II. *Trees and their Nature; or the Bud and its Attributes, in a Series of Letters to his Sons.* By ALEXANDER HARVEY, A.M., M.D.
London: James Nisbet & Co. 1856. Pp. 236.

WE regard this volume as a truly valuable contribution to botanical science. The question which it propounds is apparently a very simple one: What is a tree? but few general readers will rise from its perusal without the acknowledgment, that from Dr. Harvey they have learned for the first time what a tree really is. Not that his theory is new; for it is not so. But so far as we are aware, it never has been unfolded so systematically, or in such detail, and certainly it is very much opposed to the commonly received opinions on this branch of vegetable physiology. "The view given in these letters of the nature of trees," the author observes in the preface, "although, in the main at least, the same as that first set forth by De la Hire, as long ago as 1708, and subsequently held by Darwin, Mirbel, Du Petit-Thouars, Gaudichaud, and others, differs widely from that commonly received among us. It neither represents the popular belief, nor does it accord with the recognised doctrines of the schools. To the popular mind, indeed, it may be said to be nearly unknown, while heretofore it has failed to secure the sanction of the greater number of our scientific botanists."

To this we entirely subscribe, and although it is difficult in our limited space to do justice to an argument which is so strictly inductive, and which depends so much on its continuity to be understood and appreciated, we shall endeavour to gratify our readers with a general idea of the author's views. In doing so we shall use as much as possible the words of Dr. Harvey himself. This is the more easily done, and it is the highest compliment we can pay to the work, that so admirably condensed is the style, and yet so clearly and distinctly are the propositions stated, that no abstract or summary could be given in a form more concise than what is supplied by the words of the author himself. According to his theory, then,

"A tree is not what it is commonly believed, and what it certainly appears to be, a single or an individual plant. On the contrary, it is a collection, congeries, or congregation of individual plants of the same species, and is the production of a series of successive years. It consists, when fully equipped at midsummer, partly of living and growing plants, the growth of the current year, and partly of the persistent dead remains of the plants of former years. And of the individual plants composing it, each lives only one year, reaches its full size within the year, and, on dying at the close of it, mostly disappears and passes away. Certain parts, however, remain. These are the buds which survive the winter, and the dead stems and roots which are to serve the purposes as well of a soil as of framework to the plants of the next and succeeding years. And, accordingly, the production of the aggregate, which makes up and constitutes the tree, is referable to the living plants of each year growing parasitically at the end of, and likewise either around or within the dead stems and roots of the plants of the previous year."—P. 26.

This is the first general proposition. Advancing a step farther, he states that the theory in question forms but a part of a proposition in vegetable physiology of a still more general character:—

"The proposition is this: That all plants without exception, even those called *perennial*, are strictly *annual* plants, live therefore only one year, and reach their full size within the year; that is to say, that all plants spring up year by year either from seeds or buds, and attain their maturity within the year, forming, in the course of it, either seeds or buds, or both seeds and buds, for the production of similar plants the following year; that, as the season advances, their vital actions languish, and their organism becomes drier and more rigid—changes these which constitute their old age; that at the close of the season they die; and that on this happening, the materials composing them speedily undergo either an entire or a partial disintegration—in the one case *wholly* disappearing, in the other some portion remaining to serve ulterior purposes in the vegetable economy of nature, but still remaining only as *dead* vegetable matter."—P. 27.

This certainly is opposed to all popular ideas on the subject, but the arguments by which it is supported appear to us to be conclusive. The greater part of all trees, Dr. Harvey demonstrates to consist of vegetable tissue which has lost its vitality; this dead portion forming a mechanical support for the living portion which is yearly added to it. Accordingly, it is seen that although the heart wood may decay, and, as often happens, entirely disappear, leaving the trunk hollow within, often reducing it to a mere shell, while many of the larger branches are broken off, and little of them is left remaining, "still that little evinces as great activity in the vital processes as ever. That is to say, it is the seat of as vigorous a circulation of sap as in its earliest years; it puts forth and matures leaves, and flowers, and fruit, which are as large and as perfect as in its best days; *it is still forming fresh wood*, and having every year additional bulk given to it."—P. 20.

This is what we have all seen in every park where there are old trees, but one example given by Dr. Harvey is interesting and striking:—

"There is at Allonville, in France, an oak so decayed, that the only support it has is by the outer layers of wood and by the bark. It may be said to stand on stilts. Its trunk is a perfect hollow or cavern; and some idea, both of the size and age of the tree, and of the extent of its decay, may be formed from the fact, that in the year 1696 its hollow stem was converted into a little chapel of six or seven feet in diameter, wainscoted and paved, and in which Divine service is said to be occasionally performed. It is computed that this tree, which is upwards of thirty-five feet in girth, must have seen at least from 800 to 900 summers. Yet it is still vigorous. Every year 'it is adorned with abundance of leaves, and laden with acorns.'"—Pp. 20, 21.

In regard to the longevity of trees, the conclusion at which Dr. Harvey arrives (still contrary to the common belief) is, that there is no set limit to the age they may attain to; and no actual limit, other than that resulting from purely accidental or extraneous causes, and this because, according to his theory, there is no natural limit to the annual propagation from buds of the individual plants composing the tree. And in regard to the size to which trees may grow, he considers (again contrary to the popular belief)

"that there is no determinate limit thereto, and no actual limit, except from such extraneous causes as may prevent the formation of buds or the evolution from them of new plants." These propositions are to be understood, of course, as applying to the *body-corporate* composing the tree, not to the individual *tree plants* of which the corporation or whole tree is composed; for, according to the theory, each tree plant, that is the growth of each year, is truly an *annual*, which is formed, and lives, and (with the single exception of the buds) dies within the year; and the *size* of each of these tree plants is no greater in a tree of a thousand years old than in a seedling of its kind in the nursery; rarely exceeding a few inches, or at the utmost a very few feet, in length. And so, to quote the words of Dr. Harvey—

"A tree is simply a '*corporation sole*'—a collection, aggregate, or congregation of annual plants of the same species, the production of a series of successive years, the individual plant of each year shooting up in spring from buds adherent to the persistent dead remains of the plants of the previous year, growing as parasites on these remains, putting on the character of old age in autumn, and speedily thereafter dying—provision, however, having been made by them in summer, in and by the formation of buds, for the reproduction of similar plants the following year: and that being thus evolved, and thus growing from year to year, and having no actual limits to their reproduction in this way, there is in point of fact no actual limit to the age or to the size to which the tree collectively resulting from them, or produced by them, may attain."—Pp. 101, 102.

So far as the tree is represented as composed of a series of buds, each having independent vitality, the opinion of Dr. Harvey is shared by Professor Balfour and other botanists. But Dr. Balfour, following apparently the views of M. Gaudichaud, holds that, although the buds have an independent vitality, they are all, as united on the "common axis," which constitutes the tree, "dependent on the life of this axis for their continued growth and vigour." This is the commonly received, but, as we hold with Dr. Harvey, an erroneous theory. Dr. Harvey maintains, that the "axis" on which the buds grow, and that parasitically, is made up of the *dead* organic remains of the plants of former years, and that, in so far as it contributes to the growth and vigour of the buds and plants, it does so precisely in the same way that the soil does to the vigour and growth of the seedling plant.

The "woody layer," or annual cylinder of woody tissue, formed in connection with the several growths of the year, is, according to Dr. Harvey, both structurally and physiologically, *the roots of the young plants that issue from the buds*. This is a curious branch of the subject, and we regret that our limits forbid us following the author throughout his entire argument on the subject. Whether this woody layer is primarily of the nature of roots, or whether it be a special formation altogether, and formed *in situ*, he shows clearly enough to our apprehension, that it serves the *office of roots* to the young plants developed from the buds, being the channel whereby the nutritive matters in the soil are conveyed

upwards to the growing stems, and leaves, and flowers. We must make room for one extract, which, with the figures by which it is accompanied, will so far explain the author's views on this subject:—

"That the woody layer is both structurally and physiologically the roots of the young plants that issue from the buds, I maintain. Nor will it, I think, be difficult to demonstrate that they are. That in the manner of its formation and growth there is a peculiarity, I readily allow. That is to say, I allow that with the exception of a small portion, the fibres composing it do not actually *creep* and grow *downwards* from the base of the buds and young plants above to the soil below. The portion which I except is that part of the root beginning at the *tip* of the last year's root, and thence extending a short way beyond it into the soil. This portion does in fact grow and creep downwards, just as does the root of the seedling. Excepting this part, however, I admit that there is the peculiarity mentioned attaching to all the rest of it. And for that peculiarity I not only see a *reason*, but in it I see also a singularly ingenious *contrivance* to obviate a difficulty which the circumstances of trees create, and to meet which a strict adherence to the rule of ordinary annuals would have been a clumsy expedient.

"For observe: great as is the known power of roots in making their way through obstacles to the soil, and far as they will often travel to reach it, it seems scarcely conceivable that in a tree, say, 150 feet high, and with roots stretching perhaps fifty feet under ground, the roots of the young *terminal* plants could, in the course of a few weeks in summer, creep down and traverse the distance of 200 feet. That they do not, I admit; nay, it is certain that they do not. For if they did, it would be easy by a few simple experiments to ascertain the fact, and to measure also the rate of their descent.

"Let us now consider wherein the peculiarity of their formation lies, and how their growth is effected. The accompanying figure will aid us in the understanding of this. It is the vertical section of a tree three years old, as it exists in autumn after the fall of the leaves and flowers and fruit. At the summit of the terminal shoot there is a bud (*a*), and proceeding from the base of this downwards, and lying between the bark (*b b*) and the stem and root (*c c*) of that shoot, is a layer (*d d, d d, d d*) of cells, constituting the *Cambium-layer*. This layer may in a certain sense, and that a very correct one—if not, indeed, as I believe, truly and physiologically—be regarded as an *EXTENSION* of the BUD, and a *constituent* part of it. Formed concurrently with the bud, and in common with it, out of the general cellular basis, it may likewise be regarded as an *adaptation* of the bud to the special *circumstances* of tree-plants as *parasitic* plants, and to the special *objects* of their existence as *timber-producing* plants.

"Until a comparatively recent period, the minute structure of this layer was but imperfectly known, and its real nature so far misunderstood.* It is not what it seems to be—a glutinous or mucilaginous fluid—or semi-fluid matter. It really consists of cells of a very delicate texture. In the annexed figure, a transverse section of it is given in connection with a plant of one year's growth. Immediately beyond the woody bundles already formed (*a a*), there lies a mass of cells of a semi-

lunar form (*b b*), cut off, so to speak, by a bounding line from those bundles on

* "Pour nous, le Cambium est toujours le *fluide* nutritif, produit de la sève élaborée, qui s'épanche au printemps et en automne entre le bois et l'écorce.' 'Le Cambium est le *fluide* essentiellement nourricier du végétal, comme le sang pour les animaux.'

the one hand, and from the general cellular basis on the other. These cells are that part of the Cambium-layer out of which the woody bundles of next year will be evolved. Lying directly beyond and around these semi-lunar masses of cells, is the remainder of the Cambium-layer, consisting likewise of cells.

"Such is the condition of the tree in autumn, and such the provision made for the growth of next year's tree-plants. In spring, the bud growing in the first instance at the expense of the pith, sends out a shoot, which rises upwards and puts forth leaves; sap ascends from the soil and passes to the leaves. Being there elaborated, a portion of this sap again descends, in order to the development of the Cambium-layer. From all that portion of this layer that as yet exists (and which extends from the summit of the last year's shoot to the extreme point of last year's root), there is ultimately evolved three distinct tissues—woody tissue, cellular tissue, and bark tissue—the bark lying outside and enclosing the other two, the cellular connecting the wood and the bark. Grant that all these are formed as they lie (*in situ*). It is not, however, the whole account of the matter. For, from the lower end of the Cambium-layer, at the point where it is in contact with the tip of last year's root, a new root comes off which does in fact creep downwards, which descends into the soil, just as from the bud at the other end of the Cambium-layer the shoot ascends into the air."—Pp. 125–129.

One other extract only we shall give on this very interesting subject of the formation of the woody tissue. The author's object is to show that, "however paradoxical it may seem, this tissue is formed at once, *in situ* and by growth, downwards." And he supports his argument by a very interesting illustration—a block from the limb of a holly tree, within which a portion of chain had become more or less completely imbedded. The block had been cleft in twain after the tree was felled:—

"The history of it is briefly this:—The tree inclining, when alive and young, too far on one side, a chain was placed around it and firmly secured behind. In process of time, as the tree grew and became thicker—the chain being unyielding, and the pressure against this from within augmenting—the old bark gave way under the chain, and the woody fibres developed from the Cambium-layer grew over and enclosed it. By the growth-in-situ theory, the woody matter should merely have pushed out on either side of the chain—and as well below as above—and so forming an open gutter have left it lying there. But, instead of this, it had bridged it over. And if you examine the piece more narrowly you will discover something more. On one side, you will perceive that the bridging is but partial: the woody matter has overlapped the chain but not enclosed it. Now observe the direction in which the

"Il ne devient pas tissu cellulaire, ni tissu vasculaire; mais ces tissus déjà existans y puisent les principes au moyen desquels ils se multiplient."—Richard, *Nouveaux Elémens de Botanique*, 5^e.^{am}. Ed. (1833), p. 111.

overlapping occurs. It is not from below, but from above—the direction in which, according to the views of MM. Du Petit-Thouars and Gaudichaud, it might have been expected to occur. Not the slightest effort appears to have been made in the contrary direction. Nor is this all, this holly-tree had grown vigorously on one side and only feebly on the other. Its growth had been eccentric. And it had so chanced that the chain was placed around it in such manner as to embrace one-half of each side. Now, on the well-favoured side, the fibres, pushing down boldly and in the strength of numbers, have gone right over and buried the chain to some depth—while on the lean or ill-favoured side, the resistance presented by the chain has been too great for them to overcome, and, accordingly, they have only partially succeeded in the effort—the greater number of the fibres, indeed, like a slowly-moving or feeble stream, having turned round the obstacle instead of seeking to rise over it—a circumstance which is quite apparent on an inspection of the piece.”—Pp. 152, 153.

With regret we must take leave of Dr. Harvey's interesting and instructive work. Had our limits permitted, we should gladly have followed him farther, particularly in his able, and to our mind triumphant refutation of the opposing views of Dr. Carpenter, and the distinction insisted on by the latter as existing between the seed and the bud, and of course between their respective produce—a distinction which, as Dr. Harvey truly observes, creates far greater difficulties than it can possibly obviate.

The practical applications of the theory—the cautions as to pruning, and the precautions as to planting—are valuable. Nor must we omit to notice, that the book is profusely and admirably illustrated with plates and diagrams. Altogether the work is one which cannot fail to prove acceptable to the general reader, as well as to the man of science, to the country gentleman, the gardener, and the forester, as well as to the mere student of botany. As such we commend it heartily to our readers.

III. *Consumption: its Causes, Prevention, and Cure.* By Thos. Bartlett, M.D. London: H. Bailliere. 1855. Pp. 172.

On the Nature, Treatment, and Prevention of Pulmonary Consumption, and incidentally of Scrofula, with a Demonstration of the Cause of the Disease. By Henry M'Cormac, M.D. London, 1855. Pp. 111.

OUR first impressions of Dr. Bartlett's work were unquestionably not favourable. It appeared, on a cursory glance, to be one of that class now unfortunately so numerous—written for the public, not for the profession; and had this, on closer examination, proved to be the case, it would have met our unqualified censure. But we are glad to find that—written with a proper object, and in a laudable spirit—it deserves a candid approval.

Dr. Bartlett's descriptions of the nature and causes of consumption are clear, and, so far as they go, accurate, but call for little remark. He points out the influence of certain occupations in the