

rests on an incline. Of course the footstocks of the skates being too low behind would produce the same effect as too low a heel to the boot, *i.e.* throw the balance too far back.

Fig. 2 shows the position the skate will have on the ice if the heel is too high, *i.e.* the centre of pressure is thrown too far forward, and consequently the skate must roll up behind in order to get the proper balance.

In Fig. 3 is shown a skate in the proper position on the ice, *i.e.* with the heel raised so high as to throw the centre of pressure on the centre of the foot and skate.

The proper height of the heel of the boot to obtain this result will depend on whether the footstocks of the skates are level, as they ought to be, and the exact height will vary with different individuals, depending [on whether they naturally stoop or lean well back, and probably also on the boots they are in the habit of walking in, and therefore can only be determined accurately by trial; but a half-inch heel is by no means too low for most persons.

Third. With regard to the adjustment of the skate longitudinally, Figs. 4 and 5 will show the obvious effects of not fixing the skate properly on the foot; in Fig. 4 the skate being put too far forward, and in Fig. 5 too far back.

Having now shown how to procure the balance on any desired part of the skate, it only remains to be shown why the [position of the skate, with the balance on the centre as in Fig. 3, is the proper one; and as the effects of the various positions are most evident in skating turns, I shall confine myself entirely to them, commencing by giving the theory of turns, which I believe has never been satisfactorily explained.

It is impossible in a few words to describe accurately and fully the forces which come into action in making a turn, but my object will be attained by describing what I consider the basis of the whole theory of turns, namely, that a turn is not a twist round of the body made by the skater at the moment of the turn, but the turning round of the body is the result of a reaction of the ice on the skater caused by his putting his skate (by rolling on to the toe or heel) in such a position as to make that part of the skate bite or grip the ice, producing a force opposite, though not directly opposed, to his direction of motion, but parallel to it. The direction of this reaction is shown by the arrow *a* in Fig. 6, and being exerted at some distance from the body, it necessarily tends to turn the body round in the direction of the arrow *b*. It will be evident that the greater the distance of the point of application of this force from the curve the skater is describing, the greater will be the *couple* tending to turn round the body.

This action can be shown by means of a disk of lead *c*, in Fig. 8, with a light rod through it. If this be made to roll on a table, and a force be applied to the rod at *d* by means of the finger, the action of reversing the body and preserving the same inclination will be distinctly shown. Suppose the skater then about to make a back turn, and that he balances near the heel of his skate as in Dove's plan, then, as he can only roll a very little further back, as he is already on the heel of his skate, the leverage, and hence the couple tending to turn him round, will be almost *nil*, the cusp he makes being of the shape shown in Fig. 7, instead of being of the shape shown in Fig. 6, and consequently if he is to turn round in time he must give his body a wrench round, which is of course very inelegant, and very difficult to accomplish. If the balance is on the heel the cusps of the forward turns are much larger than the cusps of the back turns, thereby tending to make the back turns more difficult than is necessary; but even with the balance on the centre of the skate back turns will be more difficult than forward turns, as the formation of our bodies prevents the bending up of the foot more than a few degrees, even with a boot off, whereas we can bend it down 40 deg. easily.

With the balance on the centre of the skate back turns can be performed without any wrench or swing of the leg—a thing that is physically impossible if the balance is on the heel, as it must be in Dove's or Vandervell and Witham's plan. CHARLES ALEX. STEVENSON

JOHN DUNCAN; THE ALFORD WEAVER AND BOTANIST

ON the last day of 1880 the University of Aberdeen was presented with a herbarium of 1131 specimens of the British Flora, gathered, preserved, named, and localised by an aged country weaver who lives near Alford in Aberdeenshire. He is no ordinary man, as the accumulation of such a botanical collection is alone sufficient to prove. It represents a portion only of the scientific labours of nearly fifty years—for much of these have been destroyed by time and the moth. This remarkable man, who is now a pauper on the parish which has been the scene of his unextinguishable scientific enthusiasm, should be better known to the scientific world, and a short sketch of his life and labours may not be unacceptable to the readers of NATURE.

John Duncan was born on December 24, 1794, so that he is now in his eighty-seventh year. His parents were very poor, and could afford him only the merest rudiments of even the three R's as then taught, for his education had to be sacrificed to the pressure of penury. He learnt to read by laboriously spelling his way through the text in church; his writing has ever been very rude, but distinct; and his spelling is such an example of the phonetic as would delight Mr. Pitman. He was early sent to work and became a "customer weaver," making into cloth the flax and wool sent to his home by his neighbours, and such he has remained ever since. He married early in life, and had a son and two daughters; but his wife died more than thirty years ago, and all his family have gone, he remaining as the sole survivor. During the greater part of his long life he has dwelt in the valley of the Don, near Alford, and for nearly thirty years in the same cottage at Droghsburn, in the pleasant hollow of the Leochel, five miles above that village. This cottage forms one end of a line of dwellings, the other belonging to a ditcher's family who prepare his simple meals. He occupies a single room, filled with the looms and other implements of his trade, open to the thatched roof, his bed resting on some deals laid across the rafters, and reached by means of a ladder. In this narrow space John Duncan has lived for twenty-eight years, a solitary man, in serene contentment, upright and religious, working laboriously for an honest living, cheered only by the friendship of a few, his love of books and his devotion to the study of plants, which he has prosecuted with a single-minded enthusiasm that is as rare as it is beautiful. I visited him about three years ago and spent two days in his company, having long wished to do so from what I had heard of him from his dearest friend and fellow student, Charles Black. I found him in good health, working hard at his craft with sturdy and admirable independence, visited only by a few disciples whom he had inspired with a love of himself and the plants, unknown, self-contained, and happy even on the verge of want. I examined his plants, talked of their history and the crowding memories they recalled of countless wanderings in their search, saw his books on botany, theology, and general literature, which are unusually numerous and costly for a poor man, conversed with him on many subjects, chiefly connected with his studies, and his intimacy with Charles, whose friendship is now the chief comfort of his age; and I left him charmed, inspired and rebuked by his life, character, enthusiasm and wise contentment, the result of unwearied devotion to higher pursuits.

Some interest in the solitary student was roused by an

account I then gave of him. This account appeared in *Good Words* for April, May, and June, 1878, with pictures of himself and his cottage. It has recently been incorporated in whole into "Leaders of Men," by H. A. Page (Marshall, Japp, and Co., London); and he was visited by not a few kindly spirits whose open-handedness lightened somewhat the growing pressure of age and want. Since then he has worked at his loom, winning his daily bread with heroic struggle, till a short time ago, when decaying power and some paralytic touches, in his eighty-sixth year, compelled him reluctantly to give it up and remove from his small but honourable workshop and study to be kindly tended by the ditcher's widow. Many years ago his hard-won earnings—for he was always a most careful man—were dissipated through domestic causes over which he had no control, attended with heavy griefs. Since then his growing age has barely enabled him to live more than from hand to mouth, and now for some time he has had to do what must be inexpressibly keen to an independent soul like his, to accept from the parish a pauper's portion.

From his earliest days, when he used to play upon the green cliffs of the high conglomerate coast of Kincardine, John Duncan had an intense love of plants, and long before he began their scientific study collected them for their medicinal uses, guided by Culpepper's "Herbal." It was not till he was forty years of age, when he was introduced in 1835 to Charles Black, that he commenced the study of botany as a science. Charles was a remarkable man, of great individuality and ability, and though twenty years his junior, at once gained over him an ascendancy of the best kind, and inspired him with an ardent friendship that has been the sweetest solace of his long solitude. He still lives as the gardener he was then, a botanist, geologist, ornithologist, numismatist, scientific student, theologian, and omnivorous reader at Arbigland in Dumfries, near the mouth of the Nith. When these two men met, Charles was settled as gardener near Alford, and under his guidance John at once began the systematic study of botany. They soon conquered the flora of the Vale of Alford; the curious peak of Ben-a-chie, where they found at an early date the *Rubus chamaemorus*, or cloudberry, being a favourite haunt. John, having his time, as a home weaver, more at his own command, by and by extended his excursions to greater distances, and before very long did the most of the county. The enthusiasm with which these two humble men prosecuted their studies was wonderful, the morning light often surprising them at their work of classifying, drying, and arranging their accumulating treasures. The want of text-books of the science was sorely felt by them, and excited them to ingenious devices to supply it; a certain country inn, for example, being frequented by them, not for convivial purposes, but to obtain a sight of "Hooker," which had belonged to the innkeeper's dead son. The details of John's continued studies under poverty, difficulty, and trial are interesting and honourable, but these cannot be given here. In order to extend his knowledge of botany and the flora of Scotland he used to take harvest work in different parts of the country, studying in succession the plants of each district, till he had in this way traversed the most of the land from Northumberland to Banff, except some parts of the West and the Highlands; bringing home specimens living and dead, planting the one in his own neighbourhood, and adding the other to his rapidly-increasing herbarium. His knowledge of plants was minute and scientific, and the abundant technical terms were used with ease and intelligently understood by the help of a Latin dictionary he had purchased for the purpose; nor was it confined to mere technicalities, but extended to an unusual acquaintance with their habits, history, and uses. His collection of botanical works is surprisingly large and valuable, all purchased by his own hard-won earnings. His memory

being as strong as his use of the pen was weak, he did not write down any details of the plants thus collected, but he could tell all these when asked with unerring precision, as well as relate the varied incidents, interesting, humorous, happy or hard, connected with their discovery. The names and localities have however been successfully obtained from him and written down, by the help of one of his disciples, Mr. J. M. B. Taylor, of Aberdeen, who prepared the herbarium for the University.

John kept his collection neatly laid down in volumes made by himself of newspapers of the period, of tea paper, which he thought a good protection against moths, and of other homely materials scented with camphor. Many of them of course decayed or were destroyed during the forty and more years they were in his possession, but even after discarding all imperfect specimens there remained 1131 plants now fully named, localised, and arranged by Mr. Taylor from John's unerring memory. They are divided in four books, put together by John himself.

1. A general collection of some 500 specimens including ferns arranged according to the Linnæan system, 100 of which are described by Prof. Dickie, author of the "Flora of Aberdeen, Banff, and Kincardine," as rare or very rare.

2. An almost perfect collection of the flora of the Vale of Alford, many of the plants now uncommon.

3. Specimens of about 50 of the grasses from the Alford district.

4. Specimens of some 50 of the Cryptogamia of the district, chiefly mosses and lichens.

John never possessed above a few of the *very rarest* of our British plants, not having visited the higher mountains and outlying regions where only such are found, but had been fortunate in obtaining a large number of local and very local, rare and very rare species. They were mainly found along the eastern half of the country from Banff to Northumberland, excluding the Highlands.

Such is a very slight sketch of the life and labours of this remarkable weaver. The presentation of his herbarium has revealed the sad fact that, independent and toil-worn as he has ever been, even to nigh eighty-six, he has been lately compelled to bear the pain and shame of depending on the parish for his daily bread. His books are of value, and would alone fetch a considerable sum; but these, the dear companions of his life, he cannot bring himself to part with, though now unable to enjoy more than a sight of them. His beloved plants he would not barter for heaps of gold, and he has therefore presented them to Aberdeen University, there, it is to be hoped, not only to do good educational work, but to exercise an inspiring impulse over many generations of students privileged to examine these far-fetched treasures.

An appeal has recently been publicly made in favour of the aged botanist, to enable him to spend his few remaining days in comfort and independence, supported by the free-will offerings of the scientific and generous, which have been amply won by scientific work admirably achieved. Scientific societies throughout the country could not better aid research than by recognising his merit, and making a contribution for such a worthy object. Shortly after my account of him in *Good Words* the Largo Field Naturalists' Club elected John an Honorary Member, and the same has been recently done by the Inverness Scientific Society and Field Club, which also made a donation to him of 5*l.*, examples that might be honourably followed by other societies. A lively interest has been excited in his case, and has been already substantially expressed. It is devoutly to be hoped that such a man will not be allowed to go down to his grave dishonoured and neglected.¹

WILLIAM JOLLY

¹ Subscriptions may be sent to William Jolly, H.M. Inspector of Schools, Inverness.