

times their own average working weight of useful load at from 50 to 60 miles per hour is scarcely likely to have an equal even in the United States, leaving aside the question of coal economy. This is equal to saying—and any contradiction thereto would be exceedingly interesting and therefore welcome—that for a given number of thermal units expended these Italian engines pull more weight at a given speed than any other locomotive in the world. Thermal units are mentioned, and not coal quantities—than which nothing more misleading could ever be introduced in the estimate of a locomotive's fuel-value consumption, unless the calorific value of the coals actually used is reliably given.

These engines were designed for all speeds up to 82 miles per hour, but the state of Italian tracks and works prohibits more than 56½ miles per hour; but the writer has sometimes seen the tachograph recording 62 miles per hour with 400 tons on the tender drawbar; that is to say, 440 U. S. tons; or with the engine fully loaded, a gross load of over 550 U. S. tons. In freight service they pull gross loads of up to 1,030 U. S. tons.

The "Adriatic" compound system comprises four cylinders—two high-pressure on one side and two low-pressure on the opposite side of the locomotive—each pair having only one piston-valve operated by one valve-gear—Walschaert's.

With this arrangement of one valve distributing to the high-pressure and one to the low-pressure, it is possible to set the valves for different relative degrees of cut-off, according to the average velocities to be made by the locomotive. In the original Vaucrain compound this was impossible. In French locomotives the engineers, although they have two sets of distributions in their hands, do not vary the relative cut-offs, once they have found the best relative points of cut-off for the four valves. Other four-cylinder locomotives require either four valve gears or else rocking-shafts; but in the "Adriatics" all this extra mechanism is avoided, and the dissymmetrical arrangement of the cylinders has not, in practice, been found to entail any inconvenience, the motion of the engine being, on the contrary, much steadier at high speeds, and in passing through curves, than any other locomotive known to the writer, including American types, which are in general such rough-riders as to bear no more comparison with the "Adriatics" than with the motion of a Pullman car. The explanation is that the "Adriatic" footplate is suspended over the long swing links of the front truck, where the shocks are completely dissipated before reaching the main frames.

**LOOPING THE DOUBLE LOOP.**

In the field of loop-looping which has become so immensely popular of late, professional as well as amateur wheelmen have developed an amount of zeal which is without doubt worthy of a better cause.

All of the most recent achievements, such as, for example, the ride through a loop of which a portion of the upper part has been removed, or looping a complete loop and then over a gap in the second ascent, or looping the gap without the attendant loop, are fundamentally questionable acrobatic feats, that always present more or less danger to the life of the performer.

As has already been remarked, the spectators lose interest in them more and more, and as a novelty of the season they will soon disappear from the programmes, particularly since they are too often attended with trifling and even serious accidents.

The latest novelty in this line is the invention of an ingenious wheelman of Berlin, Böttner by name, who has constructed a double loop, and happily performed the feat of passing through it on his wheel. It is most certainly the pinnacle of mad daring, and will at all events not very soon witness a rival in popular favor.

In this new loop, as we show in the cut, the performer, after he has passed through half of the large loop and with his head still down, must guide the wheel into the smaller loop and out of it again, his head being again turned toward the earth, upon the finishing arc of the larger loop. Just imagine with what velocity the performer is

hurled through these two loops, and perhaps it may be possible to appreciate the stoical quietude of his nerves, his rare skill in managing his wheel, and above all the presence of mind necessary to a successful exit from the whirl.

Since the greatest possible speed is necessary to overcome the resistance offered by the two loops, the starting point is placed somewhat higher than ordi-



A PHOTO-RELIEF MADE BY THE AUTOPLASTIC PROCESS.

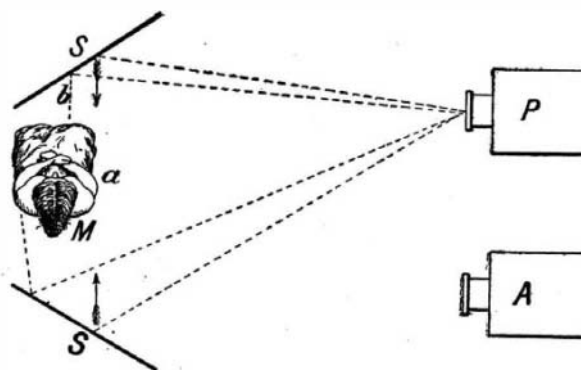


DIAGRAM SHOWING THE UNDERLYING PRINCIPLE OF THE AUTOPLASTIC PROCESS.

narily, and the first descent quite a little steeper; the retarding stretch is also built steeper than heretofore.

The whole performance is a ride of death in the true sense of the expression.

If this new sensation be exhibited in the Schumann circus, according to present plans, the intrepid wheelman will surely not finish without the most vociferous applause on the part of the breathlessly expectant public.

For the present Böttner has erected his double loop in an open lot in the southeastern section of Berlin, where he practises daily.—Illustrirte Zeitung.



LOOPING THE DOUBLE LOOP.

**THE AUTOPLASTIC PHOTOGRAPHIC PROCESS OF PRODUCING SCULPTURAL PORTRAITS.**

BY DR. ALFRED GRADENWITZ.

Many attempts have been made to reproduce plastically the external shape of a model. The photographic camera has been used in this connection as far back as in 1861 by the Parisian sculptor Willème, by taking as many views as possible of the same object from different positions. These different views were then used in calculating the various dimensions of the model, and were translated to the molding block with the aid of a pantograph. The "photo-sculptures" produced in this way attracted, it is true, not a little attention. But the skill of the artist played a more important part in the process than the actual mechanical methods employed. In fact, in all of these methods, light alone by no means produces the plastic effect.

An interesting novel process was recently presented to the Berlin public, when Signor Carlo Baese, of Florence, delivered a lecture at the Urania. The new process necessitates only the taking of ordinary views of the object, whereupon, by means of photography, without any retouching or any correcting on the part of the artist, a relief corresponding perfectly to nature is obtained by employing the swelling property of chromium gelatine.

It has been known for some time that chromium gelatine will lose more or less its power of swelling according to the intensity of the light to which it is exposed, so that a layer of that substance, on being printed beneath a negative, will reproduce the different shades of the negative in relief. Heights of the relief upward of 1 centimeter (0.3936 inches) may thus be obtained readily, while the clearness of details is such that an artist would have the greatest difficulty in securing similar results. Attempts hitherto made to utilize this property, in connection with the production of plastic pictures, failed to give any positive results, as the principal condition, namely, the existence of a negative of a transparency proportional to the relief of the model, was not fulfilled. Mr. Carlo Baese has shown how success may be attained.

With ordinary negatives, the darkening of the plate, as need hardly be mentioned, depends on a multitude of factors other than the plasticity of the model. In the first place, the colors of the model play an important part, while the actual distribution of light is not without its influence.

In the Baese process the model is illuminated by means of a projection lamp, the light rays striking it at right angles to the direction in which the photograph is to be taken. This is insured by the arrangement represented in the diagram. P is the projection lamp, throwing the light on the mirrors, SS, the rays being reflected to the model M. A is the camera. By means of a light filter, inserted in the projection apparatus, the light is graded so that the illumination decreases in intensity gradually from the left to the right, the model being illuminated so as to have the foremost parts struck by the brightest and the back parts by the darkest portions (point a bright, point b dark).

This gradation of light, which is noted on the model rather distinctly in the direction of the arrows, is so modified by the different inclination of the surfaces on which it is distributed, as to be hardly recognizable from the photographic camera. A view obtained with a similar illumination will therefore by no means reproduce the most salient portions as the most opaque; this would, by the way, not be obtained if the model were uniformly illuminated with white light. The coloring of the model, as a matter of course, would also have its influence on the plate, so as to give values quite independent of the height of the points in question.

Now, if after the exposure of this first plate, the gradation filter in the projection lamp be inverted so as to have the most transparent portion replaced by the darkest, and vice versa, the luminous intensity on the model will augment from the front toward the back. After a second exposure is made with this new illumination, no further views will be necessary. The transposition of the plate and the light filters is effected automatically,

by shifting a slide, both exposures thus being made readily within one second.

After the plates are developed, the gradation of the two views is seen to be lost almost entirely, while the coloring of the model is visible in the same way on either of the views. If one of these views be printed as a diapositive and superposed on the other negative, a composite picture will be produced, which accurately corresponds to the conditions above outlined; in fact, any projecting parts in the model will be most strongly covered, while the back parts are represented by the most transparent portions, regardless of the color of the original. This remarkable result is due to the following facts:

Any difference of inclination of the various surfaces as well as of the color will result in a given modification of the graduated illumination. As both of these causes remain unaltered during the time the two views are taken, they will exert a prejudicial effect on the two views, practically identical in both cases. One of the views being printed as a positive, the values corresponding to the negative are inverted. As this positive is superposed on the other negative, any effects of color, etc., are present in the two photographs in an opposite sense; they will therefore compensate and neutralize each other. As, on the other hand, the gradation was opposite in the two negatives, it will be once more inverted by the positive, so as to behave similarly in the two plates superposed, the effects on either of them being added to one another.

If therefore a layer of chromium gelatine be exposed to the action of light, under a similar composite picture, a subsequent development in acidulated water will result in a plastically correct reproduction of the model.

The relief presented herewith was produced after life by this purely photo-chemical process in the physical department of the Urania, after some theoretical experiments in the Charlottenburg Technical High School, made with the assistance of Prof. Miethé, had borne out the correctness of the process. These reliefs, the height of which allows of rather considerable size, may be transformed at will as to all their dimensions, by means, for instance, of the Dedrick Wyon relief-copying machine. The results so far obtained are the more remarkable as they represent mere laboratory tests.

#### THE TRANSFORMATION OF THE GRAND CAÑON INTO A NATIONAL PARK.

BY C. M. GINTHER.

With the foresight and liberality that have characterized our government from the first, the Grand cañon of the Colorado River in Arizona will be added to the national reserves, and placed under the care and custody of the government. Government surveyors have about completed a survey of a section of the cañon. This is only part of the work laid out by the United States Geological Survey, which has ordered a thorough survey of the entire San Francisco forest reserve. The best part of this wonderful Arizona gorge is within the reserve. It is given out that the United States officials have decided that it is time America's grandest and most awe-inspiring scenery be placed under government supervision. The work will require almost a year to complete, having been in progress about two years up to this time. The present section, upon which work is progressing, extends about fifteen miles east and west of Bright Angel Trail, on the south rim of the cañon, extending east to Grand View. Mr. Charles D. Walcott, who is at the head of the United States Geological Survey, has direct charge of the work. The first survey was made by Mr. John W. Powell, Mr. Walcott's predecessor, whose lamented death occurred while he was director of the United States Bureau of American Ethnology.

The work in hand has progressed far enough for the party to ascertain that many of the cañon's altitudes and measurements are incorrect; but the changes will be found to add to rather than detract from the grand measurements.

To the geologist the cañon offers an ever-increasing and endless field for study. Its mysteries are many, and within its walls it contains deposits that belong to almost every known geological age.

To the sightseer and lover of the tremendous and fearful in nature, there is nothing in the world that has equal claim to notice, for undoubtedly it is the most wondrous and gorgeous scenic field in the world.

The government will endeavor to spread a knowledge of this great reserve, in order to tempt travel to it, for no words, nor pictures, nor comparisons are vivid enough to convey even slight suggestions of its marvels. Obstacles in the way of reaching the rim of the cañon will be removed as rapidly as possible, the first step being a grant to the Santa Fé Railroad to build a line right up to the edge of the rim, the terminus of the railroad being Bright Angel Trail.

A great hotel has been erected at Bright Angel Trail, and visitors to the cañon at this point need not, as heretofore, take a hurried walk along the rim,

cast frightened glances into the abyss, and hurry away to catch the returning stage or suffer the inconvenience of lying on the ground over night. The name "Bright Angel Trail" is appropriate and suggestive, for without wings the journey into those fearful depths could never be made. It sickens most beholders even to think of trying the descent, looking into the tremendous gorges, to say nothing of attempting to find a foothold on their precipitous sides.

A few adventurous spirits have tried to go through the cañon by boat, but only Major J. W. Powell and his daring party of adventurers lived to tell their experiences. For miles the river slips between walls of naked rock worn smooth to their tops by countless years of warfare with the elements. The walls sweep down to the water's edge, and a swimmer in those flashing currents could find no ledge or projection to stay his swift destruction.

Major Powell finally emerged from the cañon, minus two boats and four men. His narrative of his escapes and struggles pictures one of the most desperate undertakings ever essayed by man. The place seems to have a fascination for many beholders, like that of Niagara Falls, which tempts persons of peculiar temperaments to rush over the brink with the green waters. Several lives have been lost in the endeavor to emulate Major Powell's feat, but not one attempt has resulted successfully, except one expedition headed by a man named Stanton. Some of his party were crazed by their fearful struggles and the awesome sights, while others were rendered physical wrecks by their desperate and sustained efforts.

To the average person the descent of the old Hance trail offers plenty of excitement, and he is willing to leave more dangerous routes to sure-footed surveyors or old-time mountainmen. In the early days this was the only descent to the river for a distance of 300 miles; and it remains the safest and shortest to this day. For the first two miles of the descent, it is a sort of Jacob's Ladder down a nearly uniform decline. At the end of the two miles a slope is reached known as the first level. This is 2,500 feet below the rim of the cañon. Hance's rock cabin, a rude shelter, fashioned by piling boulders together so as to form a sort of walled inclosure, over the top of which sticks and brush have been collected along the trail and carried with much labor to the spot, is located a short distance beyond, or below, the first level. This cabin is a famous landmark in the Southwest. It is the plan of the government to allow it to remain just as it is at present, for the sake of old associations.

After leaving the Hance cabin the explorer plunges down a steel trail, that leads past walls of red and dark-brown sandstone. Lizards and horned toads scramble across the path, but all about is silent save the ever-increasing roar of the torrent beneath. At the foot of a detached and slanting cliff 500 feet high a solitary Indian grave is encountered, with some pottery scattered around. Here also is the gigantic niche named the Temple of Seti by the painter Thomas Moran. From this point the descent must be made with the utmost care. Horses are abandoned, and the tourist lowers himself into the abyss. Sheer descents are found, which require the use of ropes, and at the last there is a drop of 40 feet, each person being swung over clinging to a rope, and supporting himself as much as he may by digging his feet into the side of the cliff as he slowly sinks past. The foot of this cliff is near the edge of the river, a narrow sandy strip intervening. The water is oily in appearance, and darts with the swiftness of an arrow past the little beach. A gigantic belt a hundred yards in width, moving with lightning speed, is an apt but inadequate comparison with the river. There is no foam, no eddies, no whirlpools, no rapids, but a resistless, onward rush of the whole body of the stream.

Huge trees are tossed about like corks, enormous stones are rolled and crushed together with a sound like thunder, where the water edges into the foot of some dizzy cliff, thousands of tons of stone crash into the water at intervals, only to be jostled and rolled away by the irresistible current.

At many points in the course of the stream through the Cañon there are waterfalls of enormous height. The river drops over cliffs hundreds of feet high, apparently into the depths of the earth, nothing being visible but a mist and spray, but there is audible such a terrifying roar and rumble as suggests titanic forces at work. A mile or so below the river emerges, having hewn for itself a passage through the living rock.

Guides licensed by the government are at the service of tourists, of whom many are women. These guides are men who are familiar with the cañon, and for a small fee escort parties or individuals to the most interesting places, furnishing horses and equipment.

The experiments made by Prof. Vladimir de Nicolaiève prove the existence of an electric field in the interior of insulators immersed in conductors of electricity. In accordance with Prof. Cohn's views, this field is limited by the contact surface between the in-

ulator and the electrolyte, while its forces show the properties of internal forces. (Physikalische Zeitschr. No. 8, April 15, 1904.)

#### Engineering Notes.

Some interesting tests are being made on the railroad between Voiron and Saint Bérion in France with ferro-concrete in lieu of wooden railroad ties, to ascertain the comparative initial and maintenance cost, efficiency, and durability of these two systems. This track is 3 feet 3 inches gage, and the ties are 3.9 feet long by 7 inches wide and 5½ inches deep. They weigh 23 pounds each, and cost approximately 90 cents each. The concrete used is composed in the proportion of 33 kilogrammes of cement to 40 liters of sand, and the reinforcement of steel bars weighs 8.4 kilogrammes per tie. Under the most unfavorable conditions, it is even considered that the first cost of the ferro-concrete ties will not exceed that of good oak ties more than in the proportion of 5 to 3, while it will be four or five times as durable.

In connection with the new scheme inaugurated by the British Admiralty for the training of artificers for the navy, two obsolete battleships have been converted into floating workshops replete with modern machinery. The two vessels selected for this purpose are the "Bellerophon" and the "Téméraire." The conning tower of the former vessel has been removed, together with the after funnel and the after boilers. In their place there has been erected a corrugated iron structure, 200 feet in length by 50 feet wide and 21 feet in height, comprising a machine shop fitted with various machines and lathes. The boiler room has been converted into a blacksmith's shop, and contains sixteen forges and anvils, a motor hammer, and coppersmith's fires. In the case of the "Téméraire," the main deck is occupied with plumbers' and fitters' workshops containing all the latest necessary machinery, while on the same deck is also an electrical department. In the forward barbette the dynamos for generating the light and supplying the power for the various motors are installed. These vessels are to be moored in the harbor, and about one hundred boys will be accommodated upon each ship.

An interesting application of the steam-heating system so extensively adopted in this country is in course of experiment in Dresden. In that city the Saxon government has established a huge central station, and from this the heat is distributed among a number of the municipal buildings, including the Royal Opera House, the Picture Gallery, Zwinger Museum, the Hofkirche, and Royal Palace. The edifices are all situated near the central heating station, which stands upon the banks of the river Elbe, whereby an adequate supply of water is always available. The station contains ten generators, producing over 55,000 pounds of steam per hour. The steam is distributed to the various public buildings by means of steam pipes laid beneath the streets. But this ingenious heating system is also utilized to fulfill a dual purpose—the generating of electricity for lighting the various edifices. The heat is generated and distributed during the early morning, when the electric supply is not required, and once the buildings are thoroughly heated, it requires but very little pressure to maintain the temperature desired throughout the day. Consequently, this arrangement enables the steam power generated during the later part of the day to drive the electric installation and maintain the pressure required. This combined heating and electric lighting system has proved highly successful and economical, and its extension to other towns in Saxony is contemplated.

The results of the inspection of the refloated British submarine "A 1," which was sunk by collision with the liner "Berwick Castle" off the Isle of Wight, has enabled a tangible hypothesis to be obtained concerning how the crew met their death. Examination of the submarine in drydock showed that the liner struck the submerged craft on the conning tower about 15 feet below the surface. The optical tube was bent to port, a ventilator broken, and the conning tower dented. The actual rent in the hull of the vessel, however, was very small. Capt. Bacon, who is in charge of the submarine flotilla of the British navy, upon examination found blood marks on the grating of the conning tower, just underneath the position of the officer in charge of the vessel, while other similar marks were found in other parts of the craft. These appear to show that the crew within the submarine were all stunned by the force of impact arising from the collision, and were drowned without recovering consciousness. This theory is substantiated by the fact that the leak could have easily been stopped from within, and the submarine brought to the surface, by blowing the ballast tanks, whereas none of the latter were blown. Every member of the crew was found at his appointed position. All the plates around the conning tower were found to be intact, and the vessel is but slightly damaged. The craft will be overhauled, and will soon be ready for service once more.