The Wisconsin engineer. Volume 16, Number 1 October 1911

Madison, Wisconsin: Wisconsin Engineering Journal Association, [s.d.]

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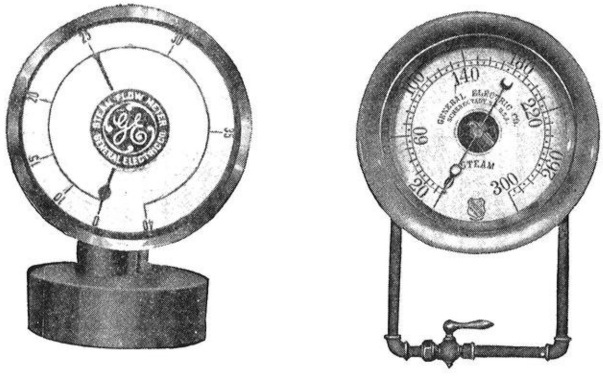
The Wisconsin Engineer

OCTOBER, 1911

Volume 16 | Number 1

$1.00 a Year | 20c a Copy

WISCONSIN ENGINEERING JOURNAL ASSOCIATION



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Volume 16 **Founded 1896** **Number 1**

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Entered as second-class matter Sept. 26, 1910, at the postoffice at Madison Wis., under the Act of March 3, 1879.

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Published monthly from October to May, inclusive, by the WISCONSIN ENGINEERING JOURNAL ASSOCIATION, Engineering Bldg., Madison, Wis.

Address all communications to The Wisconsin Engineer.

Subscription price $1.00 a year if paid before February 1; $1.25 a year after that date. Canadian subscriptions, $1.25 a year. Foreign subscriptions, $1.50 a year.

The Wisconsin Engineer

VOL. XVI   OCTOBER, 1911   NO. 1

CAPTAIN GEORGE HASKET DERBY U. S. A. (JOHN PHOENIX).

[Introductory note by JOHN G. D. MACK.]
Professor of Machine Design.

A small and almost forgotten humorous volume written more than a half century ago is "Phoenixiana," a book which was widely read and frequently quoted in the days of the civil war and for a decade afterward.

Phoenixiana claims especial attention from the engineer for two reasons; first, it was written by an engineer, and second, on account of the amusing satire on an engineering report which it contains, the so called "Official Report" reprinted below, a burlesque with which engineers of an older generation were familiar.

The book includes a very miscellaneous collection of humorous sketches, although the words "very miscellaneous" lack proper divergence as a descriptive term.

A large portion of the humor is of the rather rough unvarnished variety of the time when it was written, a style made famous a decade later by Charles Farrar Browne 1834–1867 (Artemus Ward).

In a biographical sketch of Artemus Ward, Melville D. Landon says—"the oddities of John Phoenix were his [Ward's] especial admiration."

Captain George Hasket Derby, U. S. A. (John Phoenix) was born in Massachusetts in 1823, entered the United States Military Academy in 1842, graduating July 1, 1846 with the rank or brevet second lieutenant in the ordnance department. In the following month he was transferred to the engineering corps, with which he was identified during the remainder of his life, except for a time when he was on staff duty. Immediately after graduation he was in active service in the Mexican War, being wounded in the battle of Cerro Gordo in 1847.

Lieutenant Derby made explorations in Minnesota Territory in '48–'49 and was then transferred to the Department of the Pacific. In '53–'54 he was in charge of the survey and improvements in San Diego harbor. During the years '54–'55 he was on the staff of the general commanding the Department of the Pacific; in '55–'56 had charge of the military roads of this division, then served on the Coast Survey for a few months, and later was light house engineer on the Pacific. He was promoted to the grade of first lieutenant of Topographical Engineers in '55, and to that of Captain in the same branch on July 1, 1860.

Failing health brought on by sunstroke caused his return east, and he died on May 15, 1861 in New York City.

Captain Derby had a varied engineering experience of a kind now unknown on the then far frontier, and while the "Official Report" is light reading, the above brief sketch shows it to have been written by an engineer with knowledge of his subject.

Artemus Ward made frequent reference to events of the Civil War, viewing them from different angles than any other writer, and it seems rather curious that he has not been more widely quoted in the past years reprinting of war stories.

Artemus Ward, who was not a military man, recognized in the work of John Phoenix the literary talent to which he aspired, and one wonders therefore, what comments on the civil war might have been given to the world, had Captain Derby been permitted to live through that period.

Although as an introductory note this is reaching to an unwarranted length, it would seem that at a time when so much civil war history is being written and reprinted, some facts regarding Captain Derby's class of 1846 might well be given.

This class numbering fifty-nine graduated July first, about a month after the opening of the Mexican War, in which fifty-two of the class saw active service, two being killed in battle.

Nearly every man in the class who lived until the civil war period had a more or less extensive record on one side or the other in that war, as they had reached an age, and had had the experience fitting them for command.

Among many of the class who had distinguished records in the civil war may be noted George B. McClellan, Jesse L. Reno, Alfred Gibbs, Truman Seymour, John G. Foster and C. Seaforth Stewart of the union army.

A number of the class resigned from the army to go with the south, among them being Dabney H. Maury and those two idols of the confederate army, Thomas J. (Stonewall) Jackson and George E. Pickett.

It is said that college students are very much alike from class to class, decade to decade and from age to age. Out of the infinite mass of reading material available, there is probably nothing in the whole range which can give the inspiration and thought for serious contemplation to the college student of today, and of days to come, equal to a study of the detailed history of classes of long ago, those classes whose members have fulfilled their missions in life.

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Official Report of Professor John Phoenix, A. M.

Of a Military Survey and Reconnoissance of the route from San Francisco to the Mission of Dolores, made with a view to ascertain the practicability of connecting these points by a Railroad.*

Mission of Dolores,
Feb. 15, 1855.

It having been definitely determined, that the great Railroad, connecting the City of San Francisco with the head of navigation on Mission Creek, should be constructed without unnecessary delay, a large appropriation ($120,000) was granted, for the purpose of causing thorough military examinations to be

* The Mission Dolores is only 2½ miles from the City Hall of San Francisco, and is a favorite suburban locality, lying within the limits of the City Survey. This fact is noted for the benefit of distant readers of this sketch.

made of the proposed routes. The routes, which had principally attracted the attention of the public, were "the Northern," following the line of Brannan Street, the "Central," through Folsom Street, and the "extreme Southern," passing over the "Old Plank Road" to the Mission. Each of these proposed routes has many enthusiastic advocates; but the "Central" was, undoubtedly, the favorite of the public, it being more extensively used by emigrants from San Francisco to the Mission, and therefor more widely and favorably known than the others. It was to the examination of this route, that the Committee, feeling a confidence (eminently justified by the results of my labors) in my experience, judgment and skill as a Military Engineer, appointed me on the first instant. Having notified that Honorable Body of my acceptance of the important trust confided in me, in a letter, wherein I also took occasion to congratulate them on the good judgment they had evinced, I drew from the treasurer the amount ($40,000) appropriated for my peculiar route, and having invested it securely in loans at three per cent a month (made, to avoid accident, in my own name), I proceeded to organize my party for the expedition.

In a few days my arrangements were completed, and my scientific corps organized as follows:

John Phoenix, A. M., Principal Engineer and Chief Astronomer.

Lieut. Minus Root, Apocryphal Engineer, First Assistant Astronomer.

Lieut. Nonplus A. Zero, Hypercritical Engineer, Second Assistant Astronomer.

Dr. Abraham Dunshunner, Geologist.

Dr. Targee Heavysterne, Naturalist.

Herr Von Der Weegates, Botanist.

Dr. Fogy L. Bigguns, Ethnologist.

Dr. Tushmaker, Dentist.

Enry Halfred Jinkins, R. A., Adolphe Kraut, Draftsmen.

Hi Fun, Interpreter.

James Phoenix (my elder brother), Treasurer.

Joseph Phoenix (ditto), Quarter Master.

William Phoenix (younger brother), Commissary.

Peter Phoenix (ditto), Clerk.

Paul Phoenix (my cousin), Sutler.

Reuben Phoenix (ditto), Wagon-master.

Richard Phoenix (second cousin), Assistant ditto.

These gentlemen, with one hundred and eighty-four laborers employed as teamsters, chainmen, rodmen, etc., made up the party. For instruments we had 1 large Transit Instrument (8 inch acromatic lens), 1 Mural Circle, 1 Altitude and Azimuth Instrument (these instruments were permanently set up on a mule cart, which was backed into the plane of the true meridian, when required for use), 13 large Theodolites, 13 small ditto, 8 Transit Compasses, 17 Sextants, 34 Artificial Horizons, 1 Sidereal Clock, and 184 Solar Compasses. Each employee was furnished with a gold chronometer watch, and, by a singular mistake, a diamond pin and gold chain; for directions having been given that they should be furnished with "chains and pins,"—meaning of course such articles as are used in surveying—Lieut. Root, whose zeal somewhat overran his discretion, incontinently procured for each man the above-named jewelry, by mistake. They were purchased at Tuckers (where, it is needless to remark, "you can buy a diamond pin or ring"), and afterwards proved extremely useful in our intercourse with the natives of the Mission of Dolores, and indeed, along the route.

Every man was suitably armed, with four of Colt's revolvers, a Minie rifle, a copy of Col. Benton's speech on the Pacific Railroad, and a mountain howitzer. These last named heavy articles required each man to be furnished with a wheel-barrow for their transportation, which was accordingly done; and these vehicles proved of great service on the survey, transporting not only the arms but the baggage of the party, as well as the plunder derived from the natives. A squadron of dragoons, numbering 150 men, under Capt. McSpadden, had been detailed as an escort. They accordingly left about a week before us, and we heard of them occasionally on the march.

On consulting with my assistants, I had determined to select as a base for our operations, a line joining the summit of Telegraph Hill with the extremity of the wharf at Oakland, and two large thirty-two pounders were accordingly procured and at great expense imbedded in the earth, one at each extremity of the line to mark the initial points. On placing compasses over these points to determine the bearing of the base, we were extremely perplexed by the unaccountable local attraction that prevailed; and were compelled, in consequence, to select a new position. This we finally concluded to adopt between Fort Point and Saucelito; but, in attempting to measure the base we were deterred by the unexpected depth of the water intervening, which, to our surprise, was considerably over the chain-bearers' heads. Disliking to abandon our new line, which had been selected with much care and at great expense, I determined to employ in its measurement a reflecting instrument used very successfully by the United States Coast Survey. I therefor directed my assistants to procure for me a "Heliotrope," but after being annoyed by having brought me successively a sweet-smelling shrub of that name, and a box of "Lubin's Extract" to select from, it was finally ascertained that no such instrument could be procured in California. In this extremity, I bethought myself of using as a substitute the flash of gunpowder. Wishing to satisfy myself of its practicability by an experiment, I placed Dr. Dunshunner at a distance of forty paces from my Theodolite, with a flint lock musket, carefully primed, and directed to flash in the pan when I should wave my hand. Having covered the Doctor with the Theodolite, and by a movement of the tangent screw placed the intersection of the cross lines directly over the muzzle of the musket, I accordingly waved; when I was astounded by a tremendous report, a violent blow in the eye, and the instantaneous disappearance of the instrument.

Observing Dr. Dunshunner lying on his back in one direction, and my hat, which had been violently torn from my head, at about the same distance in another, I concluded that the musket had been accidently loaded. Such proved the case; the marks of three buckshot were found in my hat, a shower of screws, lenses and pieces of brass, which fell shortly around us, told where the ball had struck, and bore fearful testimony to the accuracy of Dr. Dunshunner's practice. Believing these experiments more curious than useful, I abandoned the use of the "Heliotrope" or its substitutes, and determined to reverse the usual process, and arrive at the base of the line by subsequent triangulation. I may as well state here that this course was adopted and resulted to our entire satisfaction; the distance from Fort Point to Saucelito by the solution of a mean of 1,867,434,926,465 triangles, being determined to be *three hundred and twenty-four feet.* This result differed very much from our preconceived ideas and from popular opinion; the distance being generally supposed to be some ten miles; but I will stake my professional reputation on the accuracy of our work, and there can, of course, be no disputing the elucidation of science or facts demonstrated by mathematical process, however incredible they may appear *per se.*

We had adopted an entirely new system of triangulation, which I am proud to claim (though I hope with becoming modesty) as my own invention. It consists simply in placing the leg of a tripod on the initial point, and opening out the other legs as far as possible; the distance between the legs is then measured by a two-foot rule and the distance noted down; and the tripod moved, so as to form a second triangle, connected with the first, and so on, until the whole country to be triangulated has been gone over. By using a large number of tripods, it is easily seen with what rapidity the work may be carried on, and this was, in fact, the object of my requisition for so large a number of solar compasses, the tripod being in my opinion, the only useful portion of that absurd instrument. Having given Lieut. Root charge of the triangulation, and detached Mr. Jinkins with a small party on hydrographical duty (to sound a man's well, on the upper part of Dupont Street, and report thereon), on the fifth of February I left the Plaza, with the *savans* and the remainder of my party, to commence the examination and survey of Kearny Street.

Besides the mules drawing the cart which carried the transit instrument, I had procured two fine pack mules which carried two barrels of ale for the draftsmen. Following the tasteful example of that gallant gentleman—who conducted the Dead Sea expedition, and wishing likewise to pay a compliment to the administration under which I was employed, I named the mules "Fanny Pierce" and "Fanny Bigler." Our *cortége* passing along Kearny Street attracted much attention from the natives, and indeed, our appearance was sufficiently imposing to excite interest even in less untutored minds than those of these barbarians.

First came the cart, bearing our instruments; then a cart containing Lieut. Zero with a level, with which he constantly noted the changes of grade which might occur; then one hundred and fifty men, four abreast, armed to the teeth, each wheeling before him his personal property and a mountain howitzer; then the *savans* each with a note book and pencil, constantly jotting down some object of interest (Dr. Tushmaker was so zealous to do something that he pulled a tooth from an iron rake standing near a stable door, and was cursed therefor by the illiberal proprietor), and finally, the Chief Professor, walking arm in arm with Dr. Dunshunner and gazing from side to side, with an air of ineffable blandness and dignity, brought up the rear.

I had made arrangements to measure the length of Kearny Street by two methods; first, by chaining its sidewalks; and second by a little instrument of my own invention called the "Go-it-ometer." This last consisted of a straight rod of brass, firmly strapped to a man's leg and connected with a system of clockwork placed on his back, with which it performs, when he walks, the office of a *ballistic pendulum.* About one foot below the ornamental buttons on the man's back appears a dial plate connected with the clock-work, on which is promptly registered, by an index, each step taken. Of course, the length of step being known, the distance passed over in a single day may be obtained by a simple process.

We arrived at the end of Kearny Street, and encamped for the night about sundown, near a large brick building inhabited by a class of people called "The Orphans," who, I am credibly informed, have no fathers or mothers. After seeing the camp properly arranged, the wheelbarrows packed and a guard detailed, I sent for the chainmen and "Go-it-ometer" bearer, to ascertain the distance traveled during the day.

Judge of my surprise to find that the chainmen, having received no instructions, had simply drawn the chain after them through the streets, and had no idea of the distance whatever. Turning from them in displeasure, I took from the "Go-it-ometer'' the number of paces marked, and on working the distance, found it to be four miles and a half. Upon close questioning the bearer, William Boulder (called by his associates, ''Slippery Bill''), I ascertained that he had been in a saloon in the vicinity, and after drinking five glasses of a beverage, known among the natives as *''Lager Bier,''* he had danced a little for their amusement. Feeling very much dissatisfied with the day's survey, I stepped out of the camp, and stopping an omnibus, asked the driver how far he thought it was to the Plaza? He replied, ''Half a-mile,'' which I accordingly noted down, and returned very much pleased at so easily obtaining so much valuable information. It would appear, therefore, that ''Slippery Bill,'' under the influence of five glasses (probably 2½ quarts) of *''Lager Bier,''* had actually danced four miles in a few moments.

Kearney Street is a pass, about fifty feet in width. The soil is loose and sandy, about one inch in depth, below which Dr. Dunshunner discovered a stratum of white pine, three inches in thickness, and beneath this again, sand.

It being late in the evening when our arrangements for encamping were completed, we saw but little of the natives until the next morning, when they gathered about our camp to the number of eighteen.

We were surprised to find them of diminutive stature, the tallest not exceeding three feet in height. They were excessively mischievous, and disposed to steal such trifling things as they could carry away. Their countenances are of the color of dirt, and their hair white and glossy as the silk of maize. The one that we took to be their chief, was an exceedingly diminutive personage, but with a bald patch which gave him a very venerable appearance. He was dressed in a dingy robe of jaconet, and was borne in the arms of one of his followers. On making them a speech, proposing a treaty, and assuring them of the protection of their great Father, Pierce, the chief was affected to tears, and on being comforted by his followers, repeatedly exclaimed, ''da, da,-da, da;'' which, we were informed by the interpreter, meant ''father,'' and was intended as a respectful allusion to the President. We presented him afterwards with some beads, hawk-bells and other presents, which he immediately thrust into his mouth, saying "Goo," and crowing like a cock; which was rendered by the interpreter into an expression of high satisfaction. Having made presents to all his followers, they at length left us very well pleased, and we shortly after took up our line of march. From the notes of Dr. Bigguns, I transcribe the following description of one of this deeply interesting people:

"Kearney Street native; name—Bill;—height, two feet nine inches;—hair, white;—complexion, dirt color;—eyes, blue;—no front teeth;—opal at extremity of nose;—dress, a basquine of bluish bombazine, with two gussets, ornamented down the front with crochet work of molasses candy, three buttons on one side and eight button holes on the other—leggings of tow cloth, fringed at the bottoms and permitting free ventilation behind—one shoe and one boot;—occupation, erecting small pyramids of dirt and water; when asked what they were, replied 'pies' (word in Spanish meaning feet; supposed they might be the feet or foundation of some barbarian structure)—religious belief, obscure;—when asked who made him, replied 'PAR' (supposed to be the name of one of their principal Deities)."

We broke up our encampment and moved North by compass across Market Street, on the morning of the 6th, and about noon had completed the survey as far as the corner of Second Street.

While crossing Market Street, being anxious to know the exact time, I concluded to determine it by observation. Having removed the Sidereal Clock from the cart, and put it in the street, we placed the cart in the plane of the Meridian, and I removed the eye and object-glass of the transit, for the purpose of wiping them. While busily engaged in this manner, an individual, whom I have reason to believe is connected with a fire company, approached, and seeing the large brazen tube of the transit pointed to the sky, mistook it for a huge speaking trumpet. Misled by this delusion, he mounted the cart, and in an awful tone of voice shouted through the transit "Wash her, Thirteen!" but having miscalculated the strength of his lungs, he was seized with a violent fit of coughing, and before he could be removed had completely coughed the vertical hairs out of the instrument. I was in despair at this sudden destruction of the utility of our most valuable instrument, but fortunately recollecting a gridiron, that we had among our kitchen apparatus, I directed Dr. Heavysterne to hold it up in the plane of the true Meridian, and with an opera glass watched and noted by the clock the passage of the sun's center across the five bars. Having made these observations, I requested the principal computer to work them out, as I wished to ascertain the time immediately; but he replying that it would take some three months to do it, I concluded not to wait, but sent a man into the gorcery, corner of Market and Second, to inquire the time, who soon returned with the desired information. It may be thought singular, that with so many gold watches in our party, we should ever be found at a loss to ascertain the time; but the fact was that I had directed every one of our employees to set his watch by Greenwich mean time, which, though excellent to give one the longitude, is for ordinary purposes the meanest time that can be found. A distressing casualty that befell Dr. Bigguns on this occasion may be found worthy of record. An omnibus, passing during the time of observation, was driven carelessly near our Sidereal Clock, with which it almost came into contact. Dr. Bigguns, with a slight smile, remarked that "the clock was nearly run down," and immediately fainted away. The pursuits of science cannot be delayed by accidents of this nature, two of the workmen removed our unfortunate friend, at once, to the Orphan Asylum, where, having rung the bell, they left him on the steps and departed, and we never saw him afterwards.

From the corner of Market to the corner of Second and Folsom Streets, the route presents no object of interest worthy of mention. We were forced to the conclusion, however, that little throwing of stones prevails near the latter point, as the inhabitants mostly live in glass houses. On the 8th we brought the survey nearly up Southwick's Pass on Folsom Street, and we commenced going through the pass on the morning of the 9th. This pass consists of a rectangular ravine, about 10 feet in length, the sides lined with pine boards, with a white oak (*quercus albus*) bar, that at certain occasions forms across, entirely obstructing the whole route. We found no difficulty in getting through the Pass on foot, nor with the wheelbarrows; but the mule carts and the "two Fannies" were more troublesome, and we were finally unable to get them through without a considerable pecuniary disbursement, amounting in all to one dollar and fifty cents ($1.50). We understand that the City of San Francisco is desirous of effecting a safe and free passage through this celebrated canon, but a large appropriation ($220,000) is required for the purpose.

The following passage relating to this portion of the route, transcribed from the Geological Notes of Dr. Dunshunner, though not directly connected with the objects of the survey, are extremely curious in a scientific point of view, and may be of interest to the general reader.

"The country in the vicinity of the route, after leaving Southwick's Pass, is very productive, and I observed with astonishment, that red-headed children appear to grow spontaneously. A building was pointed out to me, near our line of march, as the locale of a most astounding agricultural and architectural phenomenon, which illustrates the extreme fertility of the soil in a remarkable degree. A small pine wardrobe, which had been left standing by the side of the house (a frame cottage with a piazza), at the commencement of the rainy season, took root, and in a few weeks grew to the prodigious height of thirty feet, and still preserving its proportions and characteristic appearance, extended in each direction, until it covered a space of ground some forty by twenty feet in measurement.

"This singular phenomenon was taken advantage of by the proprietors; doors and windows were cut in the wardrobe, a chimney erected, and it now answers every purpose of an addition to the original cottage, being two stories in height! This, doubtless, appears almost incredible, but fortunately the house and attached wardrobe may be seen any day, from the road, at a trifling expense of omnibous hire, by the skeptical. Some distance beyond, rises a noble structure, built entirely of cut-wood, called 'The Valley House, by Mrs. Hubbard.' Not imagining that a venial species of profanity was conveyed by this legend, I concluded that Mrs. Hubbard was simply the proprietor. This brought to my mind the beautiful lines of a primitive pote, Spenser,* if I mistake not:

> 'Old Mother Hubbard went to the cupboard
> To get her poor dog a bone;
> But when she got there, the cupboard was bare,
> And so the poor dog got none.'

"Feeling curious to ascertain if this were, by any possibility, the ancient residence of the heorine of these lines, perhaps an ancestress of the present proprietor, I ventured to call and inquire; and my antiquarian zeal was rewarded by the information that such was the case; and that, if I returned at a later hour during the evening, I could be allowed a sight of the closet, and a view of the skeleton of the original dog. Delighted with my success, I returned accordingly, and finding the door closed, ventured to knock; when a sudden shower of rain fell, lasting but about five seconds, but drenching me to the skin. Undeterred by this contretemps, I elevated my umbrella an knocked again, loudly, when a violent concussion upon the umbrella, accompanied by a thrill down the handle, which caused me to seat myself precipitately in a bucket by the side of the door, convinced me that electrical phenomena of an unusual character were prevalent, and decided me to return with all speed to our encampment. Here I was astounded by discovering inverted on the summit of my umbrella, a curious and deeply interesting vase, of singularly antique shape, and composed, apparently, of white porcelain. Whether this vase fell from the moon, a comet, or a passing meteor, I have not yet decided; drawings of it are being prepared, and the whole subject will receive my thorough investigation at an early day.*

"I subsequently attempted to pursue my investigations at the 'Valley House,' but the curt manner of the proprietor led me to suspect that the subject was distasteful, and I was reluctantly compelled to abandon it.

* The Doctor is in error; the lines quoted are from Chaucer.—J. P.

* This curious antique, to which I have given the name of the "Dunshunner Vase," has singularly the appearance of a wash basin! When the drawings are completed, it is to be presented to the California Academy of Natural Sciences.—J. P.

"Near the 'Valley House,' I observed an advertisement of 'The Mountain View,' by P. Buckley; but the building in which it is exhibited being closed, I had no opportunity to judge of the merits of the painting, or the skill of Mr. Buckley as an artist. A short distance further, I discovered a small house occupied by a gentleman, who appeared engaged in some description of traffic with the emigrants; and on watching his motions intently, my surprise was great to find that his employment consisted in selling them small pieces of pasteboard at fifty cents apiece! Curious to know the nature of these valuable bits of paper, I watched carefully the proprietor's motions through a window for some hours; but being at length observed by him, I was requested to leave—and I left. This curious subject is, therefore, I regret to say, enwrapped in mystery, and I reluctantly leave it for the elucidation of some future *savant*. The beautiful idea, originated by Col. Benton, that buffaloes and other wild animals are the pioneer engineers, and that subsequent explorations can discover no better roads than those selected by them, would appear to apply admirably to the Central Route. Many pigs, singly and in droves, met and passed me continually; and as the pig is unquestionably a more sagacious animal than the buffalo, their preference for this route is a most significant fact. I was, moreover, informed by the emigrants, that this route was 'the one followed by Col. Fremont when he lost his men.' This statement must be received *cum grano salis*, as, on my inquiry—'What men?' my informant replied 'A box of chessmen,' which answer, from its levity, threw an air of doubt over the whole piece of information, in my mind. There can be no question, however, that Lieut. Beale has frequently travelled this route, and that it was a favorite with him; indeed, I am informed that he took the first omnibus over it that ever left San Francisco for the Mission of Dolores.

"The climate in these latitudes is mild; snow appears to be unknown, and we saw but little ice; what there was being sold at twenty-five cents per pound.

"The geological formation of the country is not volcanic. I saw but one small specimen of trap during the march, which I observed at the 'Valley House,' with a mouse in it. From the vast accumulations of sand in these regions, I am led to adopt the opinions of the ethnologists of the 'California Academy of Natural Sciences,' and conclude that the original name of this territory was Sand Francisco, from which the final 'd' in the prefix has been lost by time, like the art of painting on glass.

"Considering the innumerable villages of pigs to be found located on the line of march, and the consequent effect produced on the atmosphere, I would respectfully suggest to the Chief Engineer the propriety of changing the name of the route by a slight alteration in the orthography, giving it the appropriate and euphonious title of the 'Scentral R. R. Route.'

"Respectfully submitted,

"ABRAHAM DUNSHUNNER, LL. D.,

"P. G. C. R. R. R. S."

From Southwick's Pass, the survey was continued with unabated ardor until the evening of the 10th instant, when we had arrived opposite Mrs. Freeman's "American Eagle," where we encamped. From this point a botanical party under Prof. Weegates was sent over the hills to the S. and W. for exploration. They returned on the 11th, bringing a box of sardines, a tin can of preserved whortelberries, and a bottle of whiskey, as specimens of the products of the country over which they had passed. They reported discovering on the old plank road, an inn or hostel kept by a native American Irishman, whose sign exhibited the Harp of Ireland encircling the shield of the United States, with the mottoes

"Erin Go Unum,
E Pluribus Bragh."

On the 14th the party arrived in good health and excellent spirits at the "Nightingale," Mission of Dolores.

History informs us, that

"The Nightingale club at the village was held,
At the sign of the Cabbage and Shears."

It is interesting to the Antiquarian to look over the excellent cabbage garden, still extant immediately opposite the Nightingale, and much more so to converse with Mr. Shears, the respected and urbane proprietor.

The survey and reconnoissance being finished on our arrival at the Mission, it may be expected that I should here give a full and impartial statement as to the merits or demerits of the route, in connection with the proposed Railroad.

Some three months must elapse, however, before this can be done, as the triangulation has yet to be perfectly computed, the subreports examined and compiled, the observations worked out, and the maps and drawings executed. Besides, I have received a letter from certain parties interested in the Southern and Northern routes, informing me that if I suspend my opinion on the "Great Central" for the present, it will be greatly to my interest,—and as my interest is certainly my principal consideration, I shall undoubtedly comply with their request, unless, indeed, greater inducement is offered to the contrary.

Meanwhile I can assure the public, that a great deal may certainly be said in favor of the Central Route. A full report accompanied by maps, charts, sub-reports, diagrams, calculations, tables and statistics, may shortly be expected.

Profiles of Prof. Heavysterne, Dr. Dunshunner and myself, executed in black court plaster by Mr. Jinkins, R. A., one of the Artists of the Expedition, in his unrivalled style of elegance, may be seen for a short time at Messrs. LeCount & Strong's—scale 1½ inch to 1 foot.

In conclusion I beg leave to return my thanks to the Professors, Assistants, and Artists of the Expedition, for the energy, fidelity and zeal, with which they have ever co-operated with me, and seconded my efforts; and to assure them that I shall be happy at any time to sit for my portrait for them, or to accept the handsome service of plate, which I am told they have prepared for me, but feel too much delicacy to speak to me about.

I remain, with the highest respect and esteem for myself and every body else,

JOHN PHOENIX, A. M.,
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ALTERATIONS IN THE STEAM AND GAS ENGINEERING LABORATORY.

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The Steam and Gas Engineering Laboratory of the University of Wisconsin has undergone many changes during the past two years, a review of which may be of interest to the readers of the Wisconsin Engineer.

About three years ago it was decided to combine the Departments of Experimental and Steam & Gas Engineering so that the co-relation of laboratory work and class work could be made more effective. This co-relation involved a decided change in the methods of conducting the laboratory and also alterations in the equipment. At the same time changes were also made to provide for the natural growth of the laboratory.

At the time this change was made, there had accumulated in the laboratory a considerable amount of experimental apparatus and old worn out engines and machines, which had not been used for years and which could not be put to any useful purpose. Furthermore, this machinery occupied valuable space and represented capital that might be employed in obtaining new and modern machines. The first important work consisted in sorting out what apparatus could not be used in the laboratory and disposing of it to the best advantage. A considerable number of small engine parts were turned over to the Department of Drawing to serve as models for the freshman classes.

The large room formerly occupied by the professor in charge of the laboratory has been divided into two very satisfactory offices, one being occupied by the present professor, the other by the instructors. The room which was formerly the instructors' office is now used for storing instruments and filing reports.

The work on Fuel and Gas Analysis has been transferred to the Fuel Laboratory in the Chemical Engineering Building, although the instructors in Steam and Gas Engineering still conduct the classes under the direction of the Department of Chemical Engineering. This combination of equipment provided laboratory facilities for this class of work which are equaled by few, if any, other colleges. The balcony rooms in the Steam and Gas Laboratory, formerly used for fuel work, were thus made available for special thesis and research investigations. Specially designed apparatus has been installed in one of these rooms for calibrating indicator springs and thermometers.

The Steam and Gas Engineering Laboratory in 1901.

The belt testing machinery was removed from the balcony and, after redesigning, was installed in the old East Store Room, which was converted into a Mechanics Laboratory. This room also contains the Thurston oil tester, a Morin dynamometer, a gear changing device, a hoist testing frame, etc.

A gasoline engine loaned by the Baker Mfg. Co. was returned at the request of the owners. The Nordberg steam engine and condenser were completely overhauled and readjusted. In fact, every engine in the laboratory has been overhauled and put in first class operating condition, so that it is ready for class work at a moment's notice.

A great deal of time was formerly wasted in hunting required pipe fittings for use in regular and thesis work. The Store Room now carries an ample stock of pipe, pipe fittings, and valves.

The result of this "house cleaning" has been to increase the efficiency of the laboratory and equipment and to give added facilities for special work and at the same time to relieve unnecessary congestion on the main floor.

THE NEW STEAM LINE.

Steam for power and other experimental purposes is obtained from the Central Heating Station. The steam main is carried through a tunnel to the north side of the laboratory. The pipes distributing steam about the laboratory were formerly run in trenches under the floor. The objections to having steam lines in such a position were briefly as follows: the steam condensed in the underground pipes and, as these were frequently not well drained and often dead-end, the water was usually carried into the engines with the steam, thus providing very wet steam and frequently doing damage to the engines; accidents were frequent due to violent water-hammer in such construction; the laboratory was kept uncomfortably hot by heat radiated from the pipes since pipe covering would not last in these tunnels owing to the sweating of adjacent water pipes; leaks were not readily discovered and when found were hard to repair.

Thus a great deal of trouble had been experience with these underground steam lines. They were also very old, inconvenient to get at, had no well defined system and were actually beginning to fail in some places. It was decided to put in a new overhead steam line and after considering many plans, a design of a 4-inch pipe line was chosen in the form of a loop completely encircling the laboratory and placed just under the edge of the balcony.

This steam line was put up in accordance with the best engineering practice. All pipe, fittings, and valves are extra heavy and will stand a working pressure of 200 pounds per square inch in case it is possible or desirable to use this pressure. Flanged pipe with forged steel flanges was supplied. Flanged fittings and flanged non-rising gate valves were installed, the latter being of the type which can be packed under pressure. Long radius pipe bends, which allow amply for expansion, were placed at the four corners of the loop. The connections to the engines are taken from tees on the top of the steam line and are provided with pipe bends wherever necessary to take up strain due to expansion. All branch lines to engines have valves close to the main steam line, thus eliminating the condensation of steam in lines supplying engines and also facilitating repairs. The steam loop itself is divided into three sections by a system of valves. The steam may be cut off from any of these sections; or superheated steam may be used on any section and saturated steam on the remainder of the line. This elaborate valve system is very convenient and has proven to be well worth the extra cost.

This steam loop has been neatly covered with Johns-Manville asbestos-fitted pipe covering painted white, and, besides being an object of good steam engineering to show to the students, adds materially to the appearance of the laboratory and to the physical comfort of the workers therein.

GAS PRODUCER AND GAS ENGINE ADDITION.

The gas producers had occupied an unsightly wooden shed adjoining the north side of the laboratory, in which no provision was made for heat or light. This shed, besides being in appearance out of harmony with the University buildings, was entirely inadequate for good laboratory work. Furthermore, the gas engines were situated in all parts of the laboratory, making a network of supply and exhaust pipes not at all desirable or convenient. A small, separately fired superheater occupied another room also adjoining the north side of the laboratory, but, being inaccessible for repairs, was usually out of commission.

To remedy all these defects, it was planned to build an addition to the north side of the laboratory, containing two rooms, one for gas engines and a separate room for the gas producers and superheater; thus keeping the coal dust away from the engines. This addition was built during the fall of 1910 and the producers, superheater and large gas engines have been installed and put in operation. Both rooms are well lighted and heated and are provided with skylights for adequate ventilation so that class work can be carried on under the best conditions.

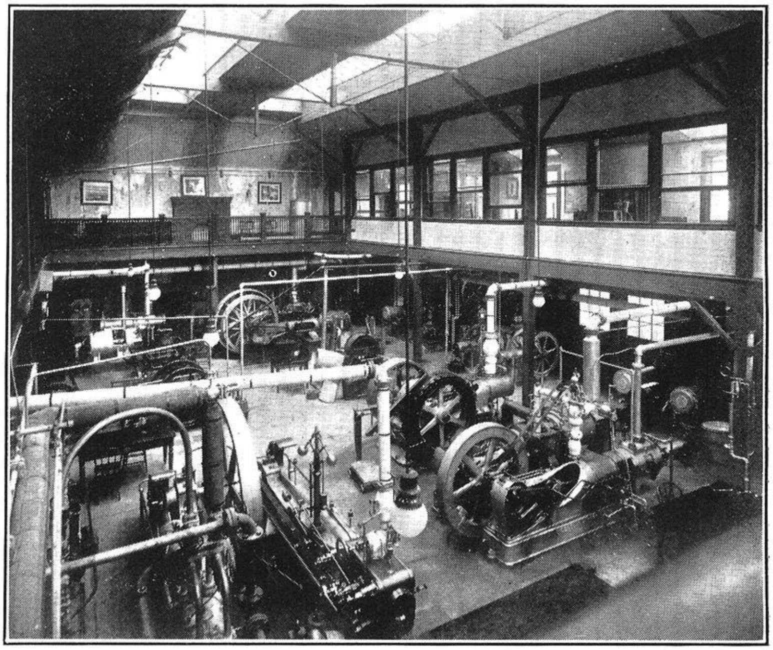
The lack of adequate piping for gas, water, and compressed air had been a constant source of trouble and confusion. New systems of gas, water, and compressed air mains now extend over the whole laboratory and have been designed to allow for the expansion of the laboratory for some time to come. A large gas engine exhaust main was also run from the north side of the laboratory to a chimney in the new addition, which will take care of the exhaust from all the gas engines now installed and may also be used with gas engines temporarily occupying testing blocks on the main floor.

NEW EQUIPMENT.

After careful examination it was found that the cylinders of the Marinette three-cylinder vertical gas engine were not properly water jacketed and thus caused violent pre-ignitions during operation. The cost of changing these cylinders was prohibitive while the excessive operating cost made the engine too expensive for experimental laboratory work. Hence it was decided to dispose of this engine. About a year ago the Foos Gas Engine Co. made the College of Engineering a proposition to exchange a special experimental engine for this old engine, and their proposal was accepted.

This Foos experimental gas engine was installed in the new addition in the fall of 1910 and promises to be one of the most valuable equipments in the laboratory. It is provided with interchangeable cylinder heads, governors, valves, igniters and other parts, by means of which it may be operated with producer gas, city or water gas, gasoline, kerosene, or alcohol. A water heater has been installed to absorb the heat of the exhaust gases and other appliances added, which makes it possible to obtain some very valuable and interesting results from this engine.

The old superheater was of a type no longer manufactured and the repairs necessary would cost considerable. The old superheater was therefore scrapped and a new type of Foster superheater installed, which will superheat 1500 lbs. of steam an hour to 550° F. The superheater is the right size for the needs of the laboratory, and easily fulfills its guarantee with natural draft. A chimney has been provided in the walls of the new west wing of the Engineering Building so that all the



The Steam and Gas Engineering Laboratory in 1911.

flue gases and waste gases from producers are now discharged above the roof of the main building.

The ventilating fans in the basement of the Engineering Building have been fitted up for testing and have proved to be a very interesting addition to the available equipment of the laboratory.

The old vertical steam engine with double eccentrics, formerly located near the Vilter refrigerating machine, did not give satisfaction. Another vertical slide valve engine, which more nearly fulfills class requirements, has been installed in its place.

An apparatus for testing commercial pipe covering was built and experimented with last year, and further tests will be conducted on it as soon as opportunity presents itself. The apparatus is built upon the principle of finding the radiation by measuring of the electrical energy necessary to keep the inside of the pipe at a constant temperature.

A bearing tester has been installed which is simply a machine so constructed that a number of bearings of any type may be placed upon the shaft, the desired loads applied by means of levers, and the horse power consumed in driving the shaft measured by an electric motor. Good results should be obtained from the tests to be run upon this machine, which will be of value as reliable information in regard to bearings is hard to find.

The discarding of old apparatus and the removal of gas engines to the new addition has left a number of engine foundations available for special test purposes and all were completely occupied during the past year.

Space forbids enumerating the smaller apparatus added, such as new Prony brakes, new platform scales, new tubs for weighing water and many other articles which have materially increased the efficiency of the laboratory.

FUTURE IMPROVEMENTS.

The policy of the Department has been to co-relate class room and laboratory work to make the students familiar with the principles of thermodynamics as shown in different types of machines, maintaining a number of small engines rather than a few large ones, and, in thesis and other research work, to obtain definite and useful results both to the students and to the engineering profession.

The alterations described in this article are part of a plan of improvement of the laboratory which will take some years to complete. The aim is to obtain the greatest possible efficiency, and to make the Steam and Gas Engineering Laboratory of the University of Wisconsin equal to any in the country.

THE COMMERCIAL UTILITY OF ELECTROLYTIC IRON.

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Although engineers are supposedly familiar with iron, since it is our most prominent construction material, our knowledge of its properties and uses are of a comparatively impure or alloyed substance, and very little information has been available regarding the properties of iron of high purity. In fact, until rather recently pure iron was considered a rarity and, although the world's production has been from forty to fifty million tons per year, a decade ago the available iron of a purity of 99.9 percent was most fittingly estimated in grams.

To obtain this high purity product a natural method of attack was to refine an impure stock electrolytically. This process was employed to a considerable extent in the facing of electrotypes with iron, not because of a resulting high purity, but rather because it afforded a means of giving a thin, accurate, and hard face to an easily formed, softer material. The advantage lay largely in the hardness of the deposit which seems to be due to the occlusion of hydrogen liberated on the cathode together with the iron itself.

Attempts were made to use higher current densities and to obtain thicker deposits, and thus extend the scope of the process to the probable field of commercial production of iron of high purity; but these attempts were generally unsuccessful, the use of high current densities resulting in rough deposits long before they had become of practicable thickness; or if smooth, thick deposits were obtained with high current densities, it was only for short periods of time and at the expense of a costly electrolyte.

To make the electrolytic refining of iron a commercial possibility, high current densities must give smooth, thick deposits in a cheap electrolyte which will allow of long continued operation of the tanks without undue depletion. The entire operation may best be compared with the electrolytic refining of copper as a standard.

In the spring of 1904, Professor C. F. Burgess and Mr. Carl Hambuechen presented a paper before the American Electrochemical Society, giving the results of an extended investigation on the electrolytic refining of iron. Their research had solved the problem to the point of possible commercial development, and good deposits of three-fourths of an inch in thickness were obtained at a cost which could be brought to one cent per pound or less, thus placing it on a comparable basis with that of refining copper. This work has been carried on in the Electrochemical laboratories of the University of Wisconsin with little interruption to the present time, and several thousand pounds of product of a purity of 99.95 percent and better have been produced.

As at present conducted, a solution of ferrous ammonium sulphate is used as the electrolyte and bars of Swedish iron about 1"x3"x10" (or most recently, of American Ingot Iron ½"x3½"x10") form the anodes; three bars suspended vertically form each anode, the surface of each, therefore, being approximately 90 to 100 square inches per side. Double anodes are employed, and the deposit is formed upon both sides of a single cathode sheet (10"x12") suspended between the anodes. The cathode starting sheets are of iron, lead, or aluminum. In the research work, since special purity of product was desired, a double refining was resorted to, and the iron was first deposited on a lead sheet in the first set of refining tanks, and this in turn used as the anode for the second refining, with an aluminum sheet as cathode. In this case, less care need be exercised in obtaining smooth deposits in the initial refining, and heavy cathode sheets about an inch or more in thickness are the result; while the cathodes in the second refining are removed when the iron deposit reaches a thickness of ¼ to ⅜ inch per side, or a total of ½ to ¾ inches. The deposited iron may be readily removed by stripping, and, on account of its brittleness due to the occluded hydrogen, may be easily broken into small pieces if desired. The current density is about 8 to 10 amperes per square foot of cathode surface, at an electromotive force of about one volt per tank; the current efficiency of deposition is close to unity. The tanks give continuous service, with periodical attention in changing anodes and cathodes, cleaning out slimes, and an occasional replenishing of the electrolyte.

The possibility of obtaining considerable quantities of iron of high purity, free from the customary elements accompanying iron made by the usual smelting operations, opened up a field for investigation of great magnitude, and this was naturally given first consideration in the plans for the utilization of the material available. To gain an adequate idea of the possible scope of such a research, the approximate composition of the various commercial irons and steels are given in the following table, together with a typical analysis of the electrolytic product.

	Swedish Iron	O. H. Soft Steel	Rail Steel	Cast Iron	Dbl. Refined Electrolytic Iron
Carbon	0.10	0.15	0.60	3.75	0.00
Silica	0.10	0.15	0.20	2.00	0.002
Sulphur	0.01	0.05	0.05	0.10	0.003
Phosphorus	0.02	0.06	0.10	0.50	0.003
Manganese	0.10	0.75	0.80	0.50	0.02

In the above table are listed the impurities usually found in commercial steels, in such quantities as are desired for the particular service required of the steel, or as a necessary accompaniment of the process of manufacture. Carbon belongs in the first class and may thus be considered as a useful element; of the remainder, sulphur and phosphorous are decidedly injurious and their elimination is sought as far as may be practicable; while silicon and manganese are necessary additions because of their indirect influence on certain harmful constituents. The generally listed analyses make no mention of the gases occluded in the steels, particularly nitrogen and oxygen. Yet the vital influences of these elements have recently been recognized and they may be considered as the cause of the marked differences, hitherto unexplained, in Bessemer and open hearth steels of seemingly identical composition.

Of the enormous number of tests of the physical quality of steels, practically all have been made up of materials whose properties may have been influenced by the above mentioned impurities; the extent of this influence is problematical and has customarily been neglected or has been excused as a necessary evil. In the newer field of alloy steels, it is especially true that the effect of the addition element, such as nickel, manganese, silicon, chromium, tungsten, molybdenum, vanadium, etc., is very markedly influenced by slight amounts of impurities, carbon in particular. It may truthfully be said, therefore, that an investigation starting with essentially pure iron as a basis, might branch out into any channel, no matter how thoroughly it has apparently been covered before, without in reality repeating the previous work.

A most promising field was the study of the alloy steels, and research of this nature has been conducted practically without interruption for several years past in the chemical engineering laboratories of this University. For a considerable portion of the time, by reason of a grant from the Carnegie Institution of Washington, sufficient money was available to enable one investigator to devote all of his time to the work, with occasional outside assistance. As may be readily seen, with the vast field opened up, one person could do but little more than scratch the surface, especially in view of the numerous difficulties arising, when the work was first begun, to keep the alloy during melting free from contamination from the furnace gases and from the impurities of the crucible. The electric furnace and magnesia crucible were found to be the best solution of the problem.

It is not the purpose of this article to enumerate the various alloys made up or the nature of the tests; its object is rather to discuss the probable usefulness of the development of the electrolytic refining of iron from the general results of the investigation. It is sufficient to say that most of the earlier work consisted in the preparation of alloys and in testing them for various properties. The scope of the work may be summed up as follows:—(1) the influences of the alloying elements in varying proportions, in the absence of carbon and particularly the sulphur, phosphorus, and manganese accompanying ordinary materials—(2) the testing of alloys which may not have been feasible previously, because of the detrimental effect of the general impurities, particularly carbon, on the nature of the alloy formed—(3) the correlation of the several properties observed, with the hope that it might aid in interpreting the inner make-up of the materials.

Work of this character must necessarily be of a more scientific nature, with results of particular commercial importance only in special instances. As might be expected, the results obtained were of two classes—(1) in general, they indicated that the elimination of the slight impurity gave properties so little different from those obtained in the ordinary materials, as to make the increased refinement of product of little commercial importance; again, it was indicated that carbon, particularly, is of great value in securing certain desired properties—(2) while in a few special instances, the greater purity of the electrolytic iron alloys was manifested in the properties observed.

In general, therefore, electrolytic iron can hardly be expected to take a conspicuous place in steel for ordinary purposes, since the properties would have to be very greatly superior to those of the less pure metals of otherwise identical composition to warrant its use, as the cost of the refining operation is necessarily high. As far as structual materials are concerned, the carbon is a beneficial agent, permitting one to vary the strength, ductility and elasticity of the alloy according to the nature of the service required; the great advantage of the electrolytic iron comes in enabling a closer regulation of the properties to be made because of the absence of the other detrimental impurities, particularly sulphur, phosphorous and oxides.

Conspicuous results may be cited in the copper steels where in the absence of carbon, copper is seen to be a beneficial agent, and not the extremely deleterious one indicated by tests upon steels of the usual holding of carbon. Again, in those materials used for their magnetic properties, small amounts of impurities, especially carbon, are injurious, and alloys made with electrolytic iron as a base material showed a higher permeability than those of corresponding additions to commercial iron.

There are many special fields of usefulness, however, where the primary cost of the material is a secondary consideration if the resultant properties are of sufficient merit. Most conspicuous are the automobile and aeroplane industries where high strength per unit of weight is of primary importance; and in the manufacture of fine tool steels where the value of the tool is gauged by its life or the amount of metal it will efficiently remove. In this class of service it has been generally recognized, without definite understanding of the reason, that physical differences due to the method of manufacture were of material bearing on the quality of the steel, and that, while crucible, open hearth, and Bessemer steels might be of apparently identical composition, the last two are entirely unsuited for the highest grade of special steels. We must have recourse to the crucible steels although there are necessarily high melting and handling costs. And for the best steels, also, it is necessary to make special selection of the raw material for the manufacture of this crucible steel, even small amounts of impurity, be it occluded gas or slag, or sulphur, or phosphorus, causing variations in the final product.

It is our recognition of the effect of these inclusions, heretofore thought insignificant, which has aroused the steel maker to the value of the electric furnace as an auxiliary in the final refining of steel, since by its use we are enabled to control temperature, slag, and atmosphere to secure the maximum elimination of the causes of variation.

It has been aptly said that anyone can make good tool steel—sometimes; but only a very few can make a good tool steel all of the time. And it may safely be said that it is better to turn out a medium grade of product, always the same, than to make a high quality material which often falls far short of the standard. Uniformity is a desideratum. There are three classes of variables entering in the manufacture of steel tools:—the initial composition of the stock, the skill in the melting of it, and the subsequent manipulation of the material. The composition plays a big part, which is well shown in the fact that tool steel makers still hold to the more expensive Swedish iron that they have always used, wholly because it has that body (whatever body may be) which they desire and do not get in the open hearth material of seemingly as good quality. Probably it is due to the sulphur and phosphorous and to a great extent in the dissolved oxides and gases. This is no doubt the reason that they adhere to the crucible furnace since it gives the proper atmosphere; and this is confirmed by the adoption of the electric furnace, where one can control the atmosphere, and also get a higher temperature, which in turn means better diffusion of the elements.

The third variable is largely dependent on the other two; that is, a lack of uniformity in the first two conditions makes necessary a greater skill in the subsequent manipulation of the tool. By the use of the electric furnace for melting of the stock; with the electrical methods for heating of the muffle furnace or barium chloride bath, and the pyrometer as a temperature control in the treatment of the tool; and the use of iron of the maximum purity and uniformity as a basis to start operations; can we not go a long way towards eliminating the personal equation, that bugaboo in tool steel manufacture, the skill of the man who handles it.

Tests made in these laboratories tend to confirm the above contentions; the results, however, are not complete enough to warrant any sweeping statements. The influence of initial purity of stock seems to be manifested in greater life and superior cutting qualities of those steels made up of a base material of electrolytic iron; also, we notice in this stock an extremely fine tempering grain and under the microscope there is little evidence of such impurities as the oxides to be seen in Swedish stock.

Recently, iron of high purity is being produced by methods other than the electrolytic one; as a result of refining ordinary steels in the electric furnace, or from the development of a higher degree of purification in the basic open hearth. Whether these can replace the Swedish stock remains to be proved.

Pure iron is a factor in the commercial world only indirectly because of the elimination of the customary impurities, as sulphur and phosphorus; manganese, and carbon in particular, can hardly be classed as such. The great measure of its utility will rest in the elimination of the variables incident to the use of customary stock as a basis for a high grade, uniform product.

SOME EXPERIMENTAL DATA ON THE USE OF FANS AS DYNAMOMETERS.

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Various types of absorption dynamometers, such as the prony brake, eddy current brake, rated generator, etc., have been used to determine the power output of electric motors, gas and gasoline engines, and under certain conditions of operation these give very satisfactory results. However, these dynamometers are all, more or less, complicated or difficult to adjust and for certain kinds of tests are entirely unsuitable. For example it is sometimes desirable to know the maximum power which the machine is able to develop, regardless of the speed. For such a test the ideal dynamometer is one where the load depends upon the speed only, all other conditions remaining constant. The object of the tests in which the following data were obtained was to determine whether fans would be suitable for use as absorption dynamometers and whether their operation follows any simple law.

The fans used were very simple in construction. A sketch is shown in Fig. 1. Two sheet steel plates, 3/32 of an inch in thickness, were bolted to the extremeties of opposite sides of a 2x4 of hard pine and the 2x4 was bolted to the pulley of a motor, as shown in the sketch. The plates were driven in the direction indicated by the arrow by power applied to the motor, and power was absorbed due to the reaction between the air and the plates. With the direction of rotation as shown the inner edge of the plate moved in advance of the outer edge, thus setting up a current of air from the inner edge, outward along the surface of the plate.

Four sets of plates, 9″x14″, 9″x12″, 9″x10″ and 9″x8″ were used and three different arms of radii 14.5″, 17.5″, 20.5″. In all cases the plates were attached with the 9″ dimensions as shown, so that for a given radius, the center of pressure on the plate was a constant distance from the center of rotation, regardless of the area of the plate.

In performing the tests the following method was used in all cases. The fan to be tested was bolted to the pulley of a motor and driven at various speeds covering a range from slightly above the normal speed of the motor down to a speed of about

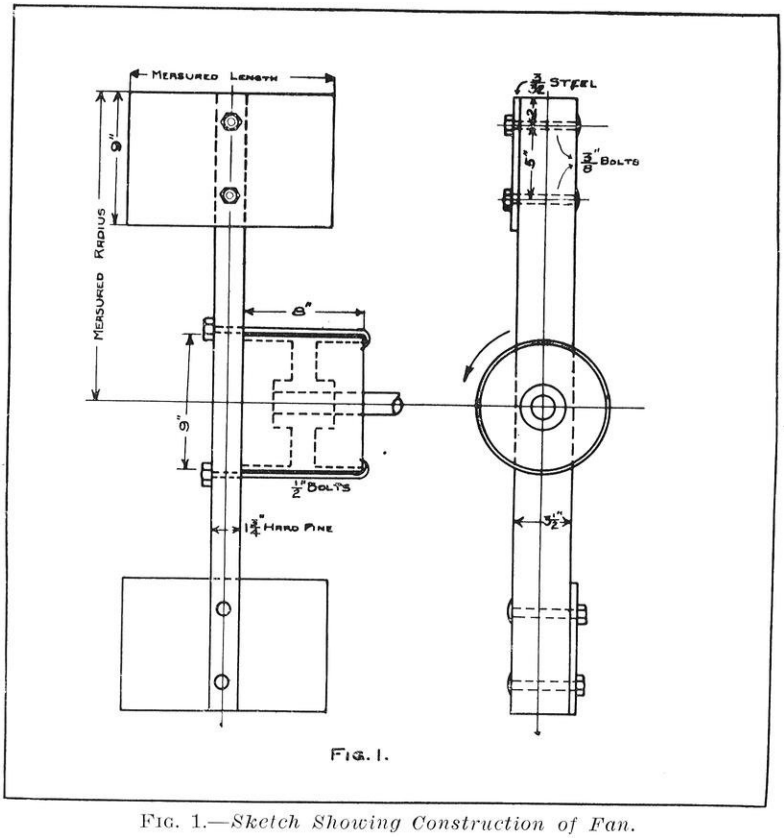

FIG. 1.—*Sketch Showing Construction of Fan.*

300 R. P. M. The machine used was a Northern Electric Co. shunt wound motor rated at 20 HP, 110 volts, 1200 R. P. M. The field of the motor was separately excited and the field current held constant, while the speed of the motor was varied by varying the armature voltage. Speeds were measured with a small speed-counter and stop watch and each reading was checked at least twice to make the determination absolutely accurate. The fan was then taken off the pulley and a series

of no load readings taken, to determine the power used in driving the motor. The resistance of the armature and brushes and leads was then measured, by the drop of potential method. From these no load readings calculations were made of stray power and $I_a^2 R$, and curves plotted. The power absorbed by the fans was determined by subtracting from the power input into the armature (volts x amperes) the stray power corresponding to that speed and the $I_a^2 R$ corresponding to the armature current used. Representing the relations by means of an equation

$$\text{Output} = \text{Input} - (\text{Stray Power} + I_a^2 R)$$

Data were taken for all four sets of plates with the 20.5″ and 17.5″ arm and for the 9″x10″ and 9″x8″ plates with an arm having a radius of 14.5″.

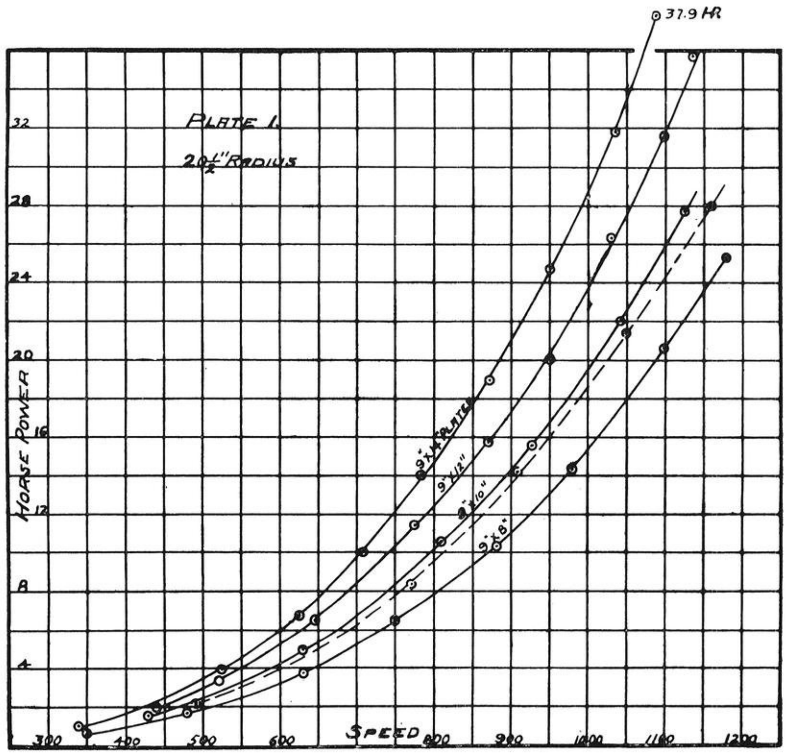

Plate 1.

DATA SHEET NO. 1.

E_a	I_a	I_f	R. P. M.	Stray Power	$I_a{}^2R$	Total Losses	Watts Input	Watts Out-put	HP Out-put	Remarks
106	306.0	2	1091	1225	3000	4225	32450	28235	37.9	
100	273	2	1035	1135	2380	3515	27300	23785	31.8	
91.5	231	2	950	1000	1730	2730	21130	18400	24.65	9"×14"
84.9	192	2	872	882	1250	2132	16300	14168	18.95	Plates
76.9	157	2	785	750	875	1625	12080	10455	14.0	20½ "Radius
69.0	126.5	2	707	640	608	1248	8740	7492	10.02	
61.2	97	2	625	533	390	923	5940	5017	6.72	
51.7	70	2	523	418	240	658	3620	2962	3.97	
32.75	34	2	340	240	82	322	1112	790	1.06	
111	273	2	1135	1300	2380	3680	30300	26620	35.75	
105.5	254	2	1098	1235	2060	3295	26800	23505	31.55	
100	223.5	2	1030	1130	1620	2750	22350	19600	26.30	
92	192	2	949	1000	1250	2250	17660	15410	20.68	9"×12"
84	161 5	2	870	880	910	1790	13560	11770	15.77	Plate
75.5	131.	2	776	735	645	1380	9895	8515	11.40	20½ "Radius
63.	91.	2	643	560	335	895	5730	4835	6.47	
50.5	61	2	520	415	197	612	3080	2468	3.31	
42.6	46	2	440	330	130	460	1960	1500	2.01	

E_a	I_a	I_f	R. P. M.	Stray Power	$I_a{}^2R$	Total Loss	Watts Input	Watts Out-put	HP Out-put	Remarks
112.5	207	2	1125	1280	1410	2690	23300	20610	27.7	
103.8	180	2	1042	1152	1110	2262	18680	16418	22.0	9"×10"
92.	145	2	928	965	765	1730	13330	11600	15.55	Plates
80.5	113.5	2	810	790	505	1295	9150	7855	10.52	without
62.	71.5	2	630	540	243	783	4430	3647	4.88	screen.
42.5	37.5	2	430	320	93	413	1592	1180	1.58	20½ "Radius
23.	16	2	240	155	32	187	368	181	.24	
114	214.5	2	1160	1340	1500	2840	24450	21610	29.0	
103.3	176	2	1048	1160	1060	2220	18200	15980	21.40	9"×10"
90.4	135.2	2	917	950	680	1630	12220	10590	14.2	Plates
75.2	98	2	770	730	400	1130	7370	6240	8.36	with screen.
47.5	45	2	490	380	125	505	2140	1635	2.19	20½ "Radius
27.8	32	2	285	195	75	270	890	620	.83	
116	184.5	2	1180	1375	1170	2545	21400	18855	25.25	
107.8	165.0	2	1098	1235	905	1940	17320	15380	20.6	
95.5	130.0	2	980	1050	645	1695	12410	10715	14.38	9"×8"
85.5	105.3	2	881	900	451	1351	9020	7669	10.28	Plates
73.3	79.0	2	748	695	285	980	5790	4810	6.45	20½" Radius
61.3	57.0	2	632	542	180	722	3495	2773	3.72	
46.5	37.0	2	480	370	93	463	1720	1257	1.68	
34.0	24.0	2	351	250	50	300	816	516	.69	

Data Sheet No. 2.

E_a	I_a	I_f	R. P. M.	Watts Input	Stray Power	I_a^2R	Total Losses	Watts Out-put	HP	Remarks
112.5	188.0	2	1145	21160	1315	1190	2505	18655	25.0	
105.5	164 5	2	1062	17360	1183	950	2133	15227	20.4	
94.3	137.0	2	966	12920	1015	690	1705	11215	15.03	9″×14″
84.0	112.5	2	867	9450	870	500	1370	8080	10.82	Plates
69.0	77	2	705	5315	640	270	910	4405	5.9	17½ ″Radius
48.8	41	2	500	2000	392	115	507	1493	2.0	
32.0	23	2	330	736	231	50	281	455	.61	
115.0	184.5	2	1185	21200	1385	1150	2535	18665	25.0	
105.3	156.0	2	1081	16450	1210	865	2075	14375	19.25	
95.5	130.0	2	980	12450	1045	635	1780	10630	14.25	9″×12″
86.5	104.5	2	890	9035	910	440	1350	7685	10.3	Plates
75.0	80	2	770	6000	730	288	1018	4982	6.67	17½ ″Radius
63.0	59	2	649	3720	562	185	747	2973	3.98	
49.2	40	2	510	1968	403	103	506	1462	1.96	
32.9	23	2	345	757	245	50	295	462	.62	
112.5	142.5	2	1165	16020	1350	745	2095	13925	18.69	
104.2	122.0	2	1072	12710	1195	572	1767	10943	14.68	
94.7	101.5	2	971	9600	1031	420	1451	8149	10.91	9″×10″
76.2	67	2	773	5105	737	223	960	4145	5.55	Plates.
66.0	51	2	670	3366	590	150	740	2426	3.26	17½ ″Radius
47.5	30	2	478	1425	370	68	438	987	1.32	
37.5	22	2	381	825	280	47	327	498	.67	
115.5	117.	2	1190	13520	1390	530	1920	11600	15.55	
107.8	101.5	2	1110	10920	1260	420	1680	9240	12.38	
98.5	87.	2	1010	8570	1095	328	1423	7147	9.57	
87.0	69.	2	898	6030	920	232	1152	4878	6.54	9″×8″
78.0	56.	2	798	4370	770	172	942	3428	4.59	Plates
67.7	44.	2	695	2975	627	120	747	2228	2.98	17½ ″Radius
59.6	36.	2	606	2147	510	88	598	1549	2.08	
46.0	24.	2	473	1103	362	52	414	689	.924	
31.5	16.	2	334	504	234	32	266	228	.319	

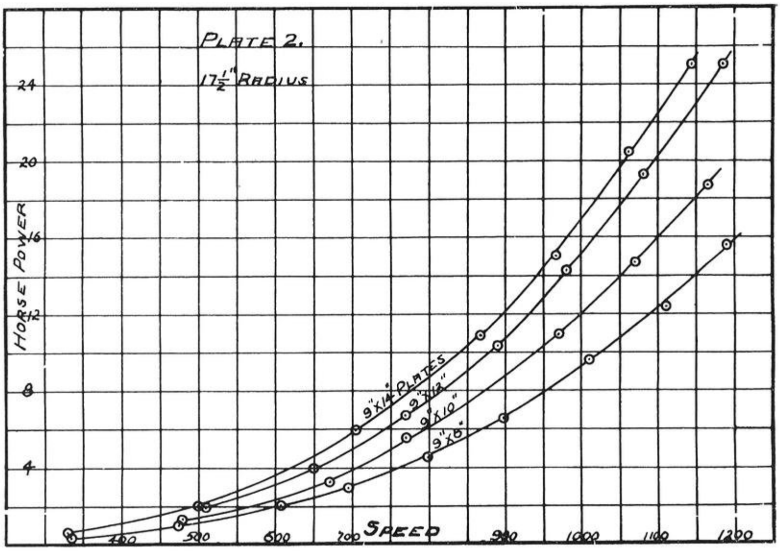

Plate 2.

DATA SHEET No. 3.

E_a	I_a	I_f	R. P. M.	Watts Input	Stray Power	$I_a{}^2R$	Total Losses	Watts Output	H. P. Output	Remarks
118.8	89.5	2	1210	10620	1420	343	1763	8857	11.88	
108.7	76.3	2	1107	8300	1250	267	1517	6783	9.1	
98.5	65.	2	1005	6400	1090	213	1303	5097	6.82	9″×10″
88.5	54.5	2	900	4825	925	165	1090	3735	5.0	Plates
73.5	41.3	2	753	3040	705	108	813	2227	2.98	14½″ Radius
60.	30.	2	613	1800	520	68	588	1212	1.63	
44.5	20.	2	456	890	350	42	392	500	.67	
121.	73.	2	1231	8830	1460	250	1710	7120	9.55	
108.7	61.	2	1114	6640	1265	195	1460	5180	6.95	
99.5	54.	2	1020	5370	1115	162	1277	4093	5.48	9″×8″
85.	42.	2	882	3570	900	110	1010	2560	3.43	Plates
66.8	28.5	2	690	1903	620	63	683	1220	1.64	14½″ Radius
50.	18.8	2	510	940	405	40	445	500	.67	
30.5	11.7	2	310	357	285	23	228	130	.175	

STRAY POWER.
DATA SHEET NO. 4.

E_a	I_a	I_f	R. P. M.	Watts Input	${}^2I_aR$	Stray Power
121.5	12.9	2	1282	1567	25	1542
103.	12.05	2	1085	1241	23	1218
86.3	11.25	2	905	971	22	949
69.	9.7	2	720	669	19	650
48.	8.4	2	500	403	15	388
37.5	7.85	2	385	294	14	280
22.4	7.1	2	224	159	13	146

ARMATURE RESISTANCE AND $I_a{}^2R$.

E	I	R_a	$I_a{}^2R$
1.22	10	.1220	12.2
1.98	25	.0790	55.0
2.80	50	.0560	145.0
3.48	75	.0464	260.0
4.12	100	.0412	412.0
4.75	125	.0380	595.0
5.41	150	.0361	810.0
6.14	177	.0347	1075.0
6.71	201	.0334	1340.0
7.30	223	.0327	1620.0
8 25	255	.0324	2080.0
8.70	270	.0322	2330.0

From these data the curves shown on the curve sheets were plotted. These curves in all cases are plotted between horsepower absorbed by the fan as ordinates and speed as absussae for a certain constant area of plate and a constant radius.

These curves show many interesting relations. In most cases the points form a very smooth curve. In fact, in a few instances, small errors in calculation were first detected because the points did not fall upon the curve. This curve follows very closely the form of one represented by the equation $y=kx^3$ where y represents the horsepower absorbed and x represents the speed. Another way of expressing this relation is by the equation $P_1\left(\frac{N_2}{N_1}\right)^3 = P_2$ where P_1 and P_2 are horsepowers corresponding to speeds N_1 and N_2 respectively. To apply this equation in the curve for the 9″x14″ plates, 20.5″ radius, let $N_1=750$ and $N_2=1000$. $P_1=12.1$, $P_2=28.7$. Substitut- in the equation $P_2=12.1\left(\frac{1000}{750}\right)^3=28.5$ which agrees very closely with the value obtained from the curve.

For the 9″x12″ plates 20.5″ radius, $N_1=500$, $N_2=1000$, $P_1=3$ and $P_2=23.6$. Substituting $P_2=3\left(\frac{1000}{500}\right)^3=24$ which checks very closely with the observed value 23.6.

For the 9″x10″ plates $N_1=500$, $N_2=100$, $P_1=2.4$, $P_2=19.4$ then $P_2=2.4\left(\frac{1000}{500}\right)^3=19.2$, a very close check with 19.4, the observed value.

For the 9″x8″ plate $N_1=500$, $N_2=1000$, $P_1=1.9$, $P_2=15.35$ then $P_2=1.9\left(\frac{1000}{500}\right)^3=15.2$, which check 15.35 closely.

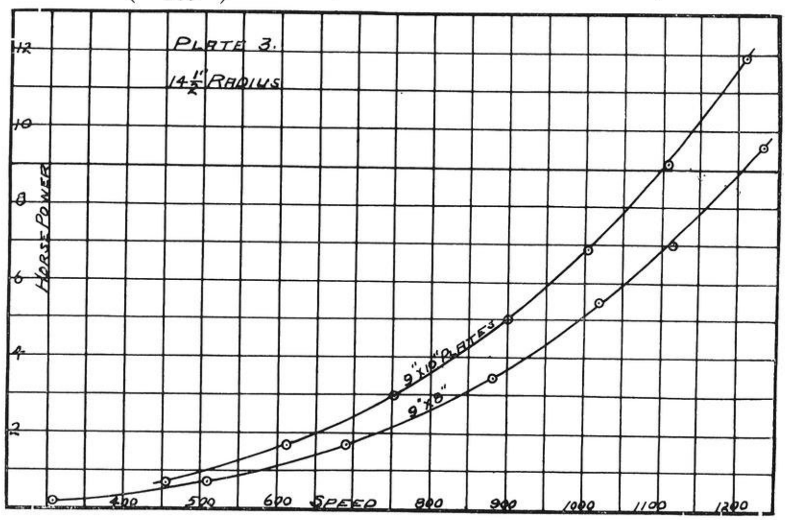

Plate 3.

This relation is approximately true also for the curves plotted from the data for the 17.5″ arm but does not hold for the results obtained from the use of the 14.5″ arm. The data for the 9″x14″ plates, 17.5″ radius does not seem consistent with the curves for the other plates. We are unable to explain the reason for this. The data for the different curves were taken on the same afternoon and there was no apparent change in conditions. The reason that the results of the test with the 14.5″

arm do not follow the same laws as those at the other radii, is probably because of the small distance between the plate and the pulley face. With this arm the distance is only 1″. This condition would decrease the quantity of air which could be drawn in at the center and forced outward along the plates and since the power absorbed depends upon the volume of air moved this would be a reason for the curves taking the shape they do, showing a relation corresponding to some power of the speed less than the cube.

To determine whether the power absorbed depended in any way upon the distance of the fan from the floor or from the surrounding walls a series of readings were taken with the fan surrounded by a screen. This screen was a 53″ square frame made of 1″x10″ lumber set directly in the plane of rotation of the fan, with the face of the screen parallel to the 10″ side of the plate. The intersection of the diagonals of the screen was coincident with the center of the shaft of the motor.

The fan used in this test was the 9″x10″ plates on the 20.5″ radius. The results are shown by the dashed curve on Plate No. 1 and may be compared directly to the curve showing the power absorbed without the screen. This comparison shows a decrease of power absorbed of about 4%. This indicates that unless the fan is placed very close to the floor or very near to some stationery object the power absorbed is independent of these distances.

No attempt will be made in this paper to discuss the relation between power absorbed and the area of plate for constant speed and constant radii, or between power absorbed and length of radii, for constant speed and constant area of plate. These considerations and others such as effect of atmospheric conditions, barometer, temperature, humidity, etc., must be left for some future discussion.

Some mention should be made of the conditions which limit the use of this fan for absorption of power. In using the arm of 20.5″ radius at a speed of 1200 R. P. M. a circumferential velocity of 12,900 feet or 2.45 miles per minute is attained. This requires that only the best material should be used in construction, to eliminate danger of accident. Even with a material which would safely stand higher speeds a limit of speed is reached when the centrifugal force becomes great enough to bend the plates. With the plates offset from a radial line a component of centrifugal force acts to bend them in the direction of rotation.

At moderate speeds this force only neutralizes the pressure of the air, which would otherwise bend the plate against the direction of rotation. At high speeds, 1600 or 1700 R. P. M. it becomes strong enough to overcome the pressure of the air and bend the plate permanently. This then fixes the limit of power which can be absolved, provided the materials are such that the operation at these high speeds is safe.

In conclusion we would say that in our estimation this use of the fan as an absorption dynamometer is a very accurate method for determining power output for conditions of constant speed or where speed may be determined. However the determination of speed must be very exact or the accuracy of the method will be greatly impaired, especially at the higher values where the load increases so rapidly with the speed.

The Wisconsin Engineer.

EDITORIAL.

On behalf of the faculty of the College of Engineering and of the "Wisconsin Engineer," we extend cordial greetings to all the patrons of this publication. Students who are returning, after a period of vacation, to take up their studies will find numerous changes and improvements in the material equipment of the University. The facilities for satisfactory study and good instruction are, we believe, better than ever before, and if everyone does his part the results are bound to come. Many returning students have been engaged in profitable work during the summer, both from the standpoint of financial return and from the educational point of view. Practical experience gained during vacations is of the very greatest value in rounding out the education of the engineering student, as such experience not only serves directly to give to the young man the necessary practice, but enables him to get more value from his theoretical studies at school. In the light of the right kind of practical experience such studies become much more vital and concrete so that the student will not only find his interest aroused, but will find it much easier to master his studies. To many students, practical experience is of such great value in connection with their theoretical studies that it would be advisable for them to spend a full year in practical work before completing their last year or two at the university. And this is indeed quite often done. There is, of course, some danger in the temptation to remain in practical work and not complete the college course, but the value of a rounded education is so generally recognized by employers that advice from them, almost without exception, is to "return to the university and get your degree." The experience at this institution is that very rarely do the students who are successful in their studies, and who have pursued their course for two or three years, fail to complete their course sooner or later and get their degree from Wisconsin. We hope that you will find the coming year the most profitable of all your school years, and with good spirit and industry on your part, we have no doubt that such will prove to be the case.

To the new students we would advise, first of all, that it is necessary to "get busy" very promptly. You will find the work required of you to be very much greater in quantity than you have bee accustomed to in your high school course, and to carry the work satisfactorily requires steady, persistant effort. If you get a good start you will find yourself making satisfactory progress, and, what is more, you will get a great deal of satisfaction in the doing of clean creditable work. There are many ways in which you will find your sport and recreation, but, after all, the most solid satisfaction you will get will be from your work. Letters frequently come to this office in which our advice is asked with reference to the selection of a profession, and, generally, from the standpoint of financial profit. To such inquiries our answer invariably is that such a selection should be made, primarily, with reference to the person's tastes and abilities, although, of course, a reasonable earning capacity is of great importance. Satisfaction in life must come mainly from work well done, and the best way to make your work enjoyable is to make up your mind that you are going to do good work and that you are going to like it.

To the alumni who desire to keep posted on the progress of the College of Engineering, we advise you to become subscribers of this journal. The important change made last year, whereby the "ENGINEER" becomes a monthly publication, makes it of much greater value to the alumni than was heretofore the case. It also makes possible the publication of a much higher class magazine, and the results of last year's efforts, we think, are ample proof of these assertions. We welcome your sugges- and criticisms with respect to all matters in the college. The information now at hand relative to the activities of the engineering alumni is very complete, and, during the coming year, will enable us to increase the number and value of our alumni notes, and to issue a directory that will be accurate and up-to-date.

F. E. Turneaure, Dean.

WILLIAM DANA TAYLOR.

Professor William Dana Taylor, who filled the chair of Railway Engineering in the University of Wisconsin from 1901 to 1906, died at his residence in Chicago on August 26, 1911. He withdrew from his university duties in February, 1906, to take up active work as chief engineer of the Chicago & Alton Railroad. In 1907, through a reorganization of railway properties, he was made chief engineer of the Toledo, St. Louis & Western Railway, and two years later, of the Iowa Central and the Minneapolis & St. Louis Railroads. He continued in active discharge of his professional duties practically to the time of his death.

Mr. Taylor was born at Montgomery, Ala., Jan. 22, 1859. In 1881 he was graduated from the civil engineering department of the Alabama Polytechnic Institute, and later took post graduate studies at Johns Hopkins, Cornell and Chicago universities. Previous to taking up his work in the engineering faculty of the University of Wisconsin he had taught in acadamies in Alabama for two years and for a period of seven years had been professor of civil engineering in the University of Louisiana. His professional activities in railway engineering proper had included service with the Mexican Central R. R. in 1882–3; on various railroads in Alabama from 1886–91; with the St. Louis, Peoria & Northern R. R. as chief engineer in 1898; and with the Chicago & Alton in 1899–1900 in charge of the reconstruction of the Glasgow bridge over the Missouri River. In 1902 Professor Taylor was given leave of absence from his teaching duties at the University of Wisconsin for a brief period to enable him to accept the position of chief engineer of the Knoxville, La Follette & Jellico R. R., a connecting link of the Louisville & Nashville system. In June 1903 he was appointed expert engineer by the Wisconsin State Board of Assessment to appraise the steam railway properties of the state, and served in this capacity until his return to active railway engineering practice in 1906. He was a member of the American Society of Civil Engineers, Western Society of Engineers, Society for the Promotion of Engineering Education, American Railway Engineering Association, and the Engineering Club of Chicago.

As a teacher Professor Taylor won the wholesome respect and the deep personal regard of student and colleague. His was a fine and strong personality: loyal to his family, his friends and his work; ever forgetful of self and of the limitations of his own strength in the service of others; simple of manner and tastes; a man of modesty and of force rarely combined; a seeker after truth; a hater of shams, ever swift and sure in taking sides for the right. These and many like qualities characterized the private and professional life of this fine christian gentleman. Called away at the very summit of a life of high attainment, his rare qualities of heart and mind enabled him to endure with fortitude the suffering of the closing months of his life. A deep sense of personal loss is shared by those who knew him and felt his influence.

FRANK ALONZO CARPENTER, '12.

The many friends of Frank A. Carpenter will be deeply grieved to hear of his drowning in the Wisconsin River on July 4, 1911.

In company with his elder brother Charley he was swimming in the Wisconsin River. They had crossed the river and were returning when Frank called for aid. His brother, who was in the lead, swam back to help the drowning boy. He was pulled under by Frank and by his efforts to help became so exhausted that he could barely save himself.

Frank Carpenter was born at White Mound, Wisconsin, September 9, 1889. In June 1907, he graduated from the Spring Green High School, and entered the University of Wisconsin with the class of 1912 enrolling in the mechanical engineering department.

He was a good student and his record gave evidence of a bright future. His genial disposition and his frank and hearty interest in his fellow students made him a favorite amongst engineers. His ability as a ball player and his work on the lower campus are a matter of record.

PETER J. GABRIEL.

Peter J. Gabriel, former instructor in forge practice died in Chicago on August 1, 1911, after an illness of several months.

DEPARTMENTAL NOTES.

STRUCTURAL ENGINEERING.

During the past summer further experiments on railroad bridges were carried out by members of this faculty, assisted by members of the faculty of Cornell University. Some three weeks were spent in the field on the C., M. & St. P. and Northwestern Railways at Byron, Illinois; Brodhead, Wisconsin; and Milwaukee, Wisconsin. Special test trains were furnished by the railroad companies and all facilities to expedite the work. The special feature of investigation this year has been the determination of secondary stresses, by which is meant the bending stresses of members near the joints. The apparatus used was a special form of extensometer developed during the past year and manufactured in the mechanician's shop of the engineering department. The results of these tests will be presented to the American Railway Engineering and Maintenance of Way Association as a part of the work of the committee on iron and steel structures.

The members of the party from this institution were Dean F. E. Turneaure, Assistant Professors W. S. Kinne and O. L. Kowalke, and instructor J. B. Kommers. Those from Cornell University were Professor C. L. Crandall and Messrs. W. F. Conwell and H. A. Axtell.

STEAM AND GAS ENGINEERING.

Prof. C. C. Thomas will be in Europe during the present academic year. The department of steam and gas engineering will be in charge of Prof. H. J. Thorkelson. The senior work of this department will be given by L. V. Ludy, Professor of Mechanical Engineering at Purdue University. Prof. Ludy will also give a course in railroad mechanical engineering.

Prof. J. G. D. Mack has made arrangements to have E. R. Townsend deliver two lectures to the engineering students. Mr. Townsend graduated from Ames in 1897 and is at present consulting hydraulic engineer for the National Board of Fire Underwriters. His lectures will be upon the following topics:

1. Fire Protection Engineering.
2. A Technical Discussion of the Fire Underwriters Electrical Requirements.

HYDRAULIC ENGINEERING.

Two new offices, a computing room and a locker and toilet room, in the east end of the second floor of the Hydraulic Laboratory, were completed early in the summer.

The registration for experimental work in the Hydraulic Laboratory during the summer session was twice as large as during the previous summer. Valuable results were obtained from experiments with the 6-inch centrifugal pump, the 10-foot overshot wheel, the $4\frac{1}{2}$-inch hydraulic ram and with a special form of Pitot tube.

During the latter part of the summer a force of five men has been engaged on the preparation for publication of results of experimental work.

Work for the coming year has been planned on the 6-inch centrifugal pump, the V notch weir, the air lift pump and the Fairbanks-Morse power pump, by experienced experimenters. There will be opportunity for a couple of students to work on the last two problems, as thesis work, for the parties are not yet completely organized. Those interested should confer with Mr. Davis, at the earliest opportunity.

Prof. C. I. Corp, Research Assistant in Hydraulic Engineering, who was engaged last year on experiments on the action of pump valves returned to the University of Kansas, after preparing the results of his experiments for publication as a Bulletin of the University of Wisconsin.

Prof. G. E. P. Smith, Honorary Fellow in Hydraulic Engineering, completed his experiments on the centrifugal pump, and returned in June to the University of Arizona.

The fellowship in hydraulic engineering has been awarded for this year to Mr. Albert A. Ort who was last year a graduate student in this department. The scholarship in hydraulic engineering has been awarded to Mr. C. M. Scudder, a graduate of the 1911 class. Mr. Dan E. Davis, Assistant City Engineer of Alliance, Ohio, has been engaged to do special research work in hydraulics.

* * *

Mr. O. L. Kowalke has been promoted to Assistant Professor of Chemical Engineering. Mr. C. A. Mann, formerly assistant in pharmacy and chemistry will be an instructor in chemical engineering.

* * *

Mr. E. C. Holden left Madison in July to make an examination of mines in Norway.

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