chromosphere than is at present the case. It is true, that owing to the increased pressure at the surface of the nucleus due to a thicker chromosphere, the temperature there may have been a little higher; but I do not think that difference would make up for the increase in absorption of the chromosphere.

Assuming then that the sun gives out more heat now in a given time than he did during the glacial period, and that the earth had already so far cooled down that her surface was not sensibly more warmed by internal heat than it is in our own epoch, the mean temperature of the earth's climate would have been lower, and the sea-level line of perpetual snow nearer the Equator in both hemispheres; and glaciers would have covered vast tracks of country which are now denuded of them.

Again, let us go back some millions of years in the world's history, till we arrive at the carboniferous period. The sun then would probably be emitting less heat than even during the glacial period; but the earth would not have cooled down to such an extent, and her internal heat would be sensible at the surface. The mean climate of the globe would have probably been warmer then than it is now, and the temperature more equally distributed, depending not so much on solar as on terrestrial radiation. This being supposed, the vegetation of England and India in those days must have presented less difference than what we find at present. Does the flora of our English and Indian coal-beds support or upset this conclusion? Can any of your correspondents answer this query, or set me right if I am wrong in my hypothesis of solar radiation?

Hampstead, July 22

J. H. RÖHR

P.S.—Is there any good mathematical treatise on heat, English or French, up to the latest information on the subject? Can you or any of your correspondents recommend me such a treatise?

Telescope Tube for Celestial Photography

I HAVE not yet seen any satisfactory plan suggested of getting over the difficulty experienced in celestial photography by the expansion and contraction of telescope tubes, by changes of temperature in metal tubes.

I therefore venture to suggest the following plan, which may be so arranged as to keep the object-glass and camera-slide *exactly* the same distance apart, and so keep the true focus when once found. The arrangement would have to be modified according to the metal of which the tube is made, but taking a brass one (the most common), with the camera attached to the eyepiece-slide, the correction will be effected by attaching to the main tube, near the eyepiece, two zinc rods the length of the main tube, upon which they must rest loosely; to the free ends of these, near the object-glass, attach a rod of iron extending to the eye-tube; let this iron rod be attached to the eye-tube when the sensitive-plate is exactly in focus; any change in temperature will then have no effect on the focus, for the expansion and contraction of the three metals will keep the distance from object-glass to sensitive-plate constant. All who have worked with a telescope giving sharp definition, will know that this is not an unnecessary precaution, as it may seem to some.

Sydney Observatory, June 14

H. C. RUSSELL

Colour of the Emerald, etc.

I HAVE to beg "A. II." to refer again to NATURE (July 24) p. 254, col. 1, line 23, where he will find it stated that "the emeralds employed were canutillos from Santa Fé de Bogotá. Their specific gravity was 2.69." It is evident, therefore, that they could only be the green silicate of alumina and glucina.

The green sapphire, known also as the "oriental emerald," is the rarest of all gems; and Mr. Harry Emanuel, in his work, "Diamonds and Precious Stones," speaking of it says, "In the whole course of my experience I have only met with one specimen." Its specific gravity would at once distinguish it from the true emerald.

The Beryl A. was colourless, opaque, and had a specific gravity of 2.65.

GREVILLE WILLIAMS

INSTINCT, PERCEPTION, AND REASONING POWER OF ANIMALS

THE correctness of the following facts, bearing on the above question, I can warrant:—

A beautiful greyhound bitch in my possession

had puppies, and I gave one of them, about a month old, to a friend of mine who was also living in Montpellier at that time. Some few days subsequently, on going to call at my friend's house, I took the greyhound with me. She appeared delighted at finding her puppy again, and expressed her strong feeling by lavishing on it, in her own way, the most tender marks of affection. After a few days I paid a second visit to my friend (unaccompanied by the greyhound), when he informed me that, in consequence of the earnest request of one of his friends, he had been induced to give him the puppy, which had thus been removed to a considerable distance. I returned home, and on my arrival was struck with the peculiar manner in which the animal met me. There was nothing of her usual expression of delight—no barking, no jumping to and fro—but she met me with a serious and thoughtful look, and began slowly to smell my clothes in different places, with the most earnest perseverance. Nor was she content with a mere cursory effort to discover the particular object, whatever it was, which, no doubt, she had in view; but she continued the same course of proceeding for at least a quarter of an hour, in fact, till I found it quite necessary to bring it to a close.

From the above statement of the conduct of the animal, the impression on my own mind was that I must have carried away from my friend's house some subtle effluvia, which tended to bring back to the mother the recollection of her puppy. And this caused me some additional surprise, inasmuch as greyhounds are possessed of great keenness of sight, but are generally considered as rather deficient in their power of smelling. The conclusion is still more remarkable. During the space of about two years I usually paid my friend a visit twice a week, and on every occasion, on my return home, the greyhound would invariably go through the same ceremony. At length the proceeding became altogether so striking that it was quite unnecessary for my wife and family (perhaps from a little innocent curiosity) to ask, "Where have you been?" They could save themselves the trouble of a question and say "I see that you have been calling on your friend."

My cousins were residing in a small village about thirty kilom. from Montpellier, and on one occasion, when I was going to spend some days with them, I took, for the first time, my greyhound with me. It so happened that not far off there was a hound bitch that belonged to one of my cousins' neighbours, and between these two animals (from the beginning of my short stay) there arose the deepest hatred and animosity, and conflicts of the most ferocious kind were matters of daily, almost hourly, occurrence. Time altogether failed in producing any better feeling between them, and to the end of my visit each was ever ready and anxious to try their strength whenever the opportunity offered. In the course of the following year I paid a second visit to the same place, accompanied by my greyhound, and about three-quarters of an hour before I reached the village the animal, as if struck with a sudden idea, rushed forward at her full speed, and all attempts to call her back proved quite ineffectual. On reaching the village I found that a terrible encounter had already taken place between the two heroines, who were on the point of renewing the attack after a temporary cessation of hostilities.

The following anecdote relating to the same greyhound seems to prove that these animals may sometimes exhibit a higher standard of reasoning power than according to general opinion they possess.

I was passing some days in the country with my aunt, who had a middle-sized spaniel bitch, of a somewhat sullen and treacherous temper. This spaniel observed, with an evident feeling of jealousy, that my greyhound was making herself quite at home in my aunt's kitchen, and whenever she had a favourable opportunity, without

exposing herself to too much danger, she never failed to give an angry bite to her unsuspecting rival, and immediately to rush for shelter under a kneading-trough, from which position my greyhound was unable to dislodge her.

After a short time the spaniel had puppies, and she was placed with two of them in a corn-loft, over the kitchen, from which there was a door which led to it by a flight of stairs; the door was usually kept closed in consequence of the known animosity between the two rivals. For some days the new mother, entirely occupied with the care of her little ones, did not descend to the kitchen, and my greyhound occasionally showed a strong desire to go up to the loft and see what was going on there. When the puppies were about seven or eight days old, their mother began to re-appear in the kitchen, and to observe towards the greyhound the same line of conduct, with the exception only of an appearance of increased hatred. At length, on one occasion, when the spaniel was eating her dinner, and the corn-loft door happened to be partly open, my greyhound, taking advantage of the opportunity, sprang up the stairs of the loft. I observed the circumstance, and on calling her down she immediately obeyed, and made her appearance before me with a look of perfect satisfaction. About an hour afterwards my aunt's husband, on going to the loft, found both the puppies dead, without the least mark of external violence, and he was at a loss to imagine what could have caused their death. For myself I had an impression on my own mind as to the cause of death, but I did not consider it necessary at the time to mention it to others. I opened the bodies of the puppies, and found my opinion confirmed. The skin was externally sound through its elasticity, but the fangs of the greyhound had done their work, and the liver had been bruised into a kind of marmalade—exactly in the same manner as the greyhound usually crushes the liver of the hare or the rabbit, which, literally speaking, are no sooner seized than dead.

In November last, when I was staying with my cousin, I was much interested in observing the proceedings of various kinds of poultry in a field almost contiguous to the house. There were six or seven young guinea fowls, ducks, hens, &c., and also a pair of old guinea fowls, which kept always by themselves, and continued running to and fro with that perpetual restlessness which is natural to them. In the midst, however, of their wildest proceedings they always appeared to keep an eye on the young guinea fowls, and whenever any of the other poultry happened to approach the spot where they were, the old guinea fowls invariably ran with all speed and drove them away. Two large hens alone seemed to be exempt from this rough treatment, and to have full permission to come near the young guinea fowls or not, just as they liked. One of the hens, in particular, seemed to enjoy some special privileges, and in case of any apparent danger, there was some immediate proof of care and protection on the part of the old guinea fowls.

The above circumstances excited my curiosity, and I obtained the following explanation:—

One of these hens had hatched some guinea fowls' eggs, but after three days had neglected to perform the new functions incumbent on her, and had left the young brood'to themselves. Fortunately, the other hen, which had previously exhibited the well-known symptoms of the fever of incubation, adopted the deserted young ones, and had nursed them with the greatest affection till they were able to take care of themselves. The old guinea fowls, it appears, had observed all these circumstances, and had retained a grateful recollection of them.

Under the roof of a small tower at my father's house in the country, a large number of sparrows (consulting their own convenience, rather than that of others), had established their nests; but in consequence of the extensive injury caused to the corn-fields by their depredations at harvest-time, my father, with a view to lessen their num-

ber, gave direction that all the nests should be removed, and thus, by this wholesale order of destruction, about 80 nests with 366 eggs suddenly disappeared. Their fondest hopes being thus blighted, and the expected fruit of all their labour nipped, as it were, in the bud, the sparrows betook themselves to noisy meetings, and, in their own way, to expressions of anger and resentment. This proceeding continued for at least a week, after which they dispersed, and went in search of some other less dangerous shelter for their future progeny. In the following year some sparrows, which had built their nests under other buildings of our country house, and which had been left unmolested, returned to them; but from that time to the present day (forty-eight years) I can safely affirm that no sparrow has ever rebuilt her nest under the roof of the tower. The singular facts of the case are these: the sparrows decidedly object and decline to build any more nests under the roof of the tower, but they are quite willing to avail themselves of the shelter of the position during the severe nights of the winter season.

Montpellier

DR. PALADILHE

THE GROWTH OF SALMON

SINCE the time of Magna Charta it has been an object, directly or indirectly, on the part of the Legislature, to protect the supplies of salmon with which our rivers used to be so abundantly stocked: but notwithstanding the laws which have at various times been enacted, this fish gradually became scarcer till, in 1861, all the old laws were repealed, and fresh and more stringent regulations made for protecting and increasing our salmon supplies. In addition to the fostering care which is bestowed, under the Salmon Fishery Acts of 1861 and 1865, on the fish in the rivers, means have been adopted to artificially rear salmon, so as to increase their numbers more rapidly than could be done in the ordinary course of nature. Mr. Frank Buckland has been the pioneer of this system of artificial breeding of salmon and trout, and the experiments and operations which have been carried on during the last few years have thrown great light on the hitherto unknown habits of this "king of fish."

Anyone who looks into the fishmongers' shops just now can see what a clean, fresh-run salmon, ready for cooking, is like—a silvery, plump creature, whose "lines" are made for speed in water, and whose graceful curves give the completest idea of vigour and strength in stemming a rapid current of water.

But very few people, probably, know what sort of an appearance this beautiful fish presents in its infancy. Hidden away during that period in the upper waters of our salmon rivers, and ultimately in the depths of the sea, it is lost to sight till it grows large enough to be taken by the salmon nets; and until lately very little was known of its natural history, or of its habits, though the experience of the last few years has revealed many interesting facts concerning the development of this fish, through the egg, fry, smolt, and grilse stages, till it becomes a full-grown salmon.

Fig. 1 represents the egg—natural size—of a salmon just laid. Each female salmon carries, on an average, 800 to 900 of such eggs to every pound of her weight. They are generally of a pinky opal colour, elastic to the touch, covered with a soft horny membrane, with a minute opening through which a particle of the spawn—the soft roe—of the male fish enters, and the egg is fertilised. From this moment the young fish gradually develops, under the influence of the cold running water. At the end of about 35 days—more or less according to the temperature, which should be about 40°—two little black specks can be seen, as at Fig. 2, which are the eyes of the embryo fish; the vertebræ may be discerned in the form of a faint red line, and a small red globule