain, free of charge, whether a patent can probably be obtained, by writing to MUNN & Co.

We also send free our Hand Book about the Patent Laws, Patents, Caveats, Trade Marks, their costs, and how procured. Address

Munn & Co., 361 Broadway, New York.
Branch Office, 622 and 624 F St., Washington, D. C.

THE SCIENTIFIC AMERICAN
Architects and Builders Edition.

$2.50 a Year. Single Copies, 25 Cents.

This is a Special Edition of THE SCIENTIFIC AMERICAN, issued monthly—on the first day of the month. Each number contains about forty large quarto pages, equal to about two hundred ordinary book pages, forming, practically, a large and splendid **Magazine of Architecture,** richly adorned with *elegant plates in colors* and with fine engravings; illustrating the most interesting examples of modern Architectural Construction and allied subjects.

A special feature is the presentation in each number of a variety of the latest and best plans for private residences, city and country, including those of very moderate cost as well as the more expensive. Drawings in perspective and in color are given, together with full Plans, Specifications, Costs. Bills of Estimate, and Sheets of Details.

No other building paper contains so many plans. details, and specifications regularly presented as the SCIENTIFIC AMERICAN. Hundreds of dwellings have already been erected on the various plans we have issued during the past year, and many others are in process of construction.

Architects, Builders, and Owners will find this work valuable in furnishing fresh and useful suggestions. All who contemplate building or improving homes, or erecting structures of any kind, have before them in this work an almost *endless series of the latest and best examples* from which to make selections, thus saving time and money.

Many other subjects, including Sewerage, Piping, Lighting, Warming, Ventilating, Decorating, Laying out of Grounds, etc., are illustrated. An extensive Compendium of Manufacturers' Announcements is also given, in which the most reliable and approved Building Materials, Goods. Machines, Tools, and Appliances are described and illustrated, with addresses of the makers, etc.

The fullness, richness, cheapness, and convenience of this work have won for it the **Largest Circulation** of any Architectural publication in the world.

MUNN & CO., Publishers, 361 Broadway, New York.

A Catalogue of valuable books on Architecture, Building, Carpentry. Masonry, Heating, Warming, Lighting, Ventilation, and all branches of industry pertaining to the art of Building, is supplied free of charge, sent to any address.

BUILDING PLANS and SPECIFICATIONS.

In connection with the publication of the BUILDING EDITION of the SCIENTIFIC AMERICAN, Messrs. Munn & Co. furnish plans and specifications for buildings of every kind, including Churches. Schools, Stores. Dwellings, Carriage Houses, Barns, etc.

In this work they are assisted by able and experienced architects. Full plans, details, and specifications for the various buildings illustrated in this paper can be supplied.

Those who contemplate building, or who wish to alter, improve, extend, or add to existing buildings, whether wings, porches, bay windows, or attic rooms, are invited to communicate with the undersigned. Our work exends to all parts of the country. Estimates, plans, and drawings promptly prepared. Terms moderate. Address

MUNN & CO., 361 Broadway, New York.

© 1887 SCIENTIFIC AMRICAN, INC.

The Scientific American Supplement. Index for Vol. 23.

JANUARY—JUNE, 1887.

The * Indicates that the Article is Illustrated with Engravings.

A

B

C

D

E

F

G

H

I

J

K

L

M

© 1887 SCIENTIFIC AMRICAN, INC.

© 1887 SCIENTIFIC AMRICAN, INC.