### Miners' Unions in Prussia.

The oldest associations amongst working men for mutual aid, of which modern trades' unions are the youngest offspring, are unquestionably the "Knappschaften," or miners' unions of Germany. They date back more than 600 years and were established wherever German miners migrated; they had written rules and regulations, and generally received corporate rights from the respective sovereigns who wished to encourage mining enterprise within their own dominions, particularly for the sake of winning precious metals. The German miners' unions exist over all Austria, Russia, Norway, and Sweden, where the art of mining was introduced from Germany; and the technical terms, still in use by the profession in these countries, bear witness to their German origin, as well as the general mining laws which regulate the acquisition of mining property from the State and the obligations of mining proprietors towards the sovereign, who holds all mineral treasures under regal rights. In no other country but Prussia, miners' unions or "Knappschaften" have been developed with so much care by legislation for the general benefit of the working miners; and though they are still capable of improvement, they can fairly be pointed out as models which are worthy of imitation for the benefit of the other working classes. The report on the miners' unions in Prussia during the year 1870 has lately been published, and we find in it data which may prove of value to the mining interests of this country, where the improvement of the social condition of a large population of miners is just now being eagerly discussed.

The war of 1870 has not failed deeply to affect the condition of the "Knappschaften," as over 30,000 members were forced by it to leave their peaceful calling and to enter the ranks of the army. The direct object of the miners' associations is to render immediate assistance to its members when they are in need of it, so that, if injured by an accident or if taken sick, they receive assistance during the duration of their illness, besides free medical treatment and medicine. If their case should make it desirable, they are received without cost at one of the unions' infirmaries; and in the event of death, the union furnishes the funeral expenses. If, through any accident or through age, they become too infirm to gain any wages by their work, they receive for life a pension out of the common fund; and according to the degree of their infirmity, they are classed as pensioners, or half pensioners, and obtain help accordingly. If a member leaves a widow and children behind him, the former receives a monthly pension until she dies or marries again, while the children are assisted until they are 14 years old, besides free school to the same age. There are two classes of union members, permanent and temporary, the latter only acquiring personal rights, while the former, after 5 years membership, have their rights extended to all the members of their family; but both classes forfeit their rights when they leave their union without permission, or cease to pay their contribution, which, as a rule, is 3½ per cent of wages earned. The property of the union is thus principally derived from contributions of the members, but also to no small extent from voluntary donations, as well as from contributions of 1 per cent on their incomes, which the mine owners are legally obliged to pay. This fund is under the management of a committee of trustees, "Knappschafts Aelteste," who are freely elected by the members and placed under the control of the Government mining engineer of the district, who is made responsible, to prevent defalcations and to see that members always obtain justice.

On the 1st of January, 1870, the miners' unions comprised 202,562 members, of whom 102,174 were permanent and 100,388 temporary. The number of persons supported by the unions during the year was 45,057, namely, 9,267 pensioners, 277 half pensioners, 13,883 widows, and 21,630 orphans, and school money was paid besides for 45,402 children. The total income of the union was $1,600,000. During the year, medical assistance was rendered to 117,025 persons, sick wages were paid for 1,436,826 days, and 9,486 members received, in all difficult cases, free medical treatment at the hospital. Most of these cases were the results of accidents.
—*Engineering.*

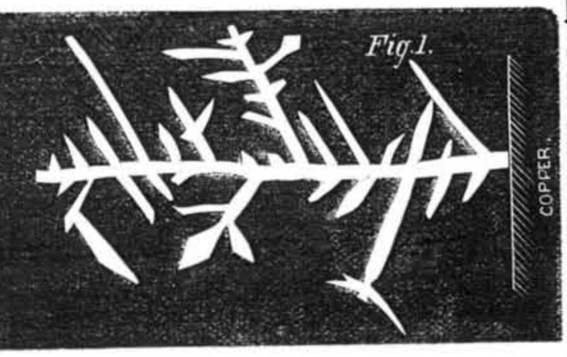
FAST RIDING.—At Dexter Park, Chicago, recently, Charles Rettiker, "the California Boy," undertook the feat of riding on horseback 200 miles in twelve consecutive hours, being at an average speed of sixteen and two thirds miles per hour. The track used was the circular one, seven eighths of a mile in length. Fresh horses were used for each round. On the the twenty-fifth round, the horse bolted the track and leaped the rail, falling upon its rider, who, however, not being much hurt, remounted and finished the round. On the 198th round, the race came to a sudden termination, as the horse again jumped the fence and threw his rider with such force that he was obliged to be taken from the park in a carriage, and he now lies in a very low state, although the physician has some hopes of his recovery. He had made 172⅞ miles in nine hours and twenty minutes, and but for the accident would undoubtedly have accomplished the feat.

GALVANIC ACTION ON IRON SHIPS.—It is an alarming fact in practice says the *Engineer*, and one that, being so perfectly in accordance with theory, ought to awaken no surprise, that should even a minute piece of copper come into contact and so remain, with the inside bottom of an iron ship then wetted with bilge water, as under the circumstances of the case, it, necessarily must be, active galvanic energy is established between the two metals, and iron being the sacrificial metal of the couple, the bottom will, sooner or later—and sooner rather than later—be eaten through in a hole somewhat larger than the superimposed copper.

## CRYSTALLIZATION OF SILVER, GOLD, AND OTHER METALS.

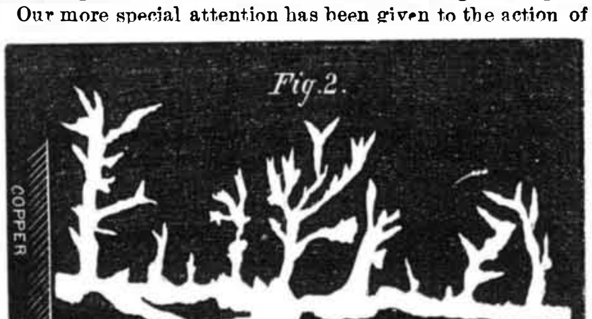
BY DR. JOHN-HALL GLADSTONE, F.R.S., F.C.S.

There are few chemical experiments so well known as the growth of the lead tree, a specimen of which is on the table, together with a silver tree that is said to have been made by the late Professor Faraday. These carry our minds back to the time of the alchemists, who called the first, *arbor Saturni*, and the second, *arbor Dianæ*; and they may be looked upon as the types of a large number of phenomena, in which

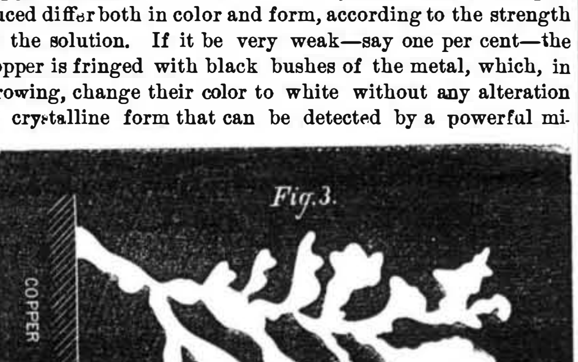



the salt in one metal in solution is decomposed by some other metal. My assistant, Mr. Tribe, and myself have been lately examining these replacements, the metallic crystals which are thus produced, and the forces that act through the liquid.

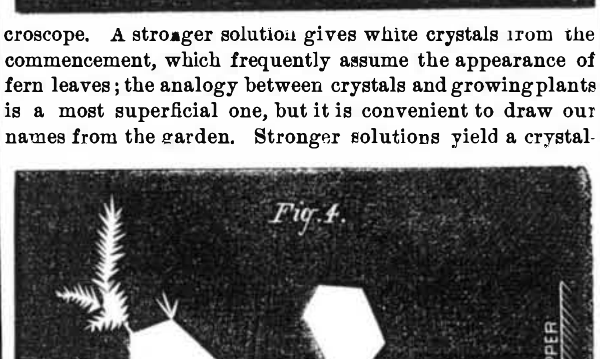
Our more special attention has been given to the action of



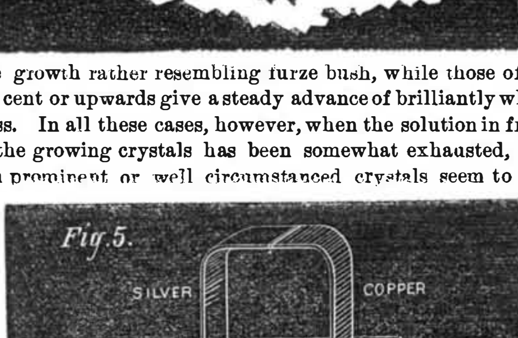

copper and nitrate of silver. The crystals of silver thus produced differ both in color and form, according to the strength of the solution. If it be very weak—say one per cent—the copper is fringed with black bushes of the metal, which, in growing, change their color to white without any alteration of crystalline form that can be detected by a powerful mi-




croscope. A stronger solution gives white crystals from the commencement, which frequently assume the appearance of fern leaves; the analogy between crystals and growing plants is a most superficial one, but it is convenient to draw our names from the garden. Stronger solutions yield a crystal-




line growth rather resembling furze bush, while those of 15 per cent or upwards give a steady advance of brilliantly white moss. In all these cases, however, when the solution in front of the growing crystals has been somewhat exhausted, certain prominent or well circumstanced crystals seem to mo




nopolize the power, and to push forward through the remaining portions of the liquid. This gives rise to beautiful branches, which assume a variety of graceful forms, but, as a general rule, the weak solutions give feathery and pointed crystals, as in Fig. 1: the moderately strong solutions tend towards jagged forms, as in Fig. 2; while the strongest grow branches that terminate, not in sharp points, but in rounded leaflets, as in Fig. 3. Besides this, there occur all kinds of crystalline combinations, as for instance, the spray sketched in Fig 4. It is very beautiful to watch the growth of these silver crystals round a piece of copper under the microscope; a blue glass underneath adds to the effect, but they are best seen when they reflect a strong light thrown upon them. If, instead of putting a piece of copper into a drop of nitrate of silver, a piece of zinc be placed in one of terchloride of gold, there is at once an outgrowth of black gold, which speedily changes to an advancing mass of yellow, or perhaps of purple metal; and it is very apt to form beautiful fringes, or to shoot its yellow branches rapidly round the margin of the drop. Acetate of thallium yields a forest of thorny crystals; and chloride of tin causes a luxuriant growth of large flat leaflets, or of symmetrical structures resembling fern leaves, except that the smaller fronds are arranged at right angles to one another. The new metal indium gives thick white crystals upon zinc; while bismuth and antimony form black fringes resembling the first action of gold.

The forms assumed by native metals resemble those produced by this process of substitution. In some cases, indeed, it seems almost certain that the deposition of these minerals was effected in the same way, as for instance, the silver which occurs sometimes in tufts, sometimes in large crystals, on the native copper of the Lake Superior district. Gold is frequently found in cubes more or less rolled, but the leaf gold from Transylvania bears a striking likeness to the crystals that form in our laboratory experiments. Silver is often found native as twisted hairs or wires of metal—a form that never occurs in the decomposition of its nitrate by copper, but which can be artificially produced in another way.

There has been noticed a singular tendency in old silver ornaments and coins to become crystalline and friable. Here is an ancient fibula from the Island of Cyprus, supposed to be at least 1,500 years old, which, through the greater portion of its substance, presents a fracture something like that of cast iron, and its specific gravity has been reduced in round numbers from 10 to 9. It contains a little copper. This property of certain metals, or their alloys, to change in condition and in volume, is worthy the attention of those whose duty it is to make our standards. Experiments should be instituted for the purpose of learning what metals or combinations of metals are least subject to this secular change.

These metallic crystals are Nature's first attempt at building. The material is the simplest possible—in fact, what chemists look upon as elementary. But how is the building carried on? What are the tools employed? Where are the bearers of burdens that bring the prepared pieces and lay them together according to the plan of the Great Architect? We must try to imagine what is taking place in the transparent solution. The silver, of course, existed at first in combination with the nitric element, and for every particle of silver deposited on the growing tree, an equivalent particle of copper is dissolved from the surface of the plate. The nitric element never ceases to be in combination with a metal, but is transferred from the one metal to the other. On the polarization theory, the positive and negative elements of the salt constantly change places and enter into fresh combinations, one consequence of which would be a gradual passage of the nitric element from the growing silver to the copper. This actually takes place, and there is a diminution of the salt at the ends of the silver branches, giving rise to an upward current, and a condensation of nitrate of copper against the copper plate, which gives rise to a strong downward current. These two currents are seen in every reaction of this nature. In the case of silver and copper, however, it has been proved that the crowding of the salt towards the copper plate is more rapid than would follow from the polarization theory. The instrument employed for determining this point was a divided cell in which two plates, one of silver and the other of copper, connected together by a wire, are immersed each in a solution of its own nitrate, contained in each division of the cell, and separated from one another merely by parchment paper. The crystals of silver deposited on the silver plate in this experiment are very brilliant.

There are other indications of the liquid being put into a special condition by the presence of the two metals which touch one another. Thus zinc alone is incapable of decomposing pure water, but if copper or platinum be deposited on the zinc in such a manner that the water can have free access to the junction of the two metals, a decomposition is effected; oxide of zinc is formed, and hydrogen gas is evolved. At the ordinary temperature, the bubbles of gas rise slowly through the liquid, but if the whole be placed in a flask and heated, pure hydrogen is given off in large quantity. We have also found that iron or lead similarly brought into intimate union with a more electro-negative metal, and well washed, will decompose pure water.

As might be expected, the action of magnesium on water may be greatly enhanced by this method; and a pretty and instructive experiment may be made by placing a coil of magnesium in pure water at the ordinary temperature, when there will be scarcely any effect visible, and then adding a solution of sulphate of copper. The magnesium is instantly covered with a growth of the other metal, and at the same time the liquid seems to boil with the rapid evolution of hydrogen bubbles from the decomposed water.

When, however, the force of the two metals in contact has to traverse a layer of water, the resistance offered by the fluid prevents its decomposition. This must also be an important element in the decomposition of a metallic salt dissolved in water, and, in fact, we have found that the addition of some neutral salt, such as nitrate of potassium, increases the action—apparently by diminishing the resistance of the liquid. If, too, we increase the quantity of the dissolved metallic salt, we get more than a proportional increase of deposited metal. Thus, in an experiment made with the different strengths of nitrate of silver on the table, the following results were obtained in ten minutes, all the circumstances being the same except the strength of the solution: 1 per cent solution dissolved ·025 grammes copper; 2 per cent dissolved ·078 grammes, and 4 per cent dissolved ·224 grammes.

In fact, it had been found that, in solutions not exceeding 5 per cent, twice the amount of nitrate of silver dissolved in water gave three times the amount of chemical action; and this was true with other metals also in weak solution. It is likely that this is not the precise expression of a physical law, but it agrees at least very closely with the results of experiment.

The power arising from this action of two metals on a binary liquid may be carried to a distance and produce similar decompositions there. This is ordinary electrolysis. Metals have been crystallized from their solutions in this way, and Mr. Braham has made excellent preparations of crystalline silver, gold, copper, tin, platinum, etc., by using poles of the same metal as is intended to be deposited upon them. The forms thus obtained are precisely analogous to those produced by the simple immersion of one metal into the soluble salt of another, and illustrate still further the essential unity of the force that originates the two classes of phenomena.

## Correspondence.

*The Editors are not responsible for the opinions expressed by their Correspondents.*

### A Plea for the Classics.

*To the Editor of the Scientific American:*

In your issue, dated May 25, I noticed, in an article entitled "How to Conduct Scientific Investigations," this sentence: "Not only are physics and mechanics more pleasant studies than Latin, and chemistry more interesting than Greek grammar, but we assert that a man may make more money, by applying a mere superficial knowledge of these sciences, than by a much more profound knowledge of the dead languages." From the above, one would draw the conclusion that money making was the chief end of man. If that be so, perhaps the writer is correct. But man was born for a higher purpose than the simple attainment of wealth. I maintain that every man who comes into the world was put here to make humanity better for his being in it, and not only for his own aggrandizement; and he who fails in this, fails to do his duty. Society demands some benefit from all, in order that it may advance. And fine literature will cause this advancement. I challenge any man to bring forth writings on any scientific subject whatever, chemistry or botany, natural history or mineralogy, and in them will be found derivations from the dead languages. Ask any eminent lawyer what advantage he has gained from the study of Latin and Greek; the universal answer will be "almost every thing." Look at his law books, and you will find nearly every alternate word to have derivation in the ancient languages. Although I do not wish to depreciate Mr. Bryant's translation of Homer, yet I assert that no one can fully appreciate the work until he has read the original Greek. A man may have the most "profound knowledge" of any science, and yet it would be almost impossible for him to deliver a lecture on that subject and not make some stupendous grammatical mistakes, provided he is ignorant of the classics, thereby making himself the laughing stock of the community. Not long since, a case came under my personal observation, in which a young man who never had looked into an English grammar, yet had a tolerable knowledge of the classics, was placed in an examination on that subject (English grammar), with several who knew nothing of Latin or Greek, but had always studied English; the consequence was that the one understanding Latin passed better than three fourths of the rest. This only goes to prove how utterly dependent our own language is on the classics. When a boy or girl is striving to obtain an education, he or she should not only study what will be of practical utility, but what will prepare the learner for the battle of life. The study of these languages gives the brain a thorough drill that can be obtained in no other manner; it compels the mind to think, and think correctly; to rely on its judgment, not on its memory; whereas mathematics and natural sciences give exercise only to the latter, which, too often, is fickle. Step into the Senate chamber of the United States, count the noses, and you will find that a majority of the members are classical scholars and college bred men. From the foregoing remarks, no reasonable man can fail to see that, while the sciences have their uses, they are still dependent upon language for their elucidation. And granting that more money may be made by their immediate use, nevertheless the classics lend influence to the "pen," which rules the world, and which, as all men know, is more "powerful than the sword." In conclusion, allow me to quote the memorable passage of Cicero: "*Idem ego contendo, cum ad naturam eximiam atque illustrem accessit ratio quædam conformatio doctrinæ, tum illud nescio quid præclaram ac singulare solere existere.*"*

G. L. F.

### Testing Turbines.

*To the Editor of the Scientific American:*

As a well written communication by Mr. A. M. Swain, in the SCIENTIFIC AMERICAN of June 1st, on the subject of turbine wheels, pointedly alludes to a short article of mine, on page 228 of the current volume, and somewhat misconstrues me, I beg to say a few words in reply, not defensive, for my impression is that such are not needed, nor controversial, for I have not the time even if you had the space.

The inference seems to have been formed that the test of which I spoke was made in raising water. I did not intend to say this. I suppose in every test, if its commercial aspect is to rule, the water discharged, time, and the net result, are the elements of calculation. In this case, the head was 110 feet, the water discharged by the hydraulic engine—not a ram—about 42 per cent of what the turbine used for the same work in raising a weight. If there is a more simple method, a more accurate one than this, I would like to know it. In Mr. Swain's communication, overshot wheels are instanced. I propose to follow them up as proof. If an ordinary over shot receives pressure earlier than at 45° away from a vertical line through its shaft, it discharges it enough earlier, than at the corresponding angle below the shaft, to render it next to certain that the full weight of the water utilized cannot be greater than what is due to the capacity of the buckets between these points. This quantity would be represented by the 90° remaining between them, or 50 per cent of the weight of water the buckets would contain if the whole diameter of the wheel were effective. How then could 70° of the discharge be raised to its head, even if taken from the tail-race? And much less could it be done if taken from a mine.

There is, doubtless, some "inaccuracy" about the process. A parallel holds good as between an overshot wheel, using about 90° of its circumference, and a hydraulic engine. In each, if the instrument is withheld from movement, the power is retained; but with a turbine, a forcible total stop page only checks the flow, and power is lost. If in the most approved turbines, 8 per cent of water under pressure is intentionally freed, is it not done to give the best effect to the balance? And if so, does it not go to show that my use of the word "speculation" was not loosely taken?

This loss by a turbine, I hold to be a fair representation of the disparity between the two systems; but it is very much understated in the 8 per cent; and the 12 per cent is demanded as a reasonable allowance for other things. Wherever allowances are asked, that have not been, perhaps cannot be, proved to be precisely right, I must still call them speculation. Only the weight of the water can be used as power, and a turbine does not use the whole. I cannot say that 86 per cent of the power of water upon an overshot wheel has not been utilized, but I am incredulous for the reasons stated, even though the buckets were made to trip, after a vertical passage the distance of the diameter of the wheel. Your correspondent, in speaking of the test I suggested, to wit, that of forcing back to its head as much water as the power would raise, has apparently overlooked the allowance I proposed for every necessary mechanical obstacle. This allowance need not complicate the process; the difference between the quantity discharged and that replaced would measure the exhaustion of power; then if the "necessary obstacles" were or could be measured, and added to the replacement effect, raising it to its original condition in the reservoir, my case would be lost. I have no arguments against turbine wheels; they are excellent devices and are doing immense service; but I only do not believe that they have ever used the percentage of power claimed.

R. H. A.

Baltimore, Md.

### The Cherokee Tribe of Indians---A Subject Interesting to Antiquarians.

*To the Editor of the Scientific American:*

If I am correct in memory, it was near twenty years ago when I met with Henry E. Colton in Macon county, North Carolina, and his business seemed to be an inquiry after the ancient relics, as well as traditional history, of the former inhabitants of the country, to wit, the Cherokee tribe of Indians. Mr. Colton directed one enquiry to myself: "What could have been the intentions of the Cherokee Indians in building so many large earth mounds that were met with in the low grounds of these mountain valleys?" My reply was that "the Cherokee tribe of Indians disclaimed all knowledge of the origin of those earth mounds, as well as the purposes for which they were built; and, furthermore, that I had evidence, satisfactory to myself, that these mountain valleys had once been inhabited by some race of people antecedent to their occupancy by the Cherokee Indians; and that this fact I inferred from the wide diversity in form, material and quality of their pottery, as well as their edged or cutting utensils, but more particularly as regarded their mode of sepulture, which, in all races, is permanently fixed; and in pursuance of this subject, I related to Mr. Colton the following incident: After the Cherokee Indians abandoned the country in the year 1821, I, in a spirit of romance, became a small farmer in a wild and picturesque valley in the country the Cherokees had left; and while plowing, in a low ground or bottom fields, in passing over a certain spot the plow produced a rumbling hollow sound, and this led to digging—rather scraping away the earth—in quest of the cause; at the depth of fourteen inches I met with charcoal, and then a clay slab that had been so highly indurated by burning that it had the hardness of a brick. An effort was made to take this slab up entire, as it was but seven feet in length and four in width; but this we failed to do, as it broke in turning it over. But what was our astonishment to find, on the reverse or under side, the complete cast of a human body, not a vestige of which was to be found! From all the appearances, the opinions I formed at that time (and these opinions have not changed) were that at some remote point in the world's human history, some peculiar race of people inhabited this country, whose mode of sepulture was to place the body of their dead in a shallow grave in a nude state and on its back, with the limbs extended at full length, cover it with soft clay mortar, pile wood upon it and consume the body with fire. Furthermore, the problem was suggested: May it not be that this race, so far back in the history of man, were the mound builders? In my farming, I found but two other of these burnt clay sepulchres. All of these facts I narrated to Mr. Colton, and about thirty years after their discovery, and after the abrasion of time and the wear of the plow share in farming my lands had reduced these casts in the clay slabs to fragments.

For the first time after the delivery of the above narrative to Mr. Colton, I met with him at a Cherokee Indian ball play, and this was in the year 1860; and he addressed me, as I then thought, somewhat rudely, in these words: "Mr. McDowell, some years ago you described to me some peculiar Indian sepulchres you had found in your fields—have you, since then, discovered any more of these?" My reply was "I have not." He rejoined: "The reason why I now name this subject is this: I published your narration, and archæologists and antiquarians give no credit to your story, because, they say, it is contradictive of all the modes of sepulture yet discovered among the various tribes of Indians on this continent, and it is due to your reputation as a man of truth to find and exhibit one other of these sepulchres." I was wilted by Mr. Colton's words and manner, because, not knowing for why, I felt as though I were half a villain. I made him, I fear, an unmannerly reply that was more practical than pious, and have not seen Mr. Henry E. Colton since, nor have I searched for another sepulchre for the purpose of redeeming my lost reputation as a man of truth.

And yet a kind Providence has saved me, from going down to my grave disgraced, in this way: The 16th day of this month was the recurrence of my seventy-seventh birthday, and a team of oxen were pulling a deep running plow through my field, when the point of the plow struck upon the side of one of these burnt clay sepulchres and rent from it a small portion of an arm. I had the plowing stopped, and the locality marked, and it shall remain intact until some scientific individual arrives who can superintend the delicate process of raising the sepulchral slab without injury to the cast of the human figure impressed upon it. I have intrusted the procurement of the proper man to direct this delicate operation to Colonel C. W. Jenks of St. Louis, now superintending, for the American Corundum Company, the working of the Cullasajah corundum mines in this county.

Franklin, Macon county, N. C. SILAS MCDOWELL.

P. S. Since the 25th inst., when Colonel Jenks and myself conversed publicly on the above subject, eleven of these sepulchres have been reported to me, found in different localities.

S. McD.

### Do Snakes Charm Birds?

*To the Editor of the Scientific American:*

In taking a morning stroll by a board fence, I discovered a cat bird fluttering along on the edge of the top board, which was about one inch in thickness; and walking closely up to it, say within four or five feet, I discovered a black snake, about four or five feet long, lying well balanced on the edge of the top board. Neither the bird nor his snakeship seemed at all disturbed at my proximity; but the former, crying and with hanging wings, would advance and retreat, each time seeming to approach nearer to the glistening eyes of its charmer. My sympathy was at once aroused for the bird, and fearing that in its next advance it would be taken captive, I took off my hat and held it on the fence about two or three feet from the snake's head "to break the charm;" but to my surprise, as before, here came the bird towards the hat; it flew over it and lit on the fence near to the serpent's tail. I then armed myself with a cudgel about two feet long, and stepped back about a rod from the parties to observe strategic movements. The bird continued the same movements at the tail which it had done at the head, advancing and retreating, drawing nearer each time, until finally it lit on the tail, then off on the fence, still fluttering, chirping and crying. His snakeship did not seem to fancy an attack in the rear, and slowly lowered about one foot of the tail end, and let it hang down the side of the board. The bird, encouraged by this move, again and again lit on the back part of the body toward the tail and once struck it with its bill. The snake not being able to turn its head back and keep its balance on so narrow a base, it retreated from the bird, coming towards me (it seems that I was not worth its notice), moving slowly along until it reached the post, passing it far enough for the middle of its body to rest on the post. I began to think that it had given up the chase; but not so, for, with all the wisdom of the serpent and the calculations of a civil engineer, he turned his head, doubling himself until his head was within about six inches of the end of the tail, head slightly elevated, and seemed to say: "Now, birdie, come on." Sure enough, it came, fluttering and crying as before. I advanced to within about three feet of the snake, stick in hand, ready for the "clash of arms." The bird approached so near before retreating, I feared to let it advance another time, and immediately made battle in its behalf, and so slew the "sarpint." A darkey, witnessing the conflict, took the snake, saying: "I will hang him up wid his belly to de clouds to make de rain come." And now I cannot tell whether or not a snake can charm a bird; can you?

H. L. EADES.

South Union, Ky.

### The Nebular Hypothesis.

*To the Editor of the Scientific American:*

Your comments on the "Nebular Hypothesis," page 345, current volume SCIENTIFIC AMERICAN, are very interesting, but I differ from you. I am confident that the equatorial zone cooled first and that the mighty force of that shrinking belt was resisted by no other force. The central mass was

*Similarly, I assert that when reason adds, to an exceptional and enlightened nature, some system of education, the celebrity and distinction that there may lie in is unknown.—*Eds.*]