THE GREAT EXPOSITION—LETTER FROM UNITED STATES COMMISSIONER PROFESSOR R. H. THURSTON.

NUMBER 5.

VIENNA WELT-AUSSTELLUNG, JUNE, 1873.

Probably every engineer who has come to visit the *Welt-Ausstellung* is greatly disappointed in his search for novelties in mechanism, or for evidence of important improvements in methods and processes of production. There seems almost nothing to be found, throughout this vast collection, which can be considered both new and important. What there is of machinery that is newest and most interesting is said, by the majority, if not all, of those who refer to the subject, to be in the United States section, where also may be found, frequently, the originals from which exhibits in other sections have evidently been copied. Not a day passes without some new example of imitation of American designs, and often of precise *fac similes* of our standard machines, presenting itself. Our own exhibit, with which we have been so greatly dissatisfied on the score of its small extent and its incompleteness, appears decidedly creditable in its marked characteristics of excellence and originality when compared with those of other nations. It is far in advance of them all.

GREAT BRITAIN

covers a larger area, in consequence of her requirements of space for textile machinery, but the number of her exhibits is less than those from the United States. Great Britain gives evidence, always observable in her departments at these exhibitions, that her mechanics are workmen of the very highest class, and that British machinery is as notable for its solidity, strength, and durability, and for excellence of workman hip, as is that from our own country for its originality and its ingenuity.

FRANCE

displays a considerable amount of machinery which, lacking preëminence in those qualities which distinguish the two great English speaking nations, is still excellent and highly creditable. In scientific apparatus, and machinery which must be classed by itself as intermediate in character between the industrial and the purely scientific, the French excel.

Other nations present exhibits which contain some exceedingly creditable examples of good design and workmanship, and which, particularly those of

GERMANY AND AUSTRIA,

are of great extent. They are almost invariably, however, very barren of really original designs, and, judging from this display, the observer is very much inclined to conclude that the talent for invention which is the leading characteristic of our mechanics is a very rare attribute among these people.

ITALY

has made a magnificent display in the Industrial Palace, and in the Fine Art gallery, where elegant textile fabrics, beautiful *bijouterie*, splendid paintings, and life like statuary prove that she is still foremost in all that most delights the artistic mind; but in the Machinery Hall she presents no single strikingly meritorious production, and the impression made upon the engineer who looks through the collection is that he is inspecting a museum of antiquities rather than of the newest and best machinery which that country has produced.

SWITZERLAND AND BELGIUM

exhibit some excellent examples of standard machines, neat in design, well built and well finished.

The most beautifully finished work in the whole exposition is probably that sent by the Creusot works, in the south of France. A small compound marine steam engine, of the Napier type, and a locomotive for heavy work, have been constructed of the best of materials, and have been given a finish which is simply magnificent.

Metal products, iron ores, and iron and steel particularly, are exhibited by all those nations which produce for the world—with the exception of the United States—in large quantity and of splendid quality. The steel is usually the product of

THE BESSEMER PROCESS,

and the facility with which every grade can be obtained is here illustrated, not only by beautiful specimens of every degree of carbonization, but by a wonderful variety of manufactured articles, in which every quality finds its most appropriate application. The fact that we are rapidly passing from the iron age to the age of steel is here most fully and convincingly exhibited. In truth, it would seem as though the transition had actually taken place.

The low grades of Bessemer metal, containing in the neighborhood of one half per centum of carbon, are vastly stronger than iron; and this strength, together with its ductility, malleability, and homogeneity, makes it vastly preferable, for almost every use, to any iron. Bessemer metal is already becoming nearly as inexpensive as the better grades of iron, and it cannot be long before the rapid extension of Bessemer manufactures, and the still rapid succession of improvements in the details of the method and of the apparatus, shall so far reduce its cost as to permit its substitution for iron for nearly all uses.

Here, it may be said in parenthesis, may be found one of the most promising signs of the times for the prosperity of our own country. Really good Bessemer metal can only be made from superior qualities of ores, and nowhere in the world can these good ores be found in such quantities, so widely distributed or so accessible, as in the United States. There seems no reason why, in a very few years, these great advantages, together with our wealth in good fuels, should not place us in a position to supply not only our own great and rapidly growing market, but even—improbable as the idea may appear—to export largely to countries which have but limited mineral resources, or which, like Great Britain, are yearly finding both the natural and the politico-industrial obstacles to further progress becoming more and more serious.

The noble exhibits made in this department by well known English, French, Belgian, and German firms are precisely what the well informed might have anticipated; but probably few visitors were aware, until the evidence was presented here, of the vast mineral wealth, and of the degree of development of the resources of the Austrian empire. The

STAATS EISENBAHN

exhibit occupies a building by itself, and affords a most interesting illustration. Several hundred miles southeast of Vienna, among the Carpathian mountains, is the Hungarian town of Resieza, where the manufacturing establishments of this railroad are situated. There have been brought from thence and placed on exhibition some of the finest of iron ores, which are to be found there in great variety. A very excellent coal is obtained from a vein of which a large section is exhibited. The principal vein is said to be 29½ feet in thickness. Several immense ingots of Bessemer metal, made with this fuel from these ores, are exhibited, and also a large number of samples of every grade, broken to show the character of the material by the appearance of the fracture, or bent or tied into knots to exhibit its immense toughness and ductility. Parts of machines, as shafts and rods, difficult shapes, plates of various thickness, tools and manufactured articles of hundreds of different sorts, all made of steel, illustrate at once its wonderful power of adaptation to all purposes, and exhibit the extent to which the "Staats Eisenbahn Gesellschaft" have developed their Hungarian possessions.

Prince Schwarzenburg, who invited us to visit his immense estate at

WITTINGAU

a few days ago, and who there exhibited to our astonished republicans an illustration of the old feudal system in its most unobjectionable form, has also a *pavillon* of his own which is equally interesting. The most careless observer cannot fail to find the most interesting evidences on all sides of the magnificent, but as yet imperfectly developed, natural resources of this great Austro-Hungarian Empire. When the proprietors of this fertile soil shall have imbibed something of the energy and the enterprise of our venerable host of Horskysfeld, and shall have profited well by the opportunity which is now offered them of introducing the agricultural machinery which our inventors have brought to such perfection, and when these valuable mines shall have been developed, and manufactures shall have become well established here, the world is likely to see a national development which has been, as yet, quite unanticipated by foreigners generally.

There are still other illustrations to be observed here of the splendid future which may be secured to the country should a wise policy, liberalizing its government, wake up and educate its people and develope its natural advantages. The good work seems begun; and, if the management of affairs is allowed to remain in as good hands as those which have conducted the great enterprise which has now attracted representatives of all nations to Vienna, it may be confidently hoped that it will be uninterrupted.

GERMANY

is best represented by the contributions of Fred. Krupp, from his immense establishment at Essen. A block of crucible steel, weighing a hundred thousand pounds, illustrates the great capacity of the steel-making department. It has been worked into shape by the great fifty tun steam hammer, which is one of the wonders of Essen. A steel cranked axle for a locomotive is a splendid piece of work, and smaller straight axles, intended for cars and for tenders, are very fine examples of hammer finish; and a considerable number of specimens of locomotive work are of the same admirable quality. Some of these are of Bessemer metal. Krupp evidently takes much pride in his artillery manufacture, and if his exhibits here are average specimens of his work, he has most excellent reason for it. A considerable number of guns for both land and sea are exhibited. On one of the largest he has adopted the "Ericsson compressor," which is one of the most beautiful and effective contrivances of its inventor. The guns are generally breech loading, are rifled with a large number of narrow grooves, and are mounted on iron carriages. The largest gun has a caliber of 305 milimeters—twelve inches—and weighs 36,600 kilogrammes, 80,000 pounds. It has a magnificent finish, and is made of beautifully homogeneous metal. These are built guns, or, as the maker describes them, are constructed upon the "ring system" of Armstrong. In most cases, the recoil of the gun is taken up by a very neat form of "hydraulic" gear, which we should expect to work well, and which experiment is claimed to have proved satisfactory.

Among British exhibitors, Cammell & Co., John Brown & Co., Vavasseur, and Armstrong & Co. compete to some extent with Krupp. The two first named present fine examples of heavy work, and their

ARMOR PLATES

attract much attention. Several are shown which heavy shot have been driven against, making deep indentations which are bordered, in some instances, by a sharp fin, forming a kind of collar and showing well the fine quality of the metal. The other firms exhibit heavy and well built guns. Several torpedoes are exhibited, which are principally noticeable as reminders of the revolution which seems impending in the methods of naval warfare—a revolution which was inaugurated as long ago, at least, as the time of our revolutionary war, and which has exhibited its greatest progress in the United States, where Bushnell, Robert Fulton, John P. Taylor, and other inventors of an earlier period, and Ericsson, Lay, and others of our contemporary engineers, have proved that it promises to change completely the tactics and the *matériel* of navies at a very early date.

There are many special exhibits which are nearly as interesting as any already referred to, and we may be able to find time for their examination at some future period.

R. H. T.

Correspondence.

Testing Steam Boilers.

To the Editor of the Scientific American:

In a late issue of your paper, you mention the need of an iron clad man to take charge of old worn out steam boilers. No doubt it would be a money-making invention; but as the demand would be greater than the supply, we should be no better off than we are now. But why do we not have the same system of boiler inspection and testing, and the examination of engineers, on land as we have on the sea? In this place, there are four saw mills; in two of them there are 130 men at work; and the engineers in both of these mills are men who know nothing about their business, except how to stop and start their engines. One of the boilers is worn out; but what remedy is there? None. On the other hand, there are four tug boats in this harbor (two of them are only allowed to run inside the harbor); and on these, each engineer has to have a license, for which he pays $10. The boilers have to be tested once a year, and the engineers' certificates renewed Now, have the engineers on those tugs (each carrying three persons) any more responsibility than those in the mills mentioned? What we want are a strict law in regard to testing boilers and a strict inspection of engineers, as we have on board boats. Let insurance companies refuse to take risks on buildings using steam power unless the owners have an inspector's certificate. Let a law be passed, compelling all men using steam power to employ no engineers but such as have passed the required examination.

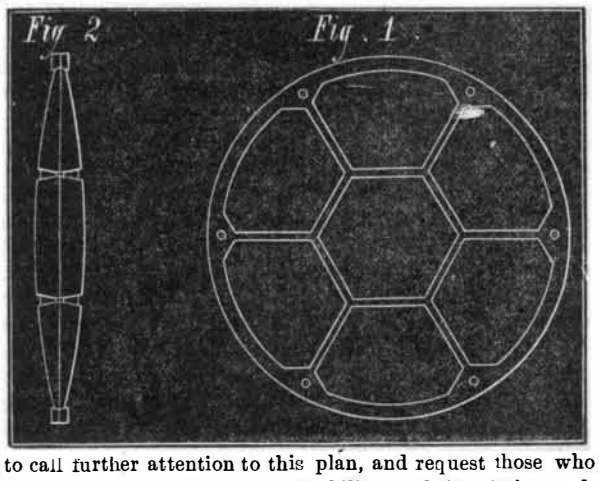
Who will set the ball rolling? We look to you to start it, and to all sensible men to keep it in motion.

Frankfort, Mich. ENGINEER.

The Million Dollar Telescope.

To the Editor of the Scientific American:

The plan, shown in Figs. 1 and 2, of constructing a large object glass, with polygonal lenses having the same focus and arranged in a metallic frame, has been suggested as the probable solution of the great telescope problem. I desire



to call further attention to this plan, and request those who have evidence of its impracticability to bring it forward. With means now at our command, an object glass of this kind can be constructed with a diameter of five feet, and very possibly six feet. If a 25 inch glass can be furnished for $50,000, one of 60 inches should not exceed $600,000. Of the proposed million dollars, this would leave $400,000 for machinery, mounting, etc., which would probably be sufficient, although it is no small task to build a tube 75 or 100 feet long, and mount it in the air so that it shall have sufficient stability and yet be easily managed. Of course the field would be divided by dark bands into polygonal sections similar to the object glass; but would this be a serious objection? I think not.

F. H. R.

New Britain, Conn.

The Lay Torpedo.

To the Editor of the Scientific American:

Your issue of July 19 has an article entitled "Recent Improvements in Torpedo Warfare," in which you give a description of the Lay torpedo. You also state that "experiments made at Newport some time since proved quite successful; but of late, we note that, from various causes, such promising results have not been attained." As this statement is made in your leading article, it has undoubtedly led the many readers of your valuable journal into an error, as well as committed a great injustice to Mr. Lay.

During the winter last past, there were two experimental trials which were unsuccessful, not on account of any fault in the principle of the boat. At one time, the rudder broke; at the other, the cable was defective. These defects were easily remedied; and on May 29, the final test of running one mile and returning was made, entirely to the satisfaction of the commission of naval officers appointed to witness it. The writer was present and knows that the whole run was a perfect success, and that the Lay torpedo boat has proved quite as successful as her inventor had ever promised. When I add that our government immediately accepted the boat, and has already paid Mr. Lay therefor, there can be very little question as to its success. I also have in my possession a letter from Captain Matthews, Chief of the Torpedo Corps, United States Navy, stating that, since such acceptance, he had made even a more successful run with the boat than that of May 29, and expressing himself highly gratified with the performance.

Please give this explanation a place in your paper, as I trust you are ever ready to make amends for any error, however slight, in your columns, especially when it takes from a worthy inventor the tribute of success.

W. W. ROWLEY,
Buffalo, N. Y. Attorney for John L. Lay.

The Causes of Boiler Explosions.

To the Editor of the Scientific American:

Having read of the appointment of a commission to investigate the causes of boiler explosions, I think it proper to assert boldly that no boiler has ever been exploded from gases generated from steam or water. A want of capacity or carelessness of the engineer, a defect of construction or general weakness of boiler, but mainly want of water is the cause of explosions. When any part of a boiler, from want of water, becomes heated, and water is let on to it, the water, striking that part, will assume a globular form; and the globules, in cooling the surface, suddenly become steam, and as a consequence the boiler explodes. Who has not seen globules form on stoves, red hot plates, etc., and suddenly expand? I have experienced this fact in boilers, upon two different occasions (accidentally); and to prove my assertions, I propose, to any party willing to bear expense of the ruination of the boiler, to fill said boiler with water to the usual hight (which is at best arbitrary); then build my fire, raise the steam to 70 pounds pressure, allowing it to escape, and then reducing water, pressure and fire, till the gage shows less than 5 pounds, with but a few gallons of water in the boiler; I will then introduce into the boiler from one to three gallons of water and raise the pressure to 70 pounds again in less time than I can write it, say from one to three seconds. I will be present at the boiler during the trial. The boiler is to be of the tubular or locomotive kind, to have a very large safety valve, and to be previously submitted to my thorough inspection. GEO. H. LENHER.

Elizabeth, N. J.

The Zodiacal Light.

To the Editor of the Scientific American:

T. R. L., in his explanation of the cause of the zodiacal light, on page 51 of your current volume, made, I think, the following mistakes:

1. There is no reason why the lune 1 I 2 G only, and not every part of the surface of the earth that is illuminated by the sun (the entire lower half), should reflect solar rays in the indicated manner. Why should the phenomenon, explained in the diagram, be seen only east and west and not north and south, and in every direction, the sun being in a vertical line below the observer?

2. A second reflection of the rays on the outline of the atmosphere can hardly take place, because the density of the gaseous envelope of our earth diminishes gradually, and hence does not exhibit a reflecting face. The air, however, does absorb and disperse some of the light which passes through it; and, therefore, "dispersion" should be substituted for the "second reflection."

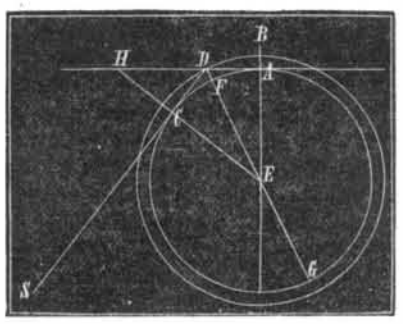
3. In the diagram, the atmosphere is supposed to be higher than the radius of the earth. Had T. R. L. made the diagram with better proportions, sketching the hight of the atmosphere as about $\frac{1}{10}$ of the radius of the earth, he would at once have seen that his theory cannot account for a "double light."

4. That section of the atmosphere, above the horizon of the observer, which is illuminated by the reflected rays is also illuminated by the direct rays of the sun, as the diagram clearly shows; and therefore, I fear, T. R. L. gives a theory, not of the zodiacal light, but of the ordinary twilight. HUGO BILGRAM.

Philadelphia, Pa.

To the Editor of the Scientific American:

Most of your readers, I am persuaded, will need no demonstration to convince them that the theory of your Mount Airy correspondent, which attributes the phenomenon of the zodiacal light to "reflection of the rays of the sun from the earth upon the atmosphere and thence to the spectator," as contained in your issue of July 26, is untenable. However, lest the diagram contained in the article alluded to may confuse some of your readers, I submit the following as a refutation of the position taken in that article.



Let E represent the center of the earth, S the point of the observer, A B the hight of the atmosphere (50 miles, we will assume), and S C an incident ray. Then, from the well known proposition (Euclid, 36, III), we have $DG \times DF = AD^2$. Therefore, $AD = \sqrt{8{,}000 \times 50}$ = about 633 miles. Because the angles of incidence and of reflection are equal, the last ray of reflected light that can be seen at D corresponds with the incident ray, SCD, which is tangent to the earth at C, and consequently CD = AD. Now, AE : AD :: radius : tangent of the angle AED, whence we find angle AED = 9°. Therefore angle AEH = angle SDH = twice angle AED = 18°; and consequently the last ray of either incident or reflected light is seen when the sun is only about 18° below the horizon of the observer. But it is well known that the zodiacal light is seen when the sun is much lower; and, according to the testimony of Mr. Jones, it may sometimes be seen when the sun is 90° below the horizon, that is, at midnight.

Hence it is certain that the zodiacal light is not "caused by reflection of the rays of the sun from the earth upon the atmosphere and thence to the spectator," as is assumed by your correspondent F. R. L.

J. E. HENDRICKS.

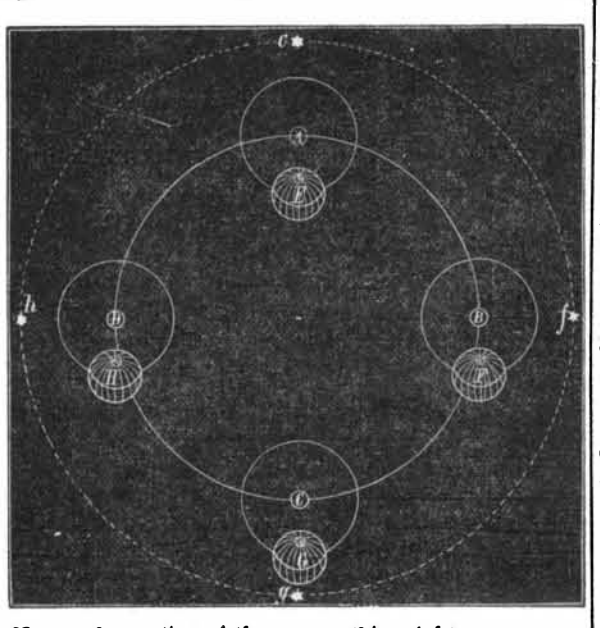
Des Moines, Iowa.

The Retrogression of the Sun.

To the Editor of the Scientific American:

One of your correspondents, on page 51 of your current volume, argues that the precession of the equinoxes is owing to the motion of the sun in an orbit, and he gives a diagram of the position of the sun and the earth at the summer solstice, in four different points of the supposed solar orbit.

Now his figure is incorrect, because, if the sun had such a motion in such an orbit, it would not change the direction of the earth's axis in the manner which he represents, or in any other manner; and the earth at the summer solstice would not be in the positions, which his figure indicates, in the given places of the sun in its orbit, but would be in the positions indicated in the diagram which I send you. This diagram is a correction of your correspondent's, with the lunar orbit left out as not affecting the question. This figure represents the direction of the earth's axis as unchanged by the sun's motion in his orbit, which is in accordance with the principles of philosophy and the motions of the moon in regard to the sun and earth.



Now such a motion of the sun as this might cause a precession of the equinoxes, but it would also cause a change in the angular distance from each other of all the stars in the heavens, which is not the case in Nature. For instance, if the sun had receded so far westward from A that it no longer appeared in conjunction with the star, *c*, but thirty degrees to the west of it (about the amount of the precession of the equinoxes since Hipparchus' catalogue), then the stars, *c* and *g*, would no longer be 180° from each other; while *e* and *h*, and *g* and *h*, would be nearer together, while *c* and *f* would be further apart than at first; besides, the motions of the stars near the poles would not be such as is observed in Nature. JOHN S. PLUMER.

Sandown, N. H.

To the Editor of the Scientific American:

Your correspondent Mr. Hepburn appears to labor under a singular delusion in regard to what is, in reality, a simple mechanical question; and thus, in trying to avoid a merely imaginary difficulty, he has fallen into a real one. For while a very slight excess of that retrograde rotation, which, in consequence of inertia, takes place in the earth as well as in all revolving bodies, is fully sufficient to account for the apparent retrogressive motion of the sun, it is equally clear that there could not be such a motion of the sun as is represented in the diagram on page 51, without such a counterbalancing weight on the other side of the center of revolution as would require a complete change in the arrangement of the solar system.

If astronomers were but able to understand the simple fact that a body in free space, while rotating on one axis in one direction, can, at the same time, have a rotation in a contrary direction on another axis crossing the first at the center of gravity, they would find no difficulty in comprehending many of the so called anomalous motions of the planets which they have so long attempted to account for on the supposition that one side of a perfectly well balanced body may sometimes be heavier than the other. JAMES A. BAZIN.

Canton, Mass.

Hot Air Engines.

To the Editor of the Scientific American:

Having had considerable experience with hot air engines, especially with the Roper engine, I have been much interested in your correspondent F. G. Woodward's remarks and suggestions in regard to them. The design which he gives, on page 37 of your current volume, though possessing some advantages (especially the self-oiling device, which is good), has many defects which, I think, make it impracticable. Among these are the fire box and fly wheel, which must both be of great weight, being placed high; and the whole engine, as it stands on the air pumps, which must necessarily be small, renders the machine too topheavy for practical use. The location of the cylinders, also, seems to make them difficult of access for the purpose of packing, cleaning, etc. The fire doors being so high, also, make it inconvenient to fire up and rake out the ashes; and, the cylinder being placed beneath the fire box, the ashes and dirt, which are sure to arise when raking out the fire, would settle in the cylinder and cut out both it and the packing.

He does not give his proposed arrangement of valves, or the kind of valves which he supposes will stand when placed above the fire. After considerable and careful observation, my impression is that no successful hot air engine can be built unless the valves are placed outside. This is a subject which deserves discussion, and I am glad to see it agitated. Hot air possesses advantages over steam which, it seems, should eventually recommend it almost universally for a light power, and whosoever has the best engine will certainly have a large field for its sale. H. S. W.

New York city.

REMARKS BY THE EDITOR:—We are glad to draw out correspondence on so important a subject. Mr. Woodward did not send a working drawing of his proposed engine, but merely a sketch of moving parts, and he may have provided sufficient support for the cylinder. He also omitted to mention several details, to which we called attention at the time. We would be pleased to hear from him, if he cares to reply to any of the criticisms contained in this letter.

The Belief of Hippocrates.

To the Editor of the Scientific American:

In reading the article, on page 320 of your volume XXVIII, on "Medical Practice in Early Times," to the progress of which, as you justly observe, Hippocrates contributed not a little, any one not acquainted with the writings of the Prince of Doctors may be led to infer from the context of the article that good Hippocrates was nothing but a materialist; whereas he firmly believed that no disease can be ascribed to a material cause. He, in fact, says that it is impossible to discover the nature of ailments if they are not known in the indivisible (part of man) from which they proceed. By indivisible, we, of course, understand the soul of man. All matter is divisible; the soul, being immaterial, is indivisible.

That Hippocrates was devoutly religious, his life and writings furnish ample proof; in this characteristic, some of our doctors would do very well to imitate his illustrious example, particularly for their patients' sake.

PHILO-HIPPOCRATES.

Kingfishers and Fish.

To the Editor of the Scientific American:

Mr. Darwin in his last book states that the kingfisher always kills the fish before swallowing it. Dr. Charles C. Abbot, of Trenton, N. J., states that the fish is swallowed without killing and often while the bird is on the wing. So far as my observation goes, when a fish is large, or about two and a half inches long, it is killed before being swallowed. I once saw a kingfisher light on a limb close to the surface of the water in a creek; and the bird, having an eye to the business in hand, did not see me (I was about fifteen feet off); it presently dived into the water and returned to its perch with a fish in its bill, about the above stated length. The bird then began to beat the head of the fish against the limb on which it was standing; after a few beats it would stop to see if the fish was dead or not; this was done three times, when the head of the fish was bleeding, and the limb against which the head was beaten was stained with blood. The fish was dead, and it was then swallowed. Now the above named gentlemen may both to a certain extent be correct. The kingfisher may swallow the small fish without killing them; in my mind there is no doubt that they do.

San Francisco, Cal. D. D. S.