

THE FIELD

QUARTERLY MAGAZINE

AND REVIEW.

FEBRUARY, 1872.

DO ANIMALS THINK?

By R. A. N.

"CERTAINLY they do, I have never doubted it since I was able to think for myself," says one, a careful observer of the ways of those over whom, by superior craft, we have gained dominion. "Well, not exactly; they have great sagacity and instinct [vague words!], but I cannot admit that they reason," says another, confident that he alone of all created beings has been selected to possess and enjoy so great a gift. (!)

Of all the errors taught in youth, unquestioned throughout maturity, and stereotyped by habit, none seems more persistent in the minds even of some cultivated and intelligent men, than this—that the lower animals have no other guiding principle in the concerns of daily life than what comes from an innate faculty which has been called (to conceal our ignorance of some mental phenomena) *instinct*. The vanity, selfishness, and indolence of mankind are well exemplified in this. They like to assert what they have been taught to believe is their prescriptive right; and, if they allow themselves to admit that the lines of demarcation between themselves and the inferior animals are not absolute and very clearly defined, they may have to consider a wider question about the ultimate destiny of intelligences recognised as such, but not included in the scheme proposed for their own. I have so often encountered the objection to entertain this second question, that I believe it has closed up all inquiry in some minds on the subject of the first. If anyone is content so to extinguish the light which would penetrate his indifference or prejudice, and prefers taking on trust a dogma resting on no better foundation than "the general opinion," to using his proper intelligence on the facts of the case, he must be left to such enjoyment as the slothful find in mental insensibility. I shall not ask him to accompany me through this paper. The appeal is made to those who have studied animals affectionately, depended on the exercise of their powers for amusement, and confidently relied upon them even for the preservation of life itself; who have made of them companions and friends, and regard the bond of sympathy felt as the visible sign of a common nature altogether above and beyond that mere collocation of parts which makes up the physical organisation—and *that* may be more perfect, for certain ends, in an oyster than in a man. It seems almost certain that the contemptuous manner in which the faculties of animals have been regarded by those who never gave them any attention, has grown out of inordinate self-esteem, dogmas instilled by early training, and, perhaps more generally—but certainly so among those who think at all—by the difficult question raised as to what was the purpose in the scheme of creation beyond usefulness

to the animal itself of faculties not denied to them by these? The miserable self-assertion of the first class may be dismissed with this question: Since geology has proved (by evidence which probably you never thought it worth while to look at) that thousands of generations of species were created and lived and enjoyed this earth before yours had any existence, do you suppose the Designer regarded your species as of the pre-eminent importance you would give it? You will say all this was prepared for you; and you need not go far to find men whose names have been brought to the front by dint of some slipshod knowledge of natural science and the persistent iteration of this comfortable philosophy ready to encourage your belief. You may shelter yourselves under their mantle, threadbare as it is. Lyell, Darwin, Huxley, Wallace, and a hundred others, however, have made it a very shabby covering even for mendicant philosophers.

Perhaps it is because we are taught in youth to believe so many things that *are* really good and true, and stand us in good stead throughout life, that we cling to and set the stamp of infallibility upon many doctrines which are neither good nor true. Some correct these impressions by their own experience, but a greater number by far refuse to give up their idols, and hug them closer where their own reason threatens them with demolition. Phenomena these men are, to be classed with the farmers in Blankshire to whom Sir Robert Peel gave an iron plough; and on revisiting them, and expressing his surprise that the old implement was still at work, he received the answer "We be all of one mind, that the new plough do make the weeds grow."

There is no just cause for hesitating to consider one proposition because it *may* involve another. Do animals think? is one for which we have at least the materials, and proceeding to reason about them or not is simply an exercise of will. Whether there is a "Paradise for Pigs" is a purely speculative question, and I do not see that we have any materials here. When Dr. Whewell and Sir David Brewster engaged in that brilliant controversy as to whether the planets are inhabited worlds, the one considered the value of the *positive* evidence we have, and the other dealt in ingenious analogies—very "gelatinous" arguments—sustained with the utmost ability; but after a long struggle Positive Philosophy bivouacked on the ground. Even if a man were to believe, in some secret corner of his heart, that our affectionate friends have their "happy hunting grounds," it would make him no worse a member of society, but an infinitely more tender, just, and merciful master. All *that* he will be, however, if, instead of looking upon them with contempt as the mere slaves of his power, he owns a brotherhood of intelligence with them, and glories in its culture. To avoid cruelty towards them, and, for the rest, to give them no place

in his affections, is unworthy of man's own intelligence, and shows as gross a mental organisation as he thus tacitly attributes to them. I do not know how to appeal to this man: he has shut himself out from a source of great pleasure. I would not choose such a man for a friend; he seems to want that breadth of nature which can contemplate something noble besides itself, neither depreciating nor unduly exalting the gifts of others; there is a churlishness at the bottom of the heart untouched by the simple pathos of an animal's eye in moods of pleasure, distress, sympathy, or affection. I should expect such a man to ride his horse to the point of the alternative between trying its courage five minutes longer or paying a veterinary surgeon's bill. I should expect him to shoot over his pointers, thinking of his "bag," caring not a straw for their hearty, honest labour, and, when they began to get a little dull, calling to his keeper for a fresh brace. Hearing the "tally" of his slaughter at the end of the day, he would go home without a glance at the drooping heads, shivering limbs, and pinched flanks of the faithful servants, but for whose patience and skill the record of the day's work would never have met his gratified eye in the columns of the *Poppingshire Herald*. He is a poor fellow that does not sympathise with the enjoyment of his companions and double his own thereby, but sends them to the kennel, and puts his legs under his comfortable mahogany, indifferent how much is taken out of their constitutions by lying in their cold straw with a full stomach of undigested food. When they are done for, others as good can be bought—to hurry through the same life, without a human friend—to minister to a few more seasons of vanity which our hero calls "sport." If some ingenious American would invent a machine to go over so many miles of moor per day, and unfailingly extend a signal arm over every pack till the last bird rose, it would suit him better than the eager flesh and blood with all its virtues, its occasional mistakes, and its very rare delinquencies. He hates a dog that "potters" even when the frosty air makes his own nostrils tingle, and enjoys the poor satisfaction of cursing the animal when his own cramped fingers have failed on the trigger. The machine is the thing for this man, because he is a selfish being, insensible to the exercise of the intelligence before him, and having no sympathy with the creatures he uses. He may not be actually cruel, but add to the above ingredient, that of a violent disposition, and you have at once the embodiment of all that is unreasonable and unfeeling, of a tyrant under whose lash animals suffer worse agonies than Mrs. Beecher Stowe's sensational "nigger."

But we appeal less for the physical well-being of our humble relative than for a higher estimate of their *mental faculties*, confident that where these are generally known and appreciated there will be a proportionate regard for their comfort and happiness. Sentiment alone, and the natural shrinking in a humane man's bosom from inflicting pain, will go a long way towards making the lives of the animals dependent upon him endurable, if not happy; but we should like to carry the reader a step further, and ask him to spare the lash or the spur, not because it would hurt his own feelings to use them, but because he is dealing with a *thinking* being, and will be doing a most unreasonable act, by attempting to force it to do or not do a given thing when it does not understand the object proposed, and has not learnt any of the steps by which it may be attained. It is a singular fact that, among careful and most successful teachers of animals there are not a few who, though their whole course of treatment is based on the assumption that they are dealing with a creature that reasons, and though they adopt precisely the same methods and expedients for reaching its comprehension, and judge of the results by the same signs which would convince them in a young human animal, illogically declare that (nevertheless) animals "do not think." An instance of this kind of "reasoning" (?) occurs in a small book lately published: and we cannot but ask ourselves how it is that the self-evident conclusion can escape the notice of the writer. The premises are clearly laid down; he might be speaking of a race of human beings

with their means of knowledge, opportunities for observation, and finally their well-defined action resulting from past experience—all the circumstances are not only similar but identical—and yet in the case of animals the corollary is opposed.

The writer says—"The birds have learnt the power of the poisoned arrow—the beasts have a wholesome dread of the ambush and the snare." And continues, "This power of communicating the results of experience, and of circulating throughout a whole species the fear of a known evil is one of the most inexplicable faculties of unreasoning and inarticulate creatures." It will be a much more "inexplicable" thing to the reader that an articulate—I cannot say "able" reasoning—creature should indulge in such gabble. The writer at least succeeds in demonstrating that articulate creatures do not at all times reason, while the legitimate conclusion from his own premises is that inarticulate animals reason throughout a whole species!

By this time those who have had the patience to follow me thus far, will demand an explanation of my question. What do I mean by asking "Do animals think?" I will incur whatever danger there may be in the attempt to lay down a definition, but as I am an earnest inquirer, and by no means offer myself as a teacher, I trust the explanation of my question will not be the occasion of a mere quibble about terms, and I engage to keep as well as I can within my own limitations. First then, negatively—no one supposes that any animal lower than man is capable of those complicated acts of reasoning which involve abstract thought. For instance, there is no evidence that animals ever think by means of symbols; there is none that they entertain abstract speculative ideas, or are able to generalise very widely from a great number of facts—though I hope to show presently that simple generalisations from a few facts are of common occurrence. Next, positively—I claim for them no more than that, given some facts which experience has presented to their observation, and which are at the moment before them, or stored up in memory, they reason upon these, come to conclusions, and act in exactly the same manner that we should ourselves; and the evidence of this is of the same kind, and the results I observe the same as appear in the human creature. In one it may be called thought, in the other whatever you please; I can distinguish no difference, and call the process by the same name. Experience, observation, memory—whence simple conclusions and corresponding acts—make up what I call simple reasoning in my fellow men, and, as I am conscious of all these operations in myself, when an animal, who I know has the same facts before him, acts in a manner exactly similar to myself, I conclude that, whatever difference of *degree* there may be in the special case, or in our mental operations generally, they are identical in *kind*. I contend nothing for the measure of the faculties and the process of thought, only for the nature of it. The measure may be so much greater in some cases as to amount to a seeming difference in kind. I lift, for example, with ease a heavy weight which a child cannot move. In one case there is no result, but I do not doubt the quality—force—to be the same, though the measure of it is not the same.

That there is immense disproportion sometimes between the results of mental operations in the highest animal and the average man need create no surprise when we reflect how great is the difference of power, even comparing man with man. It may be presumed that the brain of a mathematician and the brain of an agricultural labourer are of the same kind, though in one it is capable of solving most abstruse problems, while in the other it just suffices for little more than animal wants. Neither are we safe when we propose fixed lines of demarcation; for the results of thought—whatever its *potentiality* may be—are not remarkably superior in the lowest types entitled to rank as man to those achieved by the higher animals; and when we look to even more closely, some animals have faculties (perhaps strictly mental) superior to those of some men. An illustration in cases where we cannot obtain direct evidence, is a

mate means of comparison, and it seems more probable than not that the daily life of an insect and a man is directed by the exercise of an intelligent principle referable to the same laws of thought, however different may be the objects proposed and the end gained by each. This, I think, would be probable; but when we have the same conditions, the same objects proposed, and the same end attained—the desire being observable—both by a man and an animal, the identity of the principle seems certain. We are then in the region of direct evidence, and the consideration of our proposition is as fairly open to an ordinary observer as any question of daily life. Speculations beyond this are nothing to the purpose, and I confess that states of being of which I have had no experience, do not interest me as long as there is so much that may give a return for labour in the actual life of to-day. There are neither external nor internal aids to reflection that will help us to *know* one jot more than the universal teacher, experience, supplies. The doctrine of metempsychosis, however, seems to point, in the early thought of mankind, to the recognition of a much more subtle relationship between all animals than that of flesh and blood alone, indicating, as it did, a belief in an interchange of being. Whatever the doctrine may be worth, and I am not concerned about its truth or falsehood, it is interesting so far as it showed an expansion of the limits assigned to the animal world, and if weight be attached to the Hebrew doctrine to the contrary on account of its antiquity, metempsychosis, being, according to Bunsen and other oriental students, the older doctrine among the Brahmins, should be the weightier.

It may be objected, that, if animals think as we think, all this would have been found out long ago. To this I answer, the accepted dogma that we must not entertain the idea that they do, has lain like an incubus upon reflection, and this alone would have prevented it from becoming a popular idea.

Cultivated minds are now more disposed than ever they were to think out of shackles; the study of animals with the science of Natural History, which collects facts about them, had no existence two centuries ago; and when we have ascertained our common physical origin we are brought near to the contemplation of community in other points. The opinion of minds of the greatest range and power has been both in favour of and adverse to the proposition that the thinking principle in man and animals is essentially the same. One or two we will glance at. Descartes says, that animals "do many things better than ourselves . . . and this proves them to be void of reason, and that nature acts in them according to the disposition of their members, as we see a clock, which is only composed of wheels and weights, can measure time better than we with all our skill." Taken on its own merits, no piece of reasoning could be worse; and yet this came from one of the profoundest mathematicians that ever lived! The conclusion on the first premise would damn the reputation of any smaller man than Descartes! Subsequently, in one of his letters, he says, "I have diligently inquired whether all the notions of animals came from two principles or only one: and as I find it clear that they arise from that principle alone which is corporeal and mechanical, I can by no means allow them to have a thinking soul." Further on, on the question of analogy, he says there may be a thinking principle (*cogitatio*) in them, but less perfect than ours, and "*Ad quod, nihil est quod respondeam nisi quod si illa cogitant ut nos, animam etiam ut et nos immortalem habent, quod non est verisimile.*" (To which I can only reply, that if they think as we do, they have, like us, an immortal soul, which is not probable.) His Latin is not admirable, and he drifts into the curious position that, because it is not probable that they are immortal it is not probable that they can think. Instead of limiting himself to facts, the speculation on a future state drags him into an absurdity. People who have had animals about them all their lives will not be able to realise that Descartes "diligently inquired into" the subject at all: he certainly has not drawn any tenable distinction between the

thinking principle in man and in animals, for he admits the "machine" to have life, sensation, cunning, and the capacity to learn! Sir Isaac Newton does not seem to have held that animals do not think, but that the immediate actuating principle is the Deity, constantly directing all their actions; and many modern thinkers have referred those acts which are properly instinctive to the same cause. To establish one principle of thought for men indirect through reason, and another for animals direct through the Deity, is to complicate unnecessarily the design of creation. Analogy is against this view, but I hope to give, by-and-by, some reasons founded neither on probability nor analogy, which have led me to differ from so high an authority. As I am not making a methodical treatise, I must ask the reader to take the different parts of a very large subject as I can present them. The distinction between instinct and intelligence I may refer to presently, either before or after the facts, drawn exclusively from personal observation, that I shall offer for consideration: in the meantime, since it is accepted by many of the most careful observers and thinkers that all animals, men included, have two directing principles of action, one called intelligence, referable to acquired experience with the foreknowledge of an end to be gained, and the other—instinct—to intuition, it may be useful to compare the definitions by Dr. Reid, Sir W. Hamilton, and Lord Brougham. Dr. Reid calls instinct—"A natural blind impulse to certain actions, without having any end in view, without deliberation, and very often without any conception of what we do." Sir W. Hamilton—"An agent which performs blindly a work of intelligence and knowledge." Lord Brougham says "It acts without teaching, either from others—i.e., instruction—or the animal itself—i.e., experience: it acts without the knowledge of consequences, and accomplishes a purpose of which the animal is ignorant." We prefer the latter; but the very existence of such definitions proves that we have not got hold of the elements of instinct, and are using a term simply to pack up in a small parcel our ignorance of the moving cause and process of some actions in sentient beings. We are apparently in this position towards any act we may call instinctive; that when we see an animal endowed with highly developed senses, and organs of elaborate structure performing an act sometimes simple, as that of sucking, sometimes very complicated, as that of building cells; and *cannot trace the steps* of the process, we set the whole down to intuition, or else the direct influence of the Deity. That the animal does not know what it intends to do, as all the definitions say, seems to me a gratuitous assumption. The immediate gratification of a sense may lead it on by degrees to the accomplishment of an elaborate work. The act of sucking is looked upon as one of the first of instinctive acts, but who that has watched a litter of puppies or pigs has not seen the solicitude of the mother to indicate the source of nourishment, and invite her young by fumbling about it with their noses to get the taste of the milk, often exuding from the teat, upon their lips? The warmth and softness of the parts, the constant offering of the supply by the mother as she rolls herself towards her young, are so many appeals to their delicate senses, which, once having been gratified in the smallest degree, the first *experience* in the young creature's life is established, and the subsequent feeding is no more "without deliberation" or without a "knowledge of consequences" than that of the dog taking a beefsteak from a butcher's stall, or the porker hunting for truffles, in after life. I take it, that, the senses of taste and smell being present, they are gratified by an almost accidental contact with the teat at first, and this dawn of experience teaches the young to return to the charge. Day by day they improve in experience. They know when one teat is exhausted, and squabble with a more fortunate brother for possession of a full one; they learn to compress the teat with their gums, to press it inwards, and to use their limbs even to excite the flow of milk. I have watched the lambs for two seasons on an Australian sheep farm, thousands of mothers and young together, and found that on the third or fourth day

they began to butt while sucking. Of the many hundreds of lambs that I have tended, it seemed to me that the senses guided them all to the teat. I have had my hut full of valuable ewes, that at any time of the night I might be ready to minister to a weakly lamb, or persuade these Belgravian mothers to nurse their children; and I am convinced that, lying on my bunk and watching the animals by the firelight, I have seen the lamb discover by accident, and the mother's help, the source of his food supply. Hence I have long ago dismissed the idea that this act is *instinctive*. In the human infant it is more obviously not so, for his senses are very soon called into action by an efficient teacher, his locomotive powers not being sufficient to enable him to make discoveries for himself. The so-called migratory instinct is looked upon as one that cannot be challenged. If it were an irresistible impulse to neglect every other consideration, not a single individual of a species would be left behind at the appointed time, and yet how many do *not* follow their companions, but remain and breed. Large numbers of woodcocks do so (see THE FIELD QUARTERLY MAGAZINE AND REVIEW, Vol. II. p. 148). Mr Monk records twenty-one parishes in which they remain and breed every year. Swallows, we know, will leave their young to perish in the nests at migration time, and this is looked upon as proof of the strength of the instinct overcoming even the maternal. Birds are very social, and *imitation* may be the cause of their migrations. In going and coming we cannot be sure that each acts upon its own feeling; there are older birds who have made the journey before, and may lead the migration, the others following through a desire for companionship. If there is a power of intercommunication between them—and I cannot but believe that there is, for they perform so many *concerted* actions demanding a division of labour—the older birds, knowing by past experience the good food and warmer climate that await them, may instil into the younger a strong desire to accompany them, and imitation may do the rest. If one woodcock (not hundreds, as is the fact) were left behind, the migratory instinct of birds must at once be taken out of the class of instincts of worker bees, who never look into many of these actions popularly called *instinctive* the smaller we shall find the number becomes for which any one of the above definitions is tenable. The nesting of birds is a difficult case; there seems here no opportunity for imitation. European birds improve but little upon the first attempt, but it has been observed, by Wilson, of some tropical species which decorate their nests that the older birds do this more profusely than young pairs. Leroy has also noted the fact that some swallows' nests are better built than others; and Pouchet observed an improvement in them during his own lifetime. Turning once more to the question of migration. If birds are led to this by imitating those who can lead them and know and expect the change of food they will have; what led the first birds to migrate? The changes of the surface of the earth and distribution of land and water have been very great since the first appearance of many migratory species. A vast piece of land being slowly broken up into continents or islands, birds would gradually become accustomed to cross seas, and would transmit their knowledge to succeeding generations, for no great change has been sudden enough to cut off the knowledge of the way from a generation. The Australian *Psittacidae* are at this moment in the same position that European migratory species were once—inhabitants of a large tract of land. Some of these have an annual range of about a thousand miles of latitude, and are no doubt acquainted with the great swamps on the way, where grow the "tea-trees," affording them nectar from their flowers; thus, during almost every month of the year they can depend upon getting their favourite food. They come in immense flights, and pass along the eastern coast regularly as the trees bloom. The chatter overhead in the swamps is deafening, and the gunner may fire among the tree tops almost at random, and bring down a

dozen. They will hang wounded from the boughs, the nectar, swept by their brush-tipped tongues from the flowers, streaming from their beaks. Often have I assuaged my thirst by expressing the aromatic nectar from their crops into my mouth, and gone on my way rejoicing. The parrots thus from generation to generation have found their food over a great range, and the whole business seems to me to be one of experience; and if the huge island were, in the lapse of a thousand years, split up into parts with many miles of sea intervening, there would be no greater difficulty than there is now. Indeed, I have seen flights crossing a sea-way of forty miles to visit an island which there is direct evidence was part of the mainland at no distant date. They do not remain there more than ten or fourteen days, passing southward as the season advances towards summer, and returning in the fall to gather the ripe seeds of the *eucalypti*. I can imagine how the knowledge of the whereabouts of that island has been kept up as the strait between it and the mainland has become gradually wider. The journey is only a matter of about an hour's flight, and no doubt thousands of the visitors have been there before, and take with them birds of last year, thus maintaining the knowledge of this feeding ground which can never be lost. I cannot permit myself to set up an "unerring instinct" to account for what seems to me to be the exercise of a simple piece of experimental knowledge. When the savage starts in his canoe for this island, which he cannot see from the shore, to spear that curious cetacean, the dugong, in its shallow islets, no one supposes he follows any "unerring instinct." Both he and the parrots go for food, and both depend upon either personal or communicated knowledge for finding it. Migratory birds are often found crossing the sea at night, and often dash themselves against lighthouses. Perhaps these are inexperienced birds, or have been delayed by adverse winds and fogs, and have temporarily lost their direction. The migratory "instinct" will hardly be considered more special than the homing instinct of pigeons, and yet the latter fail to find their way home over well-known ground either at night or during fog. Something may be done by training, even under these unfavourable circumstances, as is now being attempted in Belgium with night flights; but whatever success is achieved will make the case for instinct weaker, and that for experience and knowledge stronger. During a late fog in London, several pigeons and rooks were to be seen sitting on the street telegraph wires near Temple Bar, evidently preferring to wait there until they could see their landmarks. Where was their unerring instinct? Those rooks probably had their home in the rookery in Gray's Inn Gardens, but they were, like human beings, dependent upon their senses and experience for guidance, and, like us, dazed by the fog. They concluded, like sensible creatures, to bide there till it cleared.

I leave instinct here, for a time at least. It is much more satisfactory if we can suggest any probable explanation of some of these acts of animals without taking refuge in "blind impulses" or "purposes of which the animal is ignorant;" and it is scarcely rational to conclude that because periodical, and on the whole singularly successful journeys are made by animals over distances which often completely exhaust their strength, and because we are not informed of the precise data employed, these acts are done without any preconceived ideas, and without a distinct knowledge of consequences.

That animals have clear ideas of position and relation one can doubt. The selection of the same breeding-places by the same pair for years in succession, and their topographical knowledge of feeding grounds, are proofs of this. From these it is no great step to the wider idea of position marked by the sun in his course. They may come, like us, to refer the positions of places to this practically fixed object. Their observation must be so much more exact as compared with ours, it is limited to the minute cares of existence. This proportion is observable, too, between highly civilised men and savages—with the child of nature

the outer life is intense. I cannot, then, think that the sun as a landmark has escaped their notice, and if they use it at all it may be conceived to be of immense importance in their migrations, as indicating a general direction until familiar landmarks are reached. Some of the Belgian pigeons have performed a distance of 900 miles, a considerable portion, something like 400 miles, being over unknown country; and out of eighty flown about a dozen returned in a fortnight. But those birds were rigidly trained to long flights, and all their powers of observation cultivated. Every pigeon fancier knows that they would infallibly have lost themselves had they been taken only fifty miles from home when unaccustomed to the work. There could have been no *instinct*, at all events, at work for these birds in this long flight, for the principle, if unerring, that enabled them to travel the 500 miles they had often done, would have sufficed for the 400 which they had not done.

I have endeavoured to present a few of these cases as they present themselves to me, without laying claim to having said anything new, or thought anything that might not have, and probably has, occurred to others. Every one of the cases, of what I believe to be simple thought in animals, to be given in a future paper, has been observed by myself, and I can only guarantee that each will be carefully stated from notes made at the time. If they fail in the marvellous element, so dear to some people, judging from the books of anecdotes published every day, and if the imagination is not stimulated, it must be charged to the absence, by the very nature of the case, of anything "wonderful" in the ordinary process of thought among our fellow creatures.

THE BUILDING OF BOATS AND SMALL YACHTS.

By J. C. WILCOCKS.

(Continued from p. 263, Vol. II.)

OF DRAUGHTING.

BEFORE commencing the building of any boat or small yacht, it is desirable a sketch or draught should be made for guidance during the progress of the work. Practised workmen do not often trouble themselves to make sketches or draughts for small boats, as they generally have moulds by them for any size they may require; or, if not, they soon strike one out of suitable dimensions; or, as is frequently the case, they build without any, relying on their experience and judgment for form and accuracy, which seldom fail them. Such a method, however, would not answer for amateurs, who have everything to learn, and who consequently ought to have every aid in preparing and carrying out their work. A regular ship draught is not necessary to the building of a small boat, such as is used for the joint purposes of rowing and sailing, but I should recommend every amateur before going to work to make a side view or elevation, called a sheer plan by shipbuilders, which will give the length and depth of the proposed boat, and also sketches of a midship mould and transom; also a half-breadth plan, which will show half the width and length, and on which he can mark out the internal arrangement of the thwarts, bow, and stern-sheets, and position of the masts, &c. These sketches should always be drawn to scale, and sufficiently large to make reference easy to them during the progress of the work, as well as to afford space for the clear delineation of the smaller portions of the sketch. The scale to be adopted must depend on the size of the boat, and if only a small one, half an inch to a foot will not be found too large. For instance, supposing a boat twelve feet long is desired, it will on this scale occupy on the paper the length of six inches. These are convenient dimensions, and will if desired leave sufficient space to draw in the spars and sails also on the elevation or sheer plan, on a fair sized sheet of paper. For a regular sailing boat I consider it necessary to make a fitting yacht drawing, and having arrived thus far in the subject, I think it desirable to give a description of such a drawing, and the manner of making it. We have

very able writers on naval architecture, as well as on the theory of yacht building, we cannot, therefore, do better than follow out their instructions given for our guidance. The authors whose instructions I propose we should follow, are Mr. James Peake, formerly master shipwright of Her Majesty's Dockyard, Devonport, in his work on the "Rudiments of Naval Architecture," and the late Mr. P. R. Marett in "Yachts and Yacht Building."

The draught of a ship is the delineation of the various sections or imaginary slices cut through her by lines, the lines being the outer edges of such sections. To elucidate what is meant: if an orange is cut into two parts, the edge of the peel in each of these parts will be a circle, and thus denote the shape of it. If those parts be again subdivided, their outer edges will have a similar form, and the orange by such a development would be found to assimilate to a sphere or globe. The draught is composed of three parts mutually dependent on each other; they are sectional plans considered as passing through the largest portions of the principal dimensions. They are severally named—the sheer plan, half-breadth plan, and body plan.

THE SHEER PLAN

Is descriptive of the longest and deepest longitudinal section, or that of a plane passing through the middle line of the boat or vessel from the middle line of the stem or fore boundary of her, to the middle line of the stern-post or after boundary. On this plane the position of any point may be determined for height and length, as being projected on to that plane, similar to the process followed in the delineation of a map.

THE HALF-BREADTH PLAN

Is descriptive of half the widest and longest level section in the boat or vessel, or that of a horizontal plane passing through the length at the height of the greatest breadth. On this plane the position of any point in the vessel may be fixed by projection, as to width and length.

THE BODY PLAN

Is descriptive of the largest vertical and athwartship section of the ship or boat, forming the boundary of all the others, and this plan fixes by projection the height and width of any point in the boat or vessel. There are hence three plans used to describe the boat or vessel, considered as a solid, or as being made up of three dimensions, length, breadth, and depth; and these are dependent on each other, as the sheer plan gives the height and length, the half-breadth the breadth and length, in which the length is common to the two. The sheer plan gives the length and height; the body, the breadth, and height, in which the height is common to the two. The half-breadth gives the length and breadth; the body plan the height and breadth, in which the breadth is common to the two. To determine the true position of each point of any solid, three linear measurements are required—the height, the breadth, and the length of it, all of which must be set off from, or bear reference to, a standard plane or starting point. The plans described for a boat or vessel fully furnish these dimensions for each point in her, as they may be considered the sides, top, and ends of a block formed to the dimensions of the boat or vessel; and each point in her has double reference to the several plans, or the sheer, half-breadth, and body plans.

The late Mr P. R. Marett, in his work, "Yachts and Yacht-building," gives us the following valuable instructions on the art of making the draught of a boat or vessel: The first process towards building a properly constructed vessel is to make accurate drawings of it upon paper on a reduced scale. From these drawings, other drawings of the full size are made, or "laid off" upon the floor of a large room called the "mould loft." From this last mentioned drawing, "moulds" of thin deal are made, and by help of these moulds, the timbers, comprising the frame of the vessel, are cut out, and the frame is then put together. In ship