

The cover features several detailed botanical illustrations of pink flowers and buds. In the top left, a large flower with many stamens is shown. To its right are several buds on a stem. In the bottom left, a large flower head is depicted. In the bottom right, another large flower with many stamens is shown. The central text is surrounded by these illustrations.

FIRST STUDIES
in PLANT
LIFE *in*
AUSTRALASIA

FROM GARDEN GATE TO GUM TREE:
BOTANY MADE FRIENDLY

WILLIAM GILLIES

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First Studies in Plant Life in Australasia

by

WILLIAM GILLIES



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LEAVES OF BLUE GUM SHOWING THE OIL-DOTS (AFTER VON MUELLER).

“Without a knowledge of plant life we may admire flowers and trees, but it is only as strangers, only as one may admire a great man or a beautiful woman in a crowd. But when one with even a slight knowledge of that delightful study goes out into the woods, or into one of those fairy forests which we call fields, he finds himself in the company of friends, every one of whom has something interesting to tell.”

– SIR JOHN LUBBOCK.

“People think that when they have toiled for a long time, almost all their lives, that then they will come to the flowers and the birds, and be joyful in the sunshine. But no, it will not be so; for then they will be old themselves, and their ears dull and their eyes dim, so that the birds will sound a great distance off and the flowers will not seem bright.”

– RICHARD JEFFERIES.

PREFACE

THIS book is meant for boys and girls beginning the study of plant life. It is true that I have given, wherever possible, the reason for the facts stated about plant life: a branch of the subject which is generally kept back for a senior course. I have done this because I believe that the method of keeping beginners exclusively to the facts is false to the principles of true teaching. Anyone may see this who walks into the fields with a child and takes note of the questions he puts. If you tell a child that the leaves of an elm are alternate, stipulate, pinnate, with the blade unequally divided by the midrib, he will soon grow tired; but if you lead him below an elm tree and show him that the peculiar shape of the leaves enables each leaf to catch the maximum of light, he will listen readily. Also, you have given him a key to the meaning of leaves and leaf-form that may bring him to your side with many other eager questions about other leaves. Almost unconsciously he has learned the purpose of a leaf, and this in itself helps him to understand a hundred things in the life of the leaf that were meaningless before.

Similarly, if you tell the child that a snapdragon flower is perispermous and bilabiate, with didynamous stamens and a two-lobed superior pistil, he will soon grow tired; but if you try to explain to him that the snapdragon's curious mouth is due to the visits of bees, he will listen readily. Also, you have given him a clue to

the meaning of a multitude of strange-shaped flowers; and the endless variety of form in these flowers no longer bewilders him.

It is true that in approaching plant-life in this way we have often to say to the child: "I do not know." Sometimes, too, we have to give explanations that may need to be revised with larger knowledge. But this is no reason why the child should not have the best answer to his questions that we can give. If the boy Copernicus had not been drilled in the Ptolemaic theory of the heavens, he would have had little chance of finding out the Copernican system.

Even the ignorance that we confess may often be of value to the child. When a teacher who loves his subject admits ignorance, he does it in such a way that it is a valuable stimulus to research on the part of his pupils. In a short time, they become fellow-workers with him. The atmosphere created by this method is one to quicken research and originality; and here, indeed, we have its best feature.

The old authoritative method of teaching Botany as a series of ascertained facts with all the qualities of certainty and finality not only destroyed interest in all but a few minds, but gave no impulse to inquiry—no enthusiasm of research. The barrenness of much so-called education lies in the training of young minds to receive passively certain teachings as final; the truth being that there is no finality in science. The great discoverers were great because they verified and examined and experimented for themselves; and we do them homage not for reaching finality but because they made progress. This is why such men are often impatient with the crowd of admirers who form clubs to study their work; good as such clubs are. "If I had been content," says Ruskin, "to sit at another man's feet all my life there would have been to-day no

Ruskin societies." In no part of the world, too, is the investigating mind more needed than in this new Southern World of ours. The life-histories of many of our native animals and plants is still unknown. Fine work has been done by our pioneers in Zoology and Botany, and we are grateful for their work, but the half has not yet been told. Everyone who has looked into these things for himself has seen new paths of investigation stretching out in all directions; and the boys and girls who are now being trained to observe are to be congratulated on the wide field that lies before them. Only those plants and trees have been used that are well known both in town and country. No plants have been mentioned that are known to botanists only, or that have no popular names.

The practical aspects of plant-study for Australasian scholars have not been neglected. I have tried to show that the art of the gardener and of the farmer in manuring, watering, draining, rotation of crops, budding, grafting, and the like are all copied from Nature's methods, and are only to be fully understood when learned in this way. If to-day our fields are more productive than they were fifty years ago, it is because we have won Nature to the service of man by a loving study of her ways. It was with no thought of profit, indeed, that Linnaeus and his successors studied in garden and field. Hard-headed business men looked askance at what seemed to them elegant idleness; and yet to-day the granaries of the world are more richly stored because men like these have bent over the flowers of the field. These are the men to whom Nature loves to whisper her secrets, and it is to men of this stamp that Nature gives the power to make two blades grow where before there was but one.

It is sober truth to say that if plant-life were well taught in our

schools, the produce of Australasian fields would be doubled. To statesmen who are at their wit's end to find revenue, this plan for doubling the revenue of a State may be commended.

Much of the teaching in the book has been put into the questions and exercises at the end of each chapter. Pains have been taken with these, because the information given in the book will be of little value unless there be constant personal observation, experiment, and thought.

One important result of plant-study will be an increase of interest in tree-planting. Only second to this will be the growth of a conscience in our people about the native trees that still remain to us. When people understand what a great tree means, and how even a tree fern takes fifty years to grow, they will no longer be the vandals they have been in the past.

Every teacher must have noticed that a child speaks of a plant as if it could plan and feel and even think like a human being. If we are to meet the child on his own ground, we must to some extent adopt this way of speaking. This will do no harm if the child is gradually taught, as it grows older, that the plant's power of action and change is limited by laws fixed by the Creator.

It is worthy of note, however, that a plant is able to change its form and habits in ways not dreamt of by our fathers. One of our native geraniums is the same plant that one finds in Europe, but the finer climatic conditions have enabled it to change from an annual to a perennial. Striking changes occur when some plants are taken from the interior to the coast, or from the plains to the mountains.

The changes made in flowers by the agency of insects are recorded in the rocks, and the transformations wrought upon

flowers and vegetables by the gardener are before our eyes daily. Changes like these are due to the power that a plant possesses of adapting itself to its surroundings. What this power of adaptation is we do not know; we can only say that the Creator has given to the plant the power to change within certain limits. A plant is not a musical box that can play its tunes in one way and in no other. The plant can play its tune with many variations according to its surroundings. The changes made on flowers by the constant visiting of insects or by man's agency are of great interest to children; and such facts prepare them to understand the great fact that life in plant or in animal is not fixed, but, within certain limits, plastic. Many a reformer, grown weary in the task of lifting human nature, has got fresh heart from this discovery. The limits of change, narrow in the plant and animal, are wide indeed when we rise to him who has been made in the image of God.

Two conditions have to be observed by him who would improve a plant. He must find out the laws of the plant's life, and he must obey these laws. By doing this we are making our garden plants more beautiful year by year; and the day is coming when we shall attempt with the same reverent obedience to the facts to beautify the garden wherein the plants are men and women.

The introductory chapter is meant for teachers, parents, and senior scholars.

The drawings are from the pencil of Mr. Wm. Huddleston.

W. G.

A WALK ROUND MY GARDEN

This introductory chapter is meant for parents and teachers.

1. As I walk round the garden on this fine morning, I try to find out the secret of its charm. Much of the charm cannot be put into words at all; but here are one or two reasons for the keen pleasure that it gives.

2. My plants interest me because I have watched them from seed to seed. I have sowed and thinned, watered and planted; I have guarded them from weeds and from slugs. I have watched for the first flower and wondered: Will it be white or pink? I have bent over them to see the bees at work. I have shown them proudly to my friends; and in doing all this a part of my life has passed into these flowers.

3. On the face of a garden Nature writes her calendar as she writes it nowhere else. Month after month inscribes its message on tree and plant; nay, in a well-stocked garden every week has its new feature that tells the passage of the year to the lover of flowers. There is a legend that the shade of Linnaeus, on returning to his old garden from the other world, guessed the date within seven days by looking at certain flowers that were just opening. The idea is not a fanciful one. Last year the gooseberry bush beside the summer-house broke into leaf on the 20th of July. This year, on the 22nd of the month, I walked down to the bush and found that the grey thorns were almost covered with a shimmer of green! That rhubarb plant burst

through the ground on the 10th of August last year, and this year the clods were pushed aside on the 11th of the month! What wonderful timekeepers these plants are! The last week of September brought the green flowers to the elm, though as yet no leaf had shewn; and the same week saw the new green fruit-balls of the plane tree swinging side by side with the old, brown battered ones. Year after year, the willow is in full leaf in the last week of August; and on the last week in September the beautiful leaves of the plane begin to hide the winter outlines of the tree. Have you heard of the chesnut at the Tuileries that was called old *Vingt Mars* by the gardeners who had grown grey in its company? This stick marks the place where an African lily is buried. There is no sign of life to-day; but, within a week, it will throw up a flower-stem! The flower is even now on the way to keep its tryst. George Eliot has the fine thought of God calling the bead-roll of the stars, and of the stars coming out in the evening sky, one by one. Even so, the flowers obey the heavenly summons...

4. Can you wonder that the Greeks conceived of this yearly marvel as the return of the Flower-goddess from the lower world? The myths of every land and the art of every eye have added their own charm to what is perennially charming. And one never tires of it as one tires of many things. Nay, since each spring adds a new memory to old memories, the new spring comes ever with a richer fragrance. The eyes become dim, but we see with the eyes of younger days; the ears grow dull, but we hear with the ears of the boy.

5. And here we catch a glimpse of another secret of the garden's charm. The birds sing from tree and covert, so that

we think of them as our birds—and as a part of the garden. Even from the “bare, ruined choirs” of winter, we hear the birds rehearsing for the spring burst of song; and when the full chorus comes on some fine September morning, the call to the garden is irresistible. James Russell Lowell, in speaking of the early days of Harvard University—then a wattled fold on the edge of the wilderness—tells us that among the students were some red Indians who were to be trained as missionaries. They worked hard for a time at Greek and Latin; but the forest whispered to them and the first blue bird of spring whistled them back to the woods. “Oh, Sir,” Lowell hears them saying to their teacher, “you hear we are called!” In the country, the magpie, in town, the thrush, are our blue birds that call us out of doors. For every man who has been brought up among trees or flowers there is some bird-note that will not be denied. “Oh, Sir, you hear we are called!”

6. They interest me—these plants—because some remind me of friends, and others take my thoughts abroad to far-off lands. I remember the day, ten years ago, when I brought home the little plant from which this rose bush grew. I often think of my friend when I look at its beautiful blooms. The dew on its buds helps to keep fresh our friendship. This plant I brought from Lake Tyers, four years ago: it recalls a pleasant holiday. And here are a dozen pansies raised from seed sent to me by a friend in Scotland. Beside these are tulips from bulbs sent out straight from Holland.

7. This little scarlet pimpernel—the poor man’s weather-glass¹—takes one straight to England. It has sprung up with

1 So called because it shuts up before rain.

the lawn-seed, and is trying to be at home in a strange land where rain-clouds are rare. The love lily of South Africa stands close to the belladonna lily that found its way from the Cape to England when James of Scotland was King. And here, on the border, is an acanthus that grew in Greece when sculptors were learning to give the charm of flower and leaf to their stately temples. On the fence beyond is the creeper that reminds us of the rich lands of Virginia, and, beside it, the smaller-leaved variety that came to us from Japan.

8. The scent of wall-flower draws us to a plant that reached England from the Mediterranean in the Middle Ages. This chrysanthemum carries the thought to a valley of China, and the dahlia beside it takes us to its native haunts in Mexico. It is in Mexico, too, that we find this sunflower at home. Yonder golden patch of poppies is from the foothills of California—the Californian poppy². These sweet peas on the fence lead us back again from America to Europe, and we seek the old home of the sweet pea in the valleys of Sicily. This white peony is from Siberia. Did it catch its colour from the snow? It is three centuries since this lilac was carried from Persia to England.

9. That foxglove recalls the flowers that grow on the sunny side of an old moss-covered wall in Surrey, and these harebells that nod in the wind take us to a breezy down in Sussex. The tall poplar at the garden-foot takes the thought to Lombardy, and to the wide plains of Germany and France; and the plane tree on the road beyond carries one, as on a magic carpet, to the Levant. This looking-glass bush is from New Zealand, and that silky oak is from the coast of New South Wales.

2 Eschscholtzia.

10. Memories of childhood are stirred as we come to a border of violets. Cherished for itself, this beautiful flower is prized still more because it brings back the first garden of childhood and the first flower that was planted in it. Happy the child who is set over a little plot of garden ground! Whatever may happen in after-life, that first garden of childhood is a garden of Eden from which he can never be driven out. And now we pass a bed of cress, and I recall the awestruck boy who saw one morning his own name rising in living green letters from the dark earth.

11. These green shoots breaking through the ground are daffodils. They come to us in August, but they also come to us with the winds of March, because it was then that Shakespeare saw them. It was then, too, that Wordsworth saw them. Here we have come upon another clue that leads us to the secret of the garden's charm. This flower is dear to us because Shakespeare loved it, and that because Milton wrote of it.

12. But, indeed, our thoughts cannot stay within garden walls when we ask the poets to walk with us. We wander into spring fields powdered with daisies and golden with buttercups, and to forest-glades where the blue hyacinth is "like the heavens upbreking through the earth." There are cowslips among the grass and poppies in the corn, and from the woods comes a cuckoo's call that was never heard in Australia.

13. Thus am I a citizen of the world when I walk in my garden.

14. And if the flowers take us to the ends of the earth, they also take us into times long gone by. Ages have gone to the making of a plant; and its history is written on its face if only we could read it. The smallest weed has passed through a thousand changes of soil and climate, of friends and foes, and only the All-

knowing Creator could give the full story of the meanest flower that breathes. But to us, His sons and daughters, He has given the delight of being able to spell out this story here and there. There is not a line or spot on leaf or flower but has its meaning. This is the true *language of flowers*. Happy he who can read it!

I.

How Seeds Germinate

PART I.

Teachers and parents are earnestly reminded of the great importance of creating interest in each subject before a formal lesson on that subject is given. Before a lesson on Roots is given, a large number of roots of common weeds should be pulled up and examined by the child. He should be asked to say what he sees in the root before he is allowed to see with the teacher's eye; to say what he thinks before he gets the teacher's thought; to suggest his own puzzles about the root before any puzzles are thrust upon him. Then, and not till then, should the orderly lesson be given.

1. **A seed with two seed-leaves.** Two seeds lay on a shelf – a seed of wheat and a French bean. They had been forgotten for four years, and they seemed dead as the dust that lay thick upon them. Spring-cleaning came round, and they were swept out with the dust, and cast upon a garden-bed. Now the earth was dry, and the seeds lay on the ground as lifeless as when they lay on the shelf. Then came a heavy rain, and washed soil over both seeds. A week of cold winds followed; and the seeds lay still in the damp, cold ground. And then a warm wind blew and, two days after, a strange thing happened. The earth was

gently pushed aside, and a tiny green shoot thrust itself into the world of light and air! At first it shot up quite straight (see fig. 7), and looked like a solid green stem; but, after a few days, it began to unroll. A long green leaf came out; and then another, and another. It was now clear that the little green shoot was not a solid stem, but a bundle of delicate leaves wrapped tightly round one another so that they could push through the earth into the air.

2. But now the French bean also has cracked the earth, and is coming up in a green loop (see fig. 4). In a day or two the loop has risen clear of the earth; but the outer coat of the bean is still clinging to the loop. A few days more, and the loop has straightened itself into a stem bearing two fleshy green leaves, that do not look like proper leaves. Next time we pass, two little green leaves that look like true leaves have risen from between the two fleshy leaves; and now the plant is fairly started in life.

3. By what magic did these dead-looking seeds, that had been



FIG. 1.
FRESH WHEAT SEED SPLIT
OPEN TO SHOW THE PLANTLET.

forgotten for four years³, spring into beautiful green plants? The outsides of the seeds give no answer to the puzzle. Shall we look inside?

4. **What we saw inside a French Bean:** the Plantlet. Soak some French beans for twenty-four hours. Examine a bean after it has been a few hours in the water, and you will find that the skin has puckerred up into

³ The best seed-wheat is the wheat of the previous year. Each year added to the age makes the germination more uncertain. The stories of the germination of wheat found in Egyptian mummies are not true.

wrinkles, as if the bean's clothes were too big for it. The skin has swollen faster than the seed that lies inside it. A few hours later, the water reaches the seed within the skin, and the seed swells out and fills the skin so that it is smooth again.

5. And now use finger and nail gently and split open the bean. The seed-coat peels off, and the halves of the bean fall apart. Can these halves be the two strange green fleshy leaves that we saw on the top of the loop? They have the same shape, but are white. We shall see. Fastened to a point near the end of one of the halves, is a tiny object that looks like a little plant with the leaves bunched up. You look through your lens, and see two small leaves. They must be leaves, for you see the veins quite clearly. These, then, must be the second pair of leaves that we saw. They cannot be the first pair, for these were not veined. But all this is guess-work; so now let us make an experiment.

6. How to watch seeds while germinating. The simplest way

of all is to grow the seeds in moist sawdust. This provides moisture and air; and these, along with heat, are the three needs at this stage. The seeds can be lifted out now and then, examined, and then returned to the sawdust. For small seeds, the following is a better plan: Get the top of an old lamp chimney, or any cylindrical glass tube open at both ends. Roll some fresh white blotting-paper into a tube, and slip it into the glass tube. Fill in, then, with loose moist

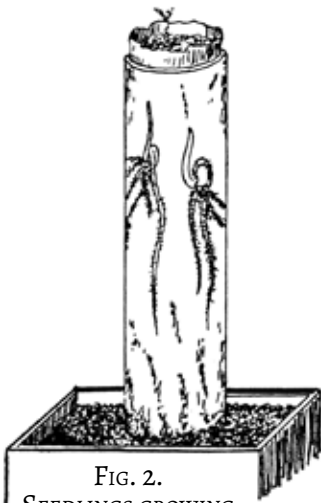


FIG. 2.
SEEDLINGS GROWING
BEHIND GLASS.

sawdust. Place now the seeds between the paper and the glass; pushing them into position with a blunt wire. Put in the half of the French bean that has the plantlet attached to it. Fix, now, the glass tube in a pot or box of earth, and keep the earth and the sawdust moist. By this plan you can watch the seeds growing as easily as you can watch bees in a glass hive.

7. **The scar on the seed.** And now while we are waiting for the seed to grow, let us look again at a whole French bean. You notice the rounded back and that the opposite side is hollowed and has a scar. (See fig. 4.) If you have ever helped to shell beans or peas you will guess at once that the scar is the point where the bean was fixed to the pod.

8. **A seed with a large plantlet.** Examine also peas and broad

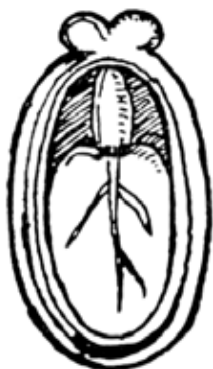


FIG. 3.

CASTOR-OIL SEED SPLIT
TO SHOW PLANTLET.

beans and then split them open. In all these cases the plantlet is small, but if you will open a castor-oil seed, you will find a plantlet as long as the seed itself. Remove the beautiful mottled outer skin of the castor-oil seed, and then, with knife or fingernail, break the seed gently into its halves. If you have done this carefully, you will now see on one of the halves the stem, and above it the leaf of the plantlet. Stem and leaf together cover the whole space. Use now your lens and you will see distinctly the veining of the leaf. Note also the tiny leaf-ruff just above the stem. This is the first pair of true leaves of the castor-oil seedling.

9. **The little root in the seed.** Coming back to the split French bean, we must now look for the little root below the plantlet.

This root is so placed that it comes out of the seed-skin by a little door near the scar. Allow a whole bean to germinate, and you will see the tiny white root pushing through this little door close to the scar. As soon as the root is clear of the bean, it begins to point downwards.

10. **The seed-leaves.** Meantime the plantlet is growing

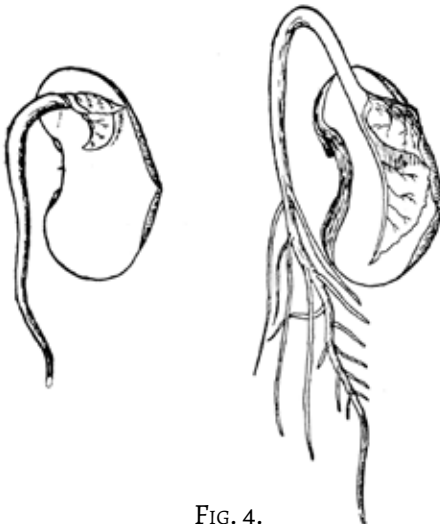


FIG. 4.

BEAN-HALF GROWING: ALL THE SEEDLING ABOVE
THE TRUE ROOTS IS NOW BECOMING GREEN.

larger. In a few days the leaves begin to take a green tint, and the green colour spreads to the stem just below the leaves, and to the whole of the bean-half. The root continues white. Already we can see that our guess was correct. The bean-half is one of the green, fleshy leaves which we saw above the ground, and the little leaves of the

plantlet are the true leaves. And so, we shall call the two bean-halves that turn into green fleshy leaves—seed-leaves. We see now that the halves in split peas are just seed-leaves that have been pulled apart.

11. And now the green stem gets longer and longer, and takes the form of a loop above the bean-half. It is clear that the loop is trying to lift the seed-leaf into the air, and so you must press in the blotting-paper so that the seed-leaf can get out. If you do this, you will see, in a day or two, the loop lifting out the bean-

half which is now a green, fleshy leaf. We have now been able to watch every step from the swelling of the seed to the opening of the second pair of leaves—the first pair of true leaves.

12. **The three needs in germination.** We have seen that seeds need heat and moisture before they will grow. They also need air. Light is not needed, and indeed, seeds germinate faster when light is shut out.

Exercises, experiments, etc.:

(1) Most seeds germinate like the French bean, but the seed-leaves of some plants remain in the ground. Make experiments with the garden pea, broad bean, sunflower, pumpkin, acorn, castor-oil seed, cress.

Notes. – (a) In each experiment a scholar should be made responsible for watering, for marking dates, and so on. (b) Grow some sunflower seedlings in a pot to be ready for the experiment described in Chapter 9.

(2) Suspend an acorn over water by a piece of string in the neck of a wide-mouthed glass jar. If the weather be warm, the evaporating water will moisten the acorn and cause germination. To show that light is not necessary, a second jar could be placed in a dark place.

(3) As a boy was stooping over a barn floor, a mass of hay fell on his back. How could the boy exert most force to free himself? Compare the method of the French bean seedling in bursting through the ground.

(4) Some split peas were accidentally sown, and some came up. Explain how this could be.

Composition exercise: Tell the story of a French bean plant from the seed to the first pair of true leaves.

Drawing exercise: Draw a French bean, (a) dry, (b) germinating; showing the progress of growth at intervals. Mark the date on each sketch.