HOW WE STAND AND WALK.

[Abstract of a Lecture Delivered before the American Institute by Prof. Burt G. Wilder.]

The second of the course of scientific lectures before the American Institute was delivered on the evening of Dec. 27, by Prof. Burt G. Wilder, of the Cornell University. The lecture was illustrated by diagrams and experiments.

After a somewhat humorous introduction the lecturer contrasted the walking of men with that of brutes. He said:

You will notice in menageries that the tallest apes are obliged to walk upon their feet as we should walk upon the hands, with the great toe standing out from the side of the foot, and the heel so short that it has not the power of supporting the body that our heel has. Here is a diagram of the skeleton of the foot of a man, and you see that the heel is long and strong; that the bones forming the arch of the foot are strongly put together. The great toe is the essential part of the foot in standing and in walking. If any of us have lost our great toes we should find immediately how difficult it is to balance ourselves upon our feet, because with man the use of the great toe lies in the propulsion of the body upon the feet, whereas in the gorilla the great toe stands out from the side of the foot like a thumb, and has no power whatever of supporting the body or propelling it like the man.

Du Chaillu tells wonderful stories of the grasping power of this hind hand of the ape, in which respect man's foot bears no comparison to it. Now, again, if you wish to see man at a disadvantage you have only to place him on all-fours, and make him walk like an ape. (The lecturer then made a diagram of a man in this position, which provoked considerable amusement). The head now hangs forwards as a great weight, requiring muscles which we do not possess to support it. The curve in the back, and the limbs are so arranged that the knee itself touches the ground, our thighs being much longer than the corresponding bones in the upper arm; and we have to raise the thighs so that the feet may touch the ground. You must not, however, forget that there was a time when we all went in this way or attempted to do so.

I cannot help here alluding to one thing, although, God be thanked! the necessity for it has almost passed out of date—the fact that some among the human race who have considered themselves even most refined and civilized, have, for various reasons and by various means, imitated some of the lower animals in their attitudes. If you were here to draw a human head and face with small jaws like this (exhibiting a head), and put on the back of it a great chignon, we should have simply the belle of the period in the position which she is obliged, by the very force of gravity, to assume in order to support this ponderous mass upon the back of her head. There is an old saying that "one good turn deserves another." I should change it in this case by saying that "one ill bend provokes another." In this Nineteenth century we have adopted what was originally the monkey bend, and not a Grecian or any other kind of bend.

There are several things to be said respecting the human foot, which is, of all the parts of the body, the least noticed. It is covered up, and not exposed at all times, like the hands. It has a degrading office, inasmuch as it is obliged to support the entire body upon it, and yet there are many things in the foot well worthy of our consideration. (Diagram of a foot, showing the way the bones are joined to form the arch, was exhibited, and the manner in which the body is supported was described). Now, in order that we should stand, it is necessary not merely that we shall be put up in an erect position—I might manufacture a pole representing a man, and set it upright, but how long do you suppose it would maintain its position? Not at all. It would topple over.

We do not realize the attention which is required of the mind to enable us to stand upright; yet there is a constant, although unconscious, attention of the brain, without which we could not maintain an erect attitude. And the muscles which lie along the legs, and which may be seen in the diagram, are in constant action. If you will stand on tiptoe, and let a person feel the muscles of the leg, they will be found in constant activity. There is a movement among them; some are falling backwards and some forwards, yet all are so adapted to each other that we are enabled to stand upright.

When we wish to lift ourselves upon tiptoe, then those muscles which are attached here (at the heel) contract with greater force. In ballet dancers and tight-rope walkers there is an immense development of the muscles of the calf, and indeed of the entire leg. The muscles attached to the end of the heel contract, the foot itself resting upon the ground, and form a lever of the second kind, as it is called, thus hoisting the body upon the toe; and the muscles which are required to keep the body on tiptoe are more than we dare enumerate almost.

Man's foot is called a plantigrade foot; that is, a foot which has the whole sole flat upon the earth. There is one other beast—and a very respectable one in his way, which has also a plantigrade foot, and that is the bear; but the bear's foot and method of using it differ from man's, and his method of using it, in this respect—that whereas as we walk we strike first the heel, and then roll forward upon the toe of each foot alternately, the bear lifts the whole of the foot together and puts it down flat, in precisely the same way that a negro clog dancer does. The bear has not the power to put down his heel first and then roll forward and give a spring as we do, but it puts it down flat, as any one of us would if we had a wooden leg. So that there is a difference both in the structure, and method of using, this useful member.

This brings us now to the subject of walking itself, which is properly the subject of the present lecture. I might take it up from half a dozen different points of view. After thinking the matter over I have concluded to approach it with reference, first, to a single familiar idea—the influence which walking, or which standing in different positions, has upon the hight of the body. There are three groups of facts which may be adduced in order to show that the hight of the body is affected to some extent during our walking and different modes of standing. One is the matter of common observation that we are shorter when standing upon one foot than when standing upon both.

[The lecturer's assistant at this point stood up beside a board, and his hight, standing first upon both feet and then upon one, was measured. Unfortunately for the theory, however, the man's altitude remained the same in both positions, a fact which brought smiles to the faces of the audience.] "I shall have to say, continued the Professor, "with a gentleman more distinguished than I can ever hope to be, who, when a certain experiment of his failed utterly, very coolly turned to his hearers and said: "Gentlemen, the experiment has failed, but the principle remains the same." [Laughter.]

The second matter in connection with this is stated by ladies—certainly good authorities in this day and generation—who say that the skirts of dresses which exactly clear the ground while the person is standing still, will, the instant they begin to walk, drag upon the earth; and in the third place, Dr. Oliver Wendell Holmes, who has written some upon this subject, has stated that a man is shorter when he walks than when standing erect. I have tried the experiment over and over again, and I am convinced that at every single point in ordinary walking a man is shorter than when standing still.

There is a certain average length of a man's body, and this length may be defined as the distance between two parallel planes which coincide respectively with his uppermost and lowermost points. But there is some difference between the length of the body and the hight. The length varies under certain conditions, and the first is that a man is taller when he takes a full breath than when he has his lungs empty. [This fact was practically demonstrated by the lecturer.] The second is that a man is shorter when he stands than when he is lying down flat upon his back. [The Professor's assistant laid down, and in that position measured five feet and eight inches; standing up, and carefully measured, it was shown that he was an inch shorter.] This difference is for the reason that when we are lying down, the whole body is allowed to stretch itself out, while in standing it settles down, so to speak. From the same cause comes the familiar fact that a man is taller in the morning than at night after he goes to bed. He loses, perhaps, an inch in the daytime. One other thing I will not stop to prove, and that is, that any deflection of the body from the perpendicular lessens the length of the body. We can prove that a man's body is shorter when it is bent. For instance, when we bend the body at the hips and spread the legs to any extent, or when we bend the knees, we become shorter. The hight of a body may be less, and yet its length be exactly the same.

In stating the phenomena of walking we have to consider two things—first, whether different parts of the body are bent upon each other when walking, and second, whether the body is swung from one side to the other. We shall find that both of these occur in every stage of walking. The walking man is peculiar in this respect, that the center of gravity is constantly shifted from one side to the other, and at the same time propelled forward. It is oscillated from side to side, and at the same time it performs a forward movement in the direction in which the person is going. Now this transfer of the center of gravity gives us that oscillation of the body which you see in very tall or stout persons when walking behind them. The leg of a giant is to the leg of a dwarf as is the pendulum of a large clock to that of a mantel clock. In the short man it swings more rapidly, in the tall man more slowly. The body is carried forward steadily, but the legs are not.

The lecturer then exhibited a gradigraph, a simple apparatus consisting of two hollow tin tubes placed so as to form a right-angle triangle, each tube containing a wooden piston resting on a spring, and having attached to the outer end a piece of charcoal. By means of this instrument he showed the variation in hight of a person while walking, and also the oscillation of the body from side to side. "I do not," said he, "claim for this instrument any wonderful powers, but it is, I think, possible by this means to get a more exact idea of the gaits of different nations. It would certainly be easy to recognize a gait having any distinct characteristics, as, for instance, a stage stride. We know that the French walk different from the Prussian, and the Prussian from the English. It is possible that this instrument may yet be perfected so as to measure the exact amount of oscillation upward and downward and from side to side. One very curious fact in regard to walking is that one side of the body always tends to outwalk the other side. It is not possible, when the eyes are shut, to walk in a straight line for any length of time. We have heard stories of persons losing their way in woods and on prairies, and coming out so as to indicate that they had been walking nearly in a circle. I have myself tried experiments in a large room, and have found on looking at a crack in the floor and closing the eyes, that it was impossible to keep that crack. I almost always turned to the right; and it will be found, where persons lose their way, that they almost invariably wander off to the right rather than the left.

IT it estimated that there are at present in this city out of employment, 1,000 bricklayers and masons, 400 stair-builders, and 800 painters.

MANUFACTURE OF SAWS IN SHEFFIELD.

[Condensed from The Ironmonger.]

We were first taken into the rolling mill, in order to witness the manufacturing process from its beginning, and we must confess we were at first rather startled by the sight which met our unaccustomed eyes, and by the sounds with which our ears were greeted. From every side, while red-hot metal was being thrown about in every direction, sounded the loud whirring of rolls, creaking of engines, snicking of shears, rumbling of wheels, and roaring of furnaces. Men stripped to their shirts, with perspiration starting from every pore, were busily employed in rolling ingots of steel, which are cast on the premises into sheets, bars, rods, etc.; but we at present have only to do with the sheets. Accordingly our conductor led us to a furnace of moderate dimensions, from which the furnace man took a red or rather white-hot ingot. We may here remark, that the ingots which are used for sheet rolling are of different shapes and dimensions, according to the size and description of saw they are intended to produce. The ingot having been taken from the furnace, is handed to the roller (we mean the man, not the rolling apparatus), who passes it between the rolls, it being received on the opposite side by another workman called the backer, and being by him repassed to the roller. After passing and repassing between the rolls several times, the ingot is transformed into a sheet of steel, the degree of thickness being determined by a gage, which the roller carries with him; he, however, seldom uses the gage, as long practice has enabled him to determine to a nicety the degree of thickness to which the ingot is to be rolled. We may here remark that the handling above spoken of is performed by tongs of a peculiar description, great dexterity being required in the use of these tongs, in order to prevent the sheet of steel slipping from the nippers.

The next operation which the sheet underwent was that of paring, which is simply the cutting, by means of a pair of shears worked by steam power, the sheet of steel into the shape and size required. In this case the sheet under operation was intended for an ordinary carpenter's or hand-saw. Toothing is the next operation, and is performed with more ease and celerity than would be imagined. The workman is seated on a high stool before a table or counter, and, by means of a small fly, strikes out the cogs, or teeth of the saw, with great rapidity. The saw he acted upon for our information contained about 115 teeth, and it will scarcely be believed that this number of teeth were made in the space of less than two minutes. The tooth-cutter informed us, in reply to a few questions which we put to him, that he could cut as many as twenty-four dozen of ordinary-sized hand-saws (say twenty-four inches long) in a day, the day consisting of about eight hours.

Hardening and tempering of the saw is the next process. For this purpose a large oven is built over a furnace, which being surrounded in every direction by fire, is continually in a state of red heat. Into this oven the saw is introduced, and when red hot is taken out and plunged into a tank or bath containing oil. After remaining in this bath for a few minutes, it is taken out, and by this process the saw is made hard, or, we would say, stiff. The saw becoming very bent, and out of shape by this process, it is necessary to smith it, or reduce it to its proper shape. But as in the process of hardening the saw has become very brittle, it is necessary to draw the temper, in order to allow of its being smithed or straightened without danger of breaking.

The next process which the saw undergoes is that of grinding. This is not, as might be supposed, for the purpose of sharpening the edge of the saw; it is done in order to take off the rough and dull looking surface, and give it a bright and highly polished appearance.

The grinding room is simply the shed or building within which the grindstones are placed. The grinding is performed by a grinder standing or sitting upon a horse (the block of wood placed at the back of the grindstones, upon which the workman stands or sits) and pressing the saw with all his weight and strength upon the grindstone. We must confess that we were agreeably surprised by the appearance of the saw-grinders, they being, we thought, remarkably mild and inoffensive-looking men, and exhibiting none of those signs of brutal ferocity which we had almost expected to find among the associates of the notorious Broadhead and Crookes, of saw-grinders' trade-union celebrity. We noticed one thing with reference to the vocation of the saw grinders, which was that their work must, to say the least of it, be very disagreeable in cold weather, owing to the continuous stream of water that is pouring over their hands, our readers being, no doubt, aware that cold water is always flowing over the grindstones in order to neutralize the friction proceeding from the contact of the steel with the stone. The grinders, we are sorry to say, labor under the disadvantage of great danger in their work—apart from the danger which is always threatening them—and which cannot always be effectually guarded against, of the grindstones flying or breaking, thereby perhaps killing or seriously injuring all or a great number of the men in the grinding room, the men knowing that they are inhaling poison, and consequently death, with every breath they take, the particles of steel and of stone entering into their lungs, and sending them off the face of the earth, at, in many cases, a premature age. This being the case with the wet grinders, how then must it be with the dry grinders, who have not the advantage which the others enjoy of having many of the deadly particles taken off by the water? Besides this, in the case of the wet grinders the stone rotates *from* the workman, in the case of the dry grinders, the stone rotates in the opposite direction, that is to say *full in their faces*. We left the grinding wheel with feel-