Correspondence.

Where Did the Photographer Stand?

To the Editor of the SCIENTIFIC AMERICAN:

Mr. Crawford's method (July 1 and 15) of finding the inclination of the picture plane from the convergence of the mortar lines in the front of the transit room did not appear to me to give satisfactory results. In fact, his measures made upon the cut shown on June 10 put *V R*, the east vanishing point, at a distance of 347 feet to the right of *O*, while mine made upon the original photograph would put it only 278 feet away. Owing to their small convergence, I made no use of these lines at all, but resorted to the method of first supposing the picture plane parallel to the front of the observatory, and thereby obtaining the distance of the camera, and then in my concluding paragraph showing that the error of this assumption did not vitiate the results in practice in this instance. This supposition of parallelism affected only the values of *A O* and *A B*, which, strictly speaking, were not reduced in the same ratio by the inclination of the plate; but as the difference was less than the unavoidable errors of measurement upon a photograph, I judged it best in practice to neglect it in this instance.

The cut shown on June 10 is in point of size 59 per cent of the original photograph. It was not made directly from the latter, but only indirectly, that is, from another photo-engraving. This will sufficiently account for the difference between Mr. Crawford's and my results. WILLIAM F. RIGGE.

Creighton University Observatory, Omaha, Neb., July 16, 1905.

Partial List of Form Elements Found in Croton Water.

To the Editor of the SCIENTIFIC AMERICAN:

On one day, July 25, 1905, the following are the form elements observed in Croton water in order of finding: 1. Gomphospheria abundant and throwing off spores. 2. Melosiræ, diatoms. 3. Naviculæ, ditto. 4. Cocinodiscus, ditto. 5. Arcella mitrata. 6. Gromia. 7. Anabaina circinalis. 8. Pelomyxæ. 9. Pediastrum com. 10. Oscillatoriaceæ. 11. Plagiophrys. 12. Volvocinæ 13. Bast fiber. 14. Humus. 15. Decayed woody fiber. 16. Coelastrum sphericum. 17. Starch grains. 18. Amorphous masses of dirt, many. 19. Plagiophrys, another variety. 20. Large cross-barred diatoms, new. 21. Pediastrum incisum. 22. Vorticella. 23. Anurea stipitata. 24. Red water fungus. 25. Large masses of vegetable epithelia. 26. Silica. 27. Amphiprora prorata. 28. Scenedesmus quadricauda. 29. Large number of double spores of alga, new to observer. 30. Staurastrum gracile. 31. New tetraspore. 32. Scenedesmus obliquus. 33. Cotton fiber. 34. Skeleton arm of a large entomostraca. 35. Monad. 36. Peridinium candelabrum. 37. Two-eyed Bosmina, heart seen plainly beating 120 per minute. Before this time one eye was the rule. 38. Wool fiber. 39. Smooth spicule of sponge. 40. Pediastrum boryanum. 41. Part of hydra. 42. Difflugia cratera. 43. Arcella mitrata with minute processes projecting all over like cilia. Never noticed before in twenty-five years. 44. Polycoccus. 45. Cosmarium binoculatum. 46. Difflugia cratera, another commoner variety.

No one is more impressed than the writer with the imperfection of this list. It should be remembered that Prof. P. F. Reinsch, of Erlangen, said that only about one-half of these were named. Those who can are invited to add to the list, and in case none do so, we advise to send for Prof. Reinsch, who is the most capable man in the world to do this needed work.

New York, July 26, 1905. EPHRAIM CUTTER.

The Reasoning Power of Animals.

To the Editor of the SCIENTIFIC AMERICAN:

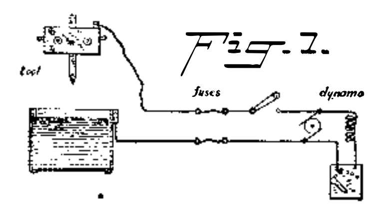
Under the above title in your issue of July 22 a correspondent says that cats that open doors by pulling on the thumb-latch or pawing knobs, or ring door bells to be let through the doors, "do in no way show reasoning power, but on the contrary it was an act of dumb imitation." Quite likely we disagree, because we give different definition to the word "reasoning." But call it "dumb imitation," if you please. To imitate, the cat had to observe how people opened doors. That required thinking. It observed for a purpose; more thinking. It wanted to pass through the door, it remembered how it had observed the door was opened, it resolved to try the same method, and it succeeded. Now here is a series of thoughts, a process of thinking from cause to effect, that to my mind is just as logical reasoning as if performed by a human being. The act was not prompted by instinct, because the cat family has not inherited the practice of opening doors. Your correspondent intimates that it came from intuition. I had supposed that intuition was a God-given faculty, possessed by only a few favored men and women who do not have to stop to reason. He admits that elephants and beavers reason, but denies that power to the cats that have been mentioned, because a certain bear appears to be continually trying to escape from its cage. I see no force in that argument. And I had also supposed that animals confined in cages walk to and fro more from restlessness than from efforts to escape. If they were constantly trying to get out, they would frequently try to break the bars of their cages, but they have long since learned that they cannot do that, and so seldom try. Such animals in their natural state lead active lives; confined in cages, their natural physical activity forces them to a kind of unconscious exercise which is a relief to restraint.

From reading various works I have got the impression that psychologists are quite generally coming to the conclusion that man and the other higher mammals do their thinking with the same kind of machine—the brain; and the amount of reasoning each does depends quite largely on the size and quality of that machine. And animals that learn of themselves how to do things by observing how human beings do them must do some thinking from cause to effect, and thus use more or less reasoning power. I have found three people in this city who have cats that open doors; two by pulling on the thumb-latch, and one by pawing the knob. C. W. BENNETT.

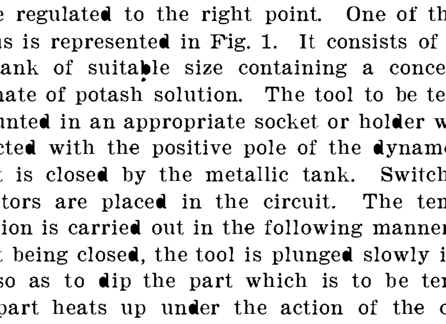
Coldwater, Mich., July 24, 1905.

ELECTRIC TEMPERING OF TOOLS.

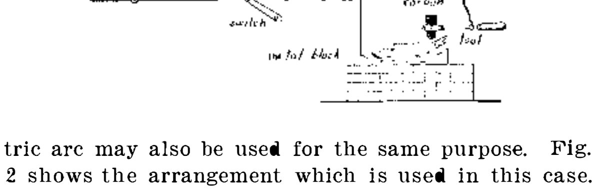
The following simple methods of tempering and annealing tools have been described by J. M. Gladhill. By using the electric current for the heat, we can easily carry out the operations, and the temperature



can be regulated to the right point. One of these apparatus is represented in Fig. 1. It consists of a sheet iron tank of suitable size containing a concentrated carbonate of potash solution. The tool to be tempered is mounted in an appropriate socket or holder which is connected with the positive pole of the dynamo. The circuit is closed by the metallic tank. Switches and regulators are placed in the circuit. The tempering operation is carried out in the following manner: The circuit being closed, the tool is plunged slowly into the bath so as to dip the part which is to be tempered. This part heats up under the action of the current. When the right temperature is judged to have been reached, the current is broken suddenly and the tempering takes place in the liquid of the bath. The elec-



tric arc may also be used for the same purpose. Fig. 2 shows the arrangement which is used in this case. The tool to be tempered is placed upon a support of fireproof material which is also a poor conductor of heat, and the arc is started at first at a low tension between the portion of the tool which we desire to temper and a carbon electrode placed near it. The tension is increased by working a rheostat until we obtain the necessary heat, but overheating or melting of the tool is avoided. As a source of current we use a direct current dynamo which will give a tension varying from 50 to 150 volts. The dynamo is operated by an electric motor working at 220 volts. In this way it is possible to produce arcs varying from 10 to 1,000 amperes by working the rheostat which the ex-



citing current of the dynamos carries. The electric method can also be used with success for annealing. This applies to tools of special form such as gears, dies, and in general to all tools where we need to have a hard temper on the outer part while the inside has a great tenacity. Generally the annealing is carried out by introducing a heated rod into the hollow tool. But this process is defective both on account of the difficulty of keeping up the temperature for a long enough time and also from the cracks which may occur from a too rapid heating up. With the electric process which we illustrate below, such accidents are not to be feared, since the rod is introduced when cold and it is heated up gradually. We are thus able to keep the temperature at the right point during the whole time which the annealing requires. This apparatus is represented in Fig. 3. We employ a transformer which lowers the tension of the alternating current to 2 volts. The secondary coil of the transformer is formed of a copper bar of large section which is connected to each end of the form carrying the tool. We regulate the strength of the current and consequently the temperature of the holder by the use of a rheostat, and thus we can obtain a perfect adjustment of the temperature during the process.—L'Electricien.

Engineering Notes.

Steel as a structural material was first used in a portion of the St. Louis Bridge, completed in 1874, but the first bridge built entirely of steel was the Glasgow Bridge, over the Missouri River, completed in 1879. The extensive use of steel, however, did not commence until 1890. Before that time steel was used only in isolated cases, or for heavy work, such as chords and eyebars for large spans.

Centrifugal pumps were known as early as the seventeenth century. Papin, the celebrated French engineer, designed a centrifugal pump in 1703. Euler brought out a pump of this type in 1754. In 1818 a form of centrifugal pump was brought out in Massachusetts, known as the Massachusetts pump. In 1830 a Mr. McCarthy erected a pump in the New York navy yard which was credited to have approached the efficiencies of the present day. In 1846 Andrews produced pumps of this type, and about this same time John and Henry Gwynne of England commenced the manufacture of centrifugal pumps as a commercial enterprise. Appold exhibited a model of a centrifugal pump at Birmingham in 1849, and at the Crystal Palace Exposition in London in 1851, Appold's pumps were an important feature.

After iron railroad bridges had been in service for about twenty years, engineers who had charge of their maintenance noticed that weak points developed under traffic, particularly in the details and connections. It also became apparent that the bridges built up to about 1875 were deficient in rigidity and lateral stability, and improvements were gradually made to remedy these defects, producing more massive construction, fewer and heavier parts, and a more extensive use of riveted connections. The pin-connected type of truss for short spans was gradually discarded, the plate girder and riveted truss taking its place, and the limiting length of spans for these types was gradually increased. Specifications for iron bridges were also revised and improved; those prepared in 1877 by Charles Hilton for the Lake Shore and Michigan Southern and by C. Shaler Smith for the Chicago, Milwaukee & St. Paul Railroad, and 1879 by Theodore Cooper for the Erie Railroad, being steps in that direction.

The Failure of Ludlow's Airship.

Israel Ludlow attempted thirteen times on July 25 to send his new creation high into the skies at Seventy-eighth Street and the North River, New York city, and finally when the craft turned over on its back it was decided that the machine could not fly in its present form. The apparatus was described a few weeks ago in these columns by Mr. Ludlow himself. Once the flying machine attained an altitude of sixty feet and then it dropped into the midst of the crowd, which scattered to the sand piles and the tall grass with promptness.

Philip Campbell, a Philadelphia aeronaut, offered to sit in the machine and take chances on its leaving the ground. The car was adjusted and a seat made for him to sit on, but instead of rising from the ground the bamboo framework with the shaking wings skidded rapidly along the ground with Campbell waddling in the center. Twice more Campbell vainly essayed the flight in the air, but never rose an inch.

Then some tests without any person in the machine were made, and on the twelfth trial the airship rose majestically sixty feet in the air, soaring like a gigantic box kite. Then, just as it was sailing finely in the air, Mr. Ludlow let go of the rope which he held, and the airship, twisting and twirling, fell into the midst of the watching crowd.

The Current Supplement.

The current SUPPLEMENT, No. 1544, has a striking front-page illustration showing a race between a steam locomotive and a powerful electric locomotive, which has just been built for the New York Central and Hudson River Railroad. The Cerebotani autotelegraph, an article contributed by the Belgian correspondent of the SCIENTIFIC AMERICAN, describes an important invention, having for its object the direct transmission of writing. The English motor omnibuses for city and country use illustrate some interesting types of public conveyances. The article on the construction of a silver glass telescope 15½ inches in aperture, and its use in celestial photography, is continued. The usual electrical notes and science notes, etc., will be found in their accustomed places.