The net commercial efficiency of the plant, taking into account all elements of loss, including that in the conducting wires, is about 70 per cent: in other words, 70 per cent of the power applied to the shafts of the generators in the underground chamber is delivered for work at the main line shaft in the mill.

The waste water from the 1,650-foot level of the Chollar Mine is piped into the Sutro Tunnel. It is now proposed to use this water a third time at a lower level for other work, by means of a similar application of electrical machinery.

It was expected at the outset that many difficulties would be met in an installation of such novel and original character, which was also by far the largest ever attempted. The projectors, the Brush Electric Company and their agents, the California Electric Light Company, who assumed charge of the details of the erection, were very greatly pleased to find that their forethought had eliminated the troubles anticipated and predicted in almost all respects. Two purely technical difficulties were encountered when the plant was started experimentally, which caused some delay and anxiety. They were, first, the lack of any governing appliance for the water-wheels; and, second, the damage to the primary generators caused by the extreme heat and dampness in the underground station.

The Brush Electric Company, in its original plans and specifications, stipulated that the water-wheel should be governed within reasonable limits; but this requirement was not met, and the first generator and motor, started up experimentally, showed the necessity of this provision. The Brush Company was surprised to receive by telegraph the first intimation that the makers of the water-wheels had wholly neglected such an important matter, but was fortunately able to close the breach at once. A water-wheel governor, invented and sketched out by Mr. W. B. Devereux, the prominent mining engineer, of Aspen, Col., had been placed in the hands of the company some time previously, and working drawings of it had been made at Cleveland. These were at once sent to California, the governors were quickly made, and this source of trouble was overcome. Mr. F. E. Smith, the electrical engineer in charge of the installation, made several modifications of the governor, after watching its performance, which proved of much value, and it has worked perfectly in practical service.

The second difficulty was met with equal promptness, and likewise entirely overcome. The temperature of the subterranean power chamber is about 72° F. The atmosphere is almost saturated with moisture, — 78 per cent. Any piece of metal taken into it begins immediately to "sweat." The generators, when placed in this chamber, were soon covered and saturated with moisture, and began to show leaks, while the motors above ground were absolutely free from any trouble.

The Brush Company was at once notified of this unanticipated source of difficulty, and Mr. Brush speedily devised a method of insulation which would certainly and completely resist the moisture of the sublimated atmosphere. Since its application the generators have worked admirably, and the entire plant is now at work regularly, performing its expected duty, and economizing the power available, as stated above.

The achievement of the Brush Electric Company, in connection with this plant on the Comstock, is a very notable one, and of the greatest interest to mining engineers. The plant is the largest electrical power plant in the world. The company is making a specialty of powerful generators and motors for power transmission and distribution, and is taking large orders for them, not only in this country, but also for foreign shipments. The latest contract announced is one with the Calumet and Hecla Mining Company for five of the large Brush generators of 130 horse-power, and five of the 80 horse-power Brush motors. A power station will in this case be built above ground for the generators, and the motors will be used for driving pumps underground. The plant goes to the copper-mine at Calumet, Mich.

A MODEL SCHOOL OF ARCHITECTURE.

THE department of architecture of Columbia College has closed its work for the year with its annual exhibition of drawings. This department was organized eight years ago largely through the liberality of Mr. F. A. Schermerhorn, who contributed the necessary funds to place it on a firm basis. It has grown with unusual rapidity, and is now one of the strongest parts of the School of Mines of Columbia College. During the past year, sixty-five students were registered in the department, an increase of twenty-five over the preceding year. The money furnished by Mr. Schermerhorn has enabled the trustees to supply a liberal collection of apparatus, models, books, photographs, and drawings; and the whole forms a collection of working material not equalled by another institution of the same kind in the country. Columbia is fortunate, also, in possessing in Professor William R. Ware, who has charge of this course, a teacher who combines sound technical knowledge with a warm sense of architectural form, and it is to him that the success of this school of architecture is chiefly due.

With a large body of students it is, of course, possible to produce large quantities of work, and this was the first noticeable feature in the recent exhibition. Four or five rooms were completely filled with the work of the students. Specimens were shown in all departments of architectural drawing. There were studies in historical ornament, many of them highly spirited sketches; problems, with details and perspectives; original designs; carefully prepared elevations; studies in perspective, in shades, and shadows; pencil drawings from the cast; memory drawings, — sketches from descriptions of photographs, and highly interesting as showing the attention that must have been given to the study of styles in order to produce such results; free-hand sketches of actual buildings and from photographs; applications of design and water colors. Nor was the quality of the work less noticeable than the quantity. In a collection of the work of an entire year, some drawings would be necessarily included that are more or less imperfect; but there were few of these, and they all evinced an extraordinary degree of application on the part of the students, and untiring energy on the part of the teachers and instructors.

Many of the pen-and-ink drawings were exquisitely done, and compared very favorably with the work of more experienced draughtsmen. The work of the students in this department does not cease with the conclusion of the college year. On the contrary, they are encouraged to enter architects' offices, and to make frequent sketches during the summer. One hundred drawings are required to be handed in at the beginning of the college year as evidences of summer work, though each day passed in an architect's office is accepted as the equivalent for a drawing. The hand and mind of the student are thus kept in constant practice, and there is no doubt but that much of the superior work in this school arises from the fact that the work is constant the year round, and is not interrupted by three months of idleness. One of the most interesting sections of the exhibition was that devoted to summer work. The exhibit was large, and included specimens of all kinds of drawings, both from actual buildings and from photographs. The quality of the subjects was an interesting commentary on the manner in which the tastes of these young men had been trained.

The problems of execution included a staircase, with perspective and detail drawings, elevation and details of a classical window, and several other subjects. All these were class-work, and were marked with the criticisms of the professor. Another interesting series were designs for a wrought-iron gate, and some studies for a Roman villa, by the first-year students. Space does not permit, nor is it necessary, to enumerate all the drawings shown. The exhibition was one to have been seen to be appreciated. The work was characterized not only by marked ability on the part of the students, but also testified to the great care and thought displayed by the teachers. The drawings showed an enthusiasm for the work which is not always to be found among undergraduates.

A word as to methods. The course in architecture extends over three of the four years' course in the School of Mines. The first college year is devoted by all the students to general studies; but in the second year the class is divided into sections, each pursuing a technical study. In the course in architecture, drawing is an important feature throughout the three years. In the first year the elements of architecture, with the forms and proportions of the five orders, are taught, together with the study of Greek and Roman architectural history. In the second year technical studies in the mechanics of solids are introduced, and a survey made of the ma-

terials employed in construction, their application and uses. In the fourth year, studies in the properties of materials are continued, and contracts, specifications, superintendence, and the details connected with the practical work of the architect, are considered. Throughout the whole course there are lectures and exercises in the history of architecture, as well as in the history of painting and sculpture, the aim being to make the students familiar with designs and styles which they might never even see in the daily routine of an architect's office.

The future of the department of architecture in Columbia College promises to be unusually brilliant. The trustees of the college have recently established a two-years' fellowship in architecture, which is the most valuable prize now open to architectural students in America. The conditions under which this will be awarded have not been decided as yet; but it will doubtless be a travelling fellowship, open to all the graduates of the department, thus enabling the recipient to pass two years in travel abroad. The income amounts to $1,300 for the two years. New York will soon possess, in the Museum of Architectural Casts now being prepared for the Metropolitan Museum of Art, the finest collection of architectural models in the world. No part of this collection is yet in place, though a portion of it has been received at the museum, and the promises of the museum authorities indicate a collection of extraordinary value and interest. With this collection within easy reach, Columbia College will stand easily in the front rank of architectural schools in this country, and will compare favorably with the best in Europe. Each year witnesses some new improvement to the department, both in the way of teaching and in the apparatus. The schools of architecture in this country are limited in number, and it will require hard work on the part of the others to keep abreast with Columbia. BARR FERREE.

NANSEN'S EXPEDITION ACROSS GREENLAND.

DR. FRIDTJOF NANSEN, whose daring expedition across the inland ice of Greenland excites so much well-merited admiration, gives the following description of his dangerous trip: —

"In the beginning of May, 1888, myself and the companions whom I had selected, Lieut. Dietrichson, Capt. Sverdrup, Mr. Christiansen, and the Lapps Samuel Balto and Ole Ravno, were ready to leave Christiania. After having reached Scotland, we sailed on the Danish steamer 'Thyra' for Iceland, whence the Norwegian sealer 'Jason' took us across Danmark Strait to the east coast of Greenland. The 'Jason' is a wooden steamer with full rigging. She is built for navigation in the ice-covered polar seas. Her bow is strengthened in order to withstand the heavy pressure of the ice setting along the east coast of Greenland. I hoped to find the ice sufficiently loose to permit us to reach the mainland by means of boats in the beginning of June. On June 11 we sighted the coast north of Angmagsalik, where Capt. Holm's expedition wintered in 1884–85. We approached the land to within forty miles, but here our progress was stopped by the ice. As it seemed to fill the sea as far as the coast, I did not feel justified in an attempt to force a landing. For this reason we staid on the 'Jason,' which went sealing in Danmark Strait. After the sealing was finished, — about the middle of July, — we approached the coast of Greenland for a second time. At this season the belt of ice was not by any means as extensive as it had been in June. On July 17 we approached Angmagsalik to within twelve miles, but we were again arrested by a heavy pack. As I supposed that we should be unable to approach any nearer the coast, I resolved to leave the steamer, and to attempt a landing. We left the 'Jason' with two boats, which were about twenty feet in length. Besides the boats, we carried a tent, two sleeping-bags made of deer-skin, and five long and narrow sledges for carrying provisions, ammunition, instruments, etc.

"In the beginning we made fair progress, as the ice was sufficiently loose to permit our boats to pass between the floes. Eventually we had to cut off a projecting point, but no serious obstacles were met with. At a few places we had to drag the boats over a floe, but our progress warranted the hope that we would reach the mainland on the following day. The farther we progressed, however, the closer the ice was packed, and the oftener the boats had to be dragged over the ice. On one such occasion one of our boats was stove. She was unloaded as quickly as possible, and the necessary repairs were made. Thus four hours were lost. When we were ready to start, we found the ice so closely packed that we had to drag the boats continually. Travelling was made still more difficult when heavy showers of rain set in. We were thoroughly tired out, and it was necessary to encamp on the ice in order to regain strength to await the loosening of the pack. While we were encamped, the current carried the ice rapidly southward, and the distance to the coast was rapidly increasing. When it cleared up again, we discovered that we were about fifteen miles south of Sermilik Fiord. We endeavored to reach the coast; but travelling was extremely difficult, as the ice consisted of small and closely packed floes. Besides this, the current continued to carry us southward, and it seemed that the distance which separated us from the coast was continually increasing. Thus the day was spent. The weather was fair, but the current thwarted all our endeavors. At one time we were close to the shore; then the current carried us far out into the sea, and we felt the heavy swell of the ocean. One night, when sleeping in our tent, we felt a heavy swell, and the small floe on which we had pitched our tent was subjected to heavy pressure. On the next morning we saw that the floe was cracked near our camp, and that we were close to the edge of the pack near the open sea. The boats were made ready, and preparations were made to leave the ice. At night we had approached the edge of the pack still more closely. The sea washed over our floe, the size of which was rapidly decreasing. We knew what was before us. In order to be ready to take up the struggle with full strength, I ordered everybody to turn in. Sverdrup was ordered to watch, and to call all hands when it should be necessary to leave the floe. Sverdrup, however, did not call us, and when we arose on the next morning we heard the breakers at a long distance. During the night our floe had been so close to the sea that one of our boats was threatened by the waves; but all of a sudden it was drawn towards the land, and entered the pack-ice.

"After a few days the current carried us so close to the land, that we were able to reach the coast. On July 29 we went ashore near Anoritok in 61° 30′ north latitude. During our twelve-days' stay on the ice, we were carried southward sixty-four miles. On the whole, the weather had been fair. Now we were on shore, but far southward from the point where I had hoped to reach Greenland, and where I intended to begin my journey inland. Therefore we had to go northward along the coast, as I was unwilling to change my plans.

"We started on the journey along the coast in the best of spirits. Whenever the ice was too close to the shore, we had to cut our way by means of axes, and we succeeded in making slow progress. On July 30 we passed the glacier Puisortok, which is so much feared by the East Greenlanders. On a point at the north side of the glacier we fell in with a party of natives who had visited the west coast on a trading excursion. This party, who were travelling in two women's boats, had met another party travelling in two boats, who were going southward on a visit to the west coast. We pitched our tent alongside their camp, paid them a visit, and were kindly received. On the next day we travelled in company with the first party northward, and reached the island of Ruds. The Greenlanders let us take the lead, in order to make use of the clear water made by our boats. In the afternoon rain set in. The Eskimo pitched their tents, while we continued our journey. Everywhere the ice lay close to the shore, and huge icebergs were pushed into the sea by the glaciers. At Tingmiarmiut we heard the dogs of the Greenlanders howling; but we had no time to spare, and continued our journey. On Griffenfeldt's Island we were overtaken by a northerly gale. At Akornarmiut we fell in with a new party of natives. They, however, were extremely timid, and as soon as they saw us they took to their heels, leaving behind their tents and one dog. We succeeded, however, in making friends with them by giving them a number of trinkets as presents, and on parting we were sincere friends. Numerous kayaks accompanied us when we continued our journey.

"Finally, on Aug. 12, we reached Umivik, whence, under the existing circumstances, I intended to start on my trip across the