tive processes. The laws of atrophy and final disappearance of disused organs, so ably advocated by Darwin, are equally striking with regard to individual tissues and cells, and it is a well-recognized fact that the higher the original development of a tissue or cell has been—i.e., the more it has been differentiated or specialized from the amœba type—the more profoundly is it affected by alterations in environment or nutrition, so as to degenerate completely, or be replaced by some form of tissue like the connective, which is of lower development but stronger vitality. The result of nerve grafting and of nerve suture after complete section have varied greatly in the hands of different operators, but, despite many discouraging failures, there is no doubt that in man, as well as in the lower animals, nerve fibres may reunite when sutured even after secondary degeneration has occurred, and they exhibit restoration of function. For this to occur, however, the nerves must be in communication with some trophic centre. Nerve grafting does not succeed so well as nerve sutures in favorable cases. It occurred to Dr. Thompson recently, while studying cerebral localization in the lower animals, that it would be interesting to graft a piece of brain tissue from one side of a dog's brain to the other, or from one animal's brain into another's, and study its vitality. Of course, he had no expectation of being able to restore abolished function by the operation, but the question of vitality of the brain tissue and the course of its degeneration is a subject which is of very wide interest. The first experiments were preliminary, made in order to ascertain whether the transplanted brain would be immediately absorbed or would slough away.

No microscopic examination was made in connection with these experiments, as it was intended only to determine the possibility of the transplanted tissue adhering. Being satisfied in regard to this matter, Dr. Thompson secured a large dog and performed his experiment. A half-inch trephine was used and a button of bone was cut nearly through over the left occipital region, leaving a small attached margin so that the button could be elevated and then depressed like a little trap-door. Through the opening 2 c.c. of brain tissue were removed. A cat was simultaneously trephined and 1.5 c.c. of brain from her left occipital region were transferred in eight seconds to the opening in the dog's brain.

The features of interest of this experiment are the facts that: 1. There was complete union, through organized connective tissue, of the contiguous portions of the two brains. 2. After seven weeks the cat's brain still maintained enough vitality to be distinctly recognized as brain tissue. 3. Brains of animals of two very different species were thus made to unite. 4. The cat and dog pias presented perfect union as well. 5. There was a sympathetic degeneration of the corresponding convolutions upon the opposite side of the dog's brain. For this curious fact Dr. Thompson can not account. He had never noticed it before, in as many as fifty operations upon this region of the brain of cats and dogs, although he had sometimes seen removal of a part of the occipital region result in extensive softening of the entire hemisphere of the same side. The opposite degeneration in this case may possibly be a mere coincidence; if so, it is a very unusual and remarkable one. There was no meningitis to favor it. 6. There was descending secondary degeneration of the dog's brain on the side of the graft, as is usual in cases of simple excision of brain cortex; hence the cat's cortex had not succeeded in acting as a nutrient centre for the dog's brain.

Dr. Thompson thinks the main fact of this experiment—namely, that brain tissue has sufficient vitality to survive for seven weeks the operation of transplantation without wholly losing its identity as brain substance—suggests an interesting field for further research, and he has no doubt that other experimenters will be rewarded by investigating it.

LETTERS TO THE EDITOR.

Temperature in Storms, and High Areas.

THERE are two classes of cases in which the temperature is higher on Mount Washington than at surrounding stations at a lower level. By far the most frequent of these is when the crest of an anti-cyclone has just passed that locality. For example, on May 22, 1887, at 7 A.M., the temperature on Mount Washington was 58°, with fair weather, and wind velocity 26 miles, from the north-west. At Portland the temperature was 52°, at Boston 56°, at Eastport 44°, at Montreal 44°, the winds being from the south-east and light. The isobar 30.40 was over Nova Scotia, and that of 29.90 was over Lake Superior. On Feb 26, 1887, at 7 A.M., New England was enclosed by the isobar 30.40, a low centre, 29.40, being over Wisconsin. The temperature on Mount Washington was +8°, at Portland +2°, at Montreal −10°, at Albany +8°, and at Eastport +2°. On Feb. 2, 1887, the isobar 30.90 was located directly north of New England, and there was no low centre nearer than Utah and Colorado. The temperature on Mount Washington was +5°, at Portland +4°, at Eastport −3°, at Montreal −10°. On March 6, 1887, the temperature on Mount Washington was 15°, at Portland 14°, at Eastport 15°, and at Quebec 7°. The isobar 30.60 appeared in Nova Scotia. On Dec. 31, 1886, at 7 A.M., the isobar 30.60 was located in Nova Scotia, and that of 29.80 in Tennessee. The temperature on Mount Washington was +9°, at Portland +2°, at Montreal −7°, with winds generally from northerly points except on Mount Washingington, where they were from the west. On Dec. 26, 1886, the isobar 30.40 was over Maine, and that of 29.80 over the upper lakes; temperature on Mount Washington +14°, at Portland +10°, at Montreal −2°, at Albany +12°, at Boston +15°. On Jan. 17, 1887, at 7 A.M., the isobar 30.50 was over the maritime provinces, and 29.30 over Michigan; temperature +20° at Mount Washington, +8° at Portland, and +17° at Albany. On Jan. 4, 1887, at 7 A.M., the isobar 30.70 enclosed New Hampshire, southern Vermont, and south-eastern New York. Within these limits at the very crest of the anti-cyclone the temperature on Mount Washington was −1°, at Portland −7°, and at Albany −4°.

Numerous other instances of the kind might be cited, and the list might be greatly enlarged also by admitting cases in which an approach to inversion of temperature was apparent although not fully attained.

The other class of cases in which there has been an inversion of temperature are much more rare and difficult to define, being due apparently to temporary anomalous conditions of one sort or another. For example, on Jan. 10, 1887, at 7 A.M., the temperature on Mount Washington was +10°, at Portland +8°, at Boston +14°, and at Eastport +30°, although a low centre surrounded by the isobar 29.50 was located in Maine. The isobar 30.00 appeared over New Brunswick, as in the previous cases, however, and the isotherms were very much crowded, there being a gradient of 30 degrees between Nova Scotia and New Brunswick. In like manner on Dec. 16, 1886, there was a low centre, 29.50, off the New England coast, and an unusually confused arrangement of the isobars and isotherms toward the north-west, a low centre, 29.80, being over Lake Huron, with the isotherms +50° over Nova Scotia and −10° near Rockliffe, Canada. Coincidentally with this anomalous condition the temperature was somewhat higher on Mount Washington than at surrounding stations.

As a rule, however, increased divergence of temperature betwixt Mount Washington and surrounding stations attends and follows the passage of cyclonic centres. For example, on April 30, 1887, the isobar 29.20 covered portions of Maine and New Hampshire, this being the very centre of the low area. On Mount Washington the temperature was 26°, at Portland 46°, at Boston, 50°, at Montreal 39°, at Albany 43°, gradually decreasing westward to the lake region, where an anti-cyclone was located. On March 25, 1887, at 7 A.M., the centre of a cyclone was exactly over New Hampshire, with pressure 29.20, and temperature on Mount Washington +20°, at Portland +39°, at Montreal +25°, at Quebec +28°, at Boston +46°, at Albany +35°. On Sept. 8, 1887, at 7 A.M., a low centre, 29.40, was at Father Point, Canada, and the barometric trough extended thence south-westward into Maine. At Mount Washington the temperature was 28°, at Portland 60°, at Montreal 54°, and at Quebec 52°. With the distribution of pressure just described, wide divergence of temperature between Mount Washington and surrounding stations is extremely common, and it is not necessary to multiply illustrations. The contrast with the comparative equalization of temperature at these stations attendant upon and immediately following the passage of the crest of anti-cyclones over New England is very striking.

The results of these observations may perhaps be summarized briefly in the statement that temperature changes indicate their approach at the summit of Mount Washington sooner than at its base. Thus, the departure of an anti-cyclone is signalized by a rise of temperature amounting, in the cases above described, to an actual inversion of temperature as compared with surrounding stations. In like manner the departure of a low centre is marked by decided decrease of temperature at the summit as compared with lower levels. In the former case there is equalization and in the latter case increased divergence of temperature at different altitudes. Hence it follows that relatively warmer air overlaps an anti cyclone at least as far east as its crest, and in like manner relatively colder air tends to overlap the warm air at cyclonic centres, but the extent to which it does so is not so clearly defined as in the case of the anti-cyclone. M. A. VEEDER.

Lyons, N.Y., Aug. 1.

Dr. Sprung: Remarks on the General Wind-Systems of the Earth.

IN the *American Journal of Science* for April I have called attention to the recent activity on the part of investigators in the field of dynamical meteorology. In that paper no attempt was made to give any opinion as to the relative merits of the different theories advanced. There could be no doubt but that a critical review of the subject was very much needed, but it must be at the hands of some one who had mastered the different theories with a thoroughness which would permit of his making a just estimate of the value of the ideas advanced by the writers. There was no doubt in my mind as to who was a (perhaps I should say the) proper person to give us this estimate. I refer to Dr. Adolph Sprung. It was with the greatest pleasure, then, that, on taking up the May number of the *Meteorologische Zeitschrift*, I found there a paper of sixteen pages by Sprung, in which he had given his views as to the correctness of the methods and some of the main results arrived at in these recent papers.

But before giving a synopsis of this *referat*, it may not be out of place to say a few words about Dr. Sprung's work, as he is probably known to but few of the present readers in any other capacity than the author of the "Lehrbuch of Meteorology," which gives us such an excellent presentation of the modern theories concerning statical and dynamical meteorology. Dr. Sprung's contributions to meteorology extend over a period of about fifteen years, and cover a wide range of topics. But there are two distinct lines in which he has made his name especially prominent as a specialist: viz., those which relate to self-registering instruments, and the mechanics of the atmosphere. He has devised a self-registering apparatus of great accuracy, which is gradually receiving a wide adoption; and the fact that its construction is in the hands of the leading German meteorological instrument-maker is itself a guaranty of its excellence. The names of "Wild" and "Sprung" will always be associated with the development of this important branch of meteorology.

It is, however, of Sprung's connection with the second topic, that of dynamical meteorology, that I wish to make special mention at the present time. From the commencement of his meteorological labors at the Deutsche Seewarte he has been a careful student of this subject; and his acquaintance with its now extensive literature is not of a cursory nature, but admits of his using the methods and results of contributors in a manner which denotes thorough comprehension. Judging from Sprung's writings, as well as by a long personal intercourse with him, I feel justified in saying that no one has a better knowledge than he, of the contents of the hundred papers which cover the field of dynamical meteorology. I do not know of a better example of the thoroughness of this study than his review of Part II. of Ferrel's "Meteorological Researches," which he published in the *Osterreiche Zeitschrift für Meteorologie* nearly ten years ago. In this same connection I may also say that no other person has done so much as Dr. Sprung towards making generally known to Europeans the great service of Professor Ferrel to meteorology.

In the comparative treatment given by Sprung in the paper now under consideration, he prefaces it by some general remarks which are of interest to us; and I will give an abstract of these, as well as of portions of the main paper.

The general circulation of the atmosphere has been lately the subject of theoretical investigation, and principally by German investigators, although earlier — through a number of years — the workers in this field had been almost exclusively Americans, and foremost of all was William Ferrel. But in 1886 Werner von Siemens published an important paper, which was the first of the series just referred to. In this investigation the results already obtained by Ferrel in his earlier works were not made use of, and the matter was treated from the first principles. But in all of the investigations an ideal and homogeneously formed earth's surface is presupposed; that is, it is assumed to consist everywhere of water or land of like qualities. On this supposition there is built up an ideal pressure distribution and system of winds. Moreover, all of the systems agree with the view so long ago advanced by Hadley, as to the initial cause of the atmospheric circulation.

The theory of Werner von Siemens is first outlined, not because it is the oldest of the modern views, but because it is the simplest. It may be briefly stated as follows: We must conceive the air to be everywhere at relative rest; the atmosphere will then possess, by means of its absolute motion of rotation, a certain amount of living force K. Now suppose the whole atmosphere to be suddenly thoroughly stirred up. Then, according to Siemens, there will be produced an everywhere uniform volocity of rotation C, and of such an amount that the total living force is just the same as before.

We will determine C. By definition

$$K = \frac{mV^2}{2}, \tag{1}$$

where m denotes the mass of a quantity of air, and V its absolute velocity of rotation (that towards east is positive); under which supposition we have

$$V = \omega\ R\ cos\ \phi, \tag{2}$$

where R is the radius of the earth (considered as a sphere), ω is its constant angular velocity, and ϕ the geographical latitude. In order to represent the mass m, covering a small ring at the latitude $R\ d\ \phi$ and radius $R\ cos\ \phi$, we will designate by μ the mass (assumed to be uniform) over the unit of surface: we have, then, (3) $m = 2\ \mu\ R^2\ \pi\ cos\ \phi\ d\ \phi$ ($= d\ M$, where M signifies the mass of the whole atmosphere): consequently

$$K = \mu\ R^4\ \omega^2\ \pi \int_{-\frac{1}{2}\pi}^{\frac{1}{2}\pi} cos^3\ \phi\ d\ \phi.$$

In general,

$$\int cos^3\ \phi\ d\phi = \frac{sin\ \phi}{3}\ (2 + cos^3\ \phi) \tag{4}$$

which for the limits $\frac{1}{2}\pi$ and $-\frac{1}{2}\pi$ reduces to $\frac{4}{3}$; therefore we have finally

$$K = \tfrac{4}{3}\ \mu\ R^4\ \omega^2\ \pi. \tag{5}$$

If, now, the computation of the living force for a uniformly equal velocity C furnishes the same amount, then

$$K = \Sigma \frac{m\ c^2}{2} = C^2\ \Sigma\ \frac{m}{2},\ \text{or}$$

$$C^2 = \frac{2\ K}{\Sigma\ m.} \tag{6}$$

From (3) we have, then,

$$M = \Sigma\ m = 2\ \mu\ R^2\ \pi \int_{\frac{1}{2}\pi}^{\frac{1}{2}\pi} cos\ \phi\ d = \phi = 4\ \mu\ R^2\ \pi. \tag{7}$$

By consideration of (5) we have, then,

$$C = R\ \omega\ \sqrt{\tfrac{2}{3}}\ (= 379 \text{ metres per second}). \tag{8}$$

Subtracting from this $R\ \omega\ cos\ \phi$, the motion of the earth at the latitude ϕ, and we get the relative easterly motion v; then from (8) and (2) we have

$$v = R\ \omega\ (\sqrt{\tfrac{2}{3}} - cos\ \phi). \tag{9}$$

It is of special interest to find the latitude ϕ_0 in which $v = 0$. This gives

$$\begin{cases} Cos\ \phi_0 = \sqrt{\tfrac{2}{3}} \\ \phi = 35^\circ\ 16'. \end{cases} \tag{10}$$

For the belt between the two parallels of 35°, there must be, according to (9), a westerly air-current (east wind) which is greatest