temperature was encountered. The heat and sulphurous vapors are almost stifling. Here it is that mineral deposition is still going on. Most noticeable is it in the case of sulphur, minute sparkling crystals of which line the cavities. Not only are cinnibar and sulphur present but gold also in small amount. In the lower tunnel a brown bitumen is abundant in the rock cavities. It results from the vaporization of bituminous matter in the deeper seated portions of these cretaceous rocks. The cinnibar for which the mine is being developed occurs impregnating the silicious sinter and aragonite, evidently having been formed with them. In exploring the deeper and hotter portions of this mine but little stretch of the imagination is needed to picture oneself within the very bowels of the earth.

In the upper tunnel is well illustrated the cooler conditions requisite for the deposition of sulphur. While in the lower tunnel it is found in comparatively small amount, in the upper the rock is richly impregnated with sulphur crystals. The cavities of the brecciated sinter fairly sparkle with them.

On the north extension of the Elgin, sulphur works have been opened for the mining of sulphur, which exists mixed with soft friable tufas of a variable appearance and composition.

A careful study of the Elgin mine would be a means of making one familiar with the formation of sulphur and cinnibar in the coast ranges. While the conditions are of course not all alike, the springs varying in temperature and composition, the manner of deposition is everywhere much the same for these minerals.

LETTERS TO THE EDITOR.

*** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as a proof of good faith.

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The Editor will be glad to publish any queries consonant with the character of the journal.

The Data of Bird Flight.

IN *Science* for Jan. 26, 1894, p. 46, Mr. C. F. Amery, commenting on Professor Langley's recent "Internal Work of the Wind," makes inroads into what had seemed to be the fund of accepted observational data in regard to bird flight—soaring flight in particular. Possibly there is not to be found in print any deliberate and detailed summary of the bare, unexplained, facts of the bird's performance, upon which there is agreement among recent students of the subject, but a considerable list of accordant observations may readily be made up from the several notable papers of the last few years, which have dealt with the general problem from a new experimental point of view. The interested public is aware that the whole matter of air-navigation has of late been taken up *de novo*, by searching inductive methods, and it is fairly to be inferred that renewed observation of soaring birds, in connection therewith, has been more orderly and appreciative of essentials, hence more definite and trustworthy. It is, therefore, disconcerting to the non-specialist to find seemingly fundamental data of the investigation discredited.

Mr. Amery affirms, in effect, that the soaring bird cannot keep up to a level course in straight onward flight, whatever the motion, bodily or differential, of the air through which it passes; that it is by circling that altitude is maintained or gained. Yet it is a matter of frequent comment in regard to the sailing flight of certain sea birds, notably the "wandering" albatross, that they perform just this feat. Circling is the persistent habit of the soaring land birds, of which, among many competitors, the eastern vulture is perhaps past-master for varied skill; and there is conspicuous suggestion of a cause-and-effect relation in sustained circle-soaring. But the sea bird travels a wider field, and more commonly sails a straight course; moreover, its normal plane of flight is not at high altitudes, but within the possible vertical range of the sea-going observer, whose interest, furthermore, the bird reciprocates—in fact, if not in kind—so that its performance is brought into notice at short range. And the burden of testimony is that, in air conditions ranging between extremes of storm and calm, the albatross and other sea birds do, in fact, for long distances, travel the wind on undeviating courses, in virtually effortless flight. It has been my opinion that this paradoxical statement was yet a statement of fact, and that it was only the diverse explanations of this and other similarly puzzling phenomena that were in controversy.

For several years I have been an attentive observer of soaring birds, but my incentive has been limited to the interest of verification for myself of what were believed to be the accepted data of the modern investigation. Mr. Amery's dictum puts us (or at least myself) all the more into disorder because there is seemingly no recognition that, from such a postulate, we must undermine a body of doctrine.

If, perhaps, it is I, as a non-specialist in the audience, who am the one in fault, then there is compensation in the added value my verification-notes will have acquired, as contributions to a question still open. On that contingency I draw upon them here.

The best representatives of the air-sailers, among sea and land birds respectively, of which I have had opportunity for close observation, have been the remarkably tame gulls of San Francisco Bay, and the hawks of the Rocky Mountain region. The gulls are tamed by the ferry passengers, who feed them with crumbs, to be caught on the wing. They follow alongside, a little beyond arm's length. In a wind of moderate strength (I am not able to speak with certainty about directions) they will for some minutes maintain, without wing stroke, fixed positions, with reference to the boat, as steadily as though perched on the rail. In review of the lines of spectators, they abruptly drift forward and backward, and rise and sink between deck levels. As with flies in the air of a railroad car, the general forward course appears to be no matter of their concern. These subordinate motions are all in the vertical plane of the general forward motion—parallel to the boat's side, just beyond cane and umbrella reach. To the vertical plane, the line of the wings is held unvaryingly at right angles. Upon this steady horizontal axis there is, however, rotation at the shoulder; but barely perceptible in amount, and quick, with momentary pauses, discontinuous, and unrythmical—apparently an exceedingly alert and vigilant balancing process. The tail is slightly and slowly opened and closed, fanlike; and slightly, but quickly, tilted sideways, and up and down. The head is moved deliberately, in all directions, with the effect of a quiet glance, independent of the general nervous activity. At an increased distance, as with the leaning ship that has carried the roar of the wind in its sails beyond hearing, only the easy poise is noted. Occasionally a gull will venture to alight on the pilot house. He wheels into position, and, the feet hanging downward, connection is made through the last inch or two carefully, as in train-coupling with both sections in motion; but the wings remain fully extended until the body is at rest, when they are folded in gently, as though pains must be taken to avoid again catching the wind. If startled from his perch, he makes a strong wing stroke, and slants swiftly backward and downward; but the usual mode is a repetition, in reverse, of the alighting process: without the initial impulse of a stoop and spring, he floats outward and upward, ahead of the boat; then, perhaps, circles into place

alongside. In dead calm, few birds leave the ferry slips for the trip, and these labor heavily across in flapping procession.

From observation of land birds I have but one note of interest. It relates to the repeatedly observed feat of a small hawk. In this instance there is no advance in any direction. Like the humming-bird he stands poised, without visible support, at a point in space; but his outspread wings and tail are as steadily held as if wired into place by the taxidermist. He points straight into the wind. If he utilizes its shifting "internal forces," he draws upon them, with extraordinary expertness, for a constantly recompounded resultant, to be maintained equal, and vertically opposed, to the pull of gravity. With almost the suddenness of the humming-bird, he will dart from one fixed position to another, seemingly by expenditure of will power only. I believe that it is high winds alone that afford him this sport, or opportunity. And I have never seen him thus poised over level ground, but among hills, even with their summits, and from one to another, close in their lee, like the humming-bird, again, in a garden. On two occasions I have had a fine chance at this skilled aeronaut, from surveying stations on hill tops. I have been able to keep him for several minutes on the cross-hairs of my telescope. As with the sailing gull, there is the same calm eye and the same quick and delicate teetering of the wings; but the individual feathers, excepting at their strongly up-bent tips, exhibit no blur of continuous motion.

If my opinion in regard to such observations as these be correct, Mr. Amery's assertion is disproved, and belongs to a stage of the investigation beyond which we have advanced.

WILLARD D. JOHNSON.

Le Droit Park, Washington, D. C.

The Mining Building at Chicago.

To what Mr. G. L. English so well says in *Science* of Feb. 16, in defence of the gallery exhibits against the slurs of the anonymous article in *Science* of Feb. 2, on "The Columbian and the Centennial Expositions," I wish to add a word for the "ground floor." Much of the fault found by the writer of the article in question was deserved, but if he had looked for points of merit as well as of demerit he would readily have found them. The exhibit of New South Wales was wonderful for its extent, variety and completeness. It was a strictly economic display but not without scientific features as well. Everything in it was plainly numbered and labeled, and full descriptive catalogues with corresponding numbers were to be had freely on application. The Canadian Geological Survey made a very complete display of rocks, minerals and ores, in which specimens and groups were carefully arranged and plainly labeled, but the Canadians made an excellent showing at the Centennial and might therefore have been excluded from the comparison by this anonymous correspondent. Pennsylvania, New York and Michigan made displays of their great specialties of production, which were well mounted and cased where necessary and were plainly labeled. New York's geological obelisk was certainly of greater educational than technical value, while the needle of Pennsylvania anthracite coal representing the exact section of a single bed was instructive as well as impressive. North Carolina, New Jersey and Missouri aimed to have their exhibits of direct educational and scientific as well as economic value. New Jersey took especial pains to have her ores, minerals, clays and marls distinctly labeled and to put the labels where they could not be overlooked, while a complete series of the geological maps of the State adorned the walls of the space assigned to her. The Missouri exhibit was labeled with the common as well as the scientific name and the chemical composition of each group of minerals or ores represented, in addition to the printed and written labels on each specimen. About 75 framed maps, charts, diagrams and photographs were displayed in this exhibit each of which bore an adequately descriptive label. The "great piles" of ore and metal here had a definite meaning, which was plainly stated on a large label prominently placed. I might go on and mention many points of excellence in other exhibits on the ground floor, without going into details as to the instructive array of mining, milling and quarrying machinery on exhibition, but I have said enough to show that there were more than "one or two" exceptions to this correspondent's strictures. The general public seemsd, indeed, to care more for the Ada Rehan statue than it did for education in mining, mineralogy, or geology, but that is not the fault of the exhibitors who strove to instruct as well as to interest those who strayed into their spaces in the Mining Building, and I quite agree with Mr. English in thinking that the mining exhibit at Chicago far exceeded that at Philadelphia in every respect, though of course any one at all versed in the matter could detect many defects which might have been remedied.

E. O. HOVEY.

New York, March 1.

Petrified Eyes.

IN *Science* of Feb. 2 Mr. Geo. G. Groff, under the title of "Petrified Eyes," calls attention to a statement in some popular school geology that "huge saucer eyes," of a thirty-foot monster, were so perfectly petrified that the "lenses have been split off and used as magnifiers."

About a hundred years ago some students of Palæontology, at Heidelberg, made to represent fossils, out of clay, spiders in their webs, snails with antennæ perfectly preserved, a plump mouse, and other similar things, and left them where they could be found on class excursions. The professor described and pictured them in a book as remarkable fossils. On a latter excursion he found his name fossilized. He gradually realized that he had been hoaxed, and chagrin hastened his death.

Ever since then it has been established that only chitinous, horny, or bony parts of an animal are petrified; soft parts are never petrified. They may leave impressions in a fine soft mud, as the examples of jelly-fish in the Solenhofen—Bavaria—stone so well show. The outlines of the body of worms, fish, reptiles, mammals, are preserved by the shaping of the mud in which they were deposited—not by the membranes themselves being chemically replaced. This is true even of the tougher membranes of the body, as for instance the hide, and much more so with any part as delicate as the crystalline lense. The ease with which the lense is destroyed is shown by one of the three methods employed in treating *cataract* of the eye, where by means of needles the lense is broken up and is finally absorbed by the fluid in the anterior of the eyeball.

Quarrymen seem to delight in finding "fossil eyes," as they name many things from the teeth of *Gyrodus* to quartz boulders.

While the lense could not be petrified, the bony eye cavity, or the cavity formed by the sclerotic ring possessed by many fishes and reptiles (*e.g.*, *Portheus*, *Ichthyosaurus*) could be filled with gypsum, calcite, or quartz in such a manner as to furnish a plano-convex lense.

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