compared, something like equality would probably be the result. Much of the force of a moving man is lost from the inequalities of the way. His body, supported on two points only when at rest, oscillates like a pendulum from one to the other as he moves. The ant crawls close to the ground, and has only a small part of the body unsupported at once. This economizes force at each step, but on the other hand multiplies the number of steps so greatly, since the smallest irregularity of the surface is a hill to a crawling creature, that the total loss of force is perhaps greater, since it has to slightly raise its body a thousand times or so to clear a space spanned by a man's one step.

By what peculiarity of our minds do we seem to expect the speed of an animal to be in proportion to its size? We do not expect a caravan to move faster than a single horseman, nor an eight hundred pound shot to move twelve thousand eight hundred times farther than an ounce ball. Devout writers speak of a wise provision of Nature. "If," say they, "the speed of a mouse were as much less than that of a horse as its body is smaller, it would take two steps per second, and be caught at once." Would not Nature have done better for the mouse had she suppressed the cat? Is it not a fact that small animals often owe their escape to their want of swiftness, which enables them to change their direction readily? A man can easily overtake a mouse in a straight run, but the ready change of direction baffles him.

M. Plateau has experimented on the strength of insects, and the facts are unassailable. He has harnessed carabid, necrophori, June-beetles (Melolontha), and other insects in such a way that, with a delicate balance, he can measure their powers of draught. He announces the result that the smallest insects are the strongest proportioned to their size, but that all are enormously strong when compared bulk, for bulk, with vertebrates. A horse can scarcely lift two-thirds of its own weight, while one small species of June-beetle can lift sixty-six times its weight; forty thousand such June-beetles could lift as much as a draught-horse. Were our strength in proportion to this, we could play with weights equal to ten times that of a horse.

This seems, again, great kindness in Nature to the smaller animal. But all these calculations leave out the elementary mechanical law: "What is gained in power is lost in time." The elevation of a ton to a given height represents an expenditure of an equal amount of force, whether the labor is performed by flea, man, or horse. Time supplies lack of strength. We can move as much as a horse by taking more time, and can choose two methods—either to divide the load or use a lever or a pulley. If a horse moves half its own weight three feet in a second, while a June-beetle needs a hundred seconds to convey fifty times its weight an equal distance, the two animals perform equal work proportioned to their weights. True, the cockchafer can hold fourteen times its weight in equilibrium (one small June-beetle sixty-six times), while a horse cannot balance nearly his own weight. But this does not measure the amount of oscillatory motion induced by the respective pulls. For this, both should operate against a spring.

A small beetle can escape from under a piece of cardboard a hundred times its weight. Pushing its head under the edge and using it as a lever, it straightens itself on its legs and moves the board just a little, but enough to escape. Of course, we know a horse would be powerless to escape from a load a hundred times its own weight. His head cannot be made into a lever. Give him a lever that will make the time he takes equal to that taken by the insect, and he will throw off the load at a touch. The fact is that in small creatures the lack of muscular energy is replaced by time.

Of two muscles equal in bulk and energy the shortest moves most weight. If a muscular fiber ten inches in length can move a given weight five inches, ten fibers one inch long will move ten times that weight a distance of half an inch. Thus smaller muscles have an absolutely slower motion, but move a greater proportional weight than larger. The experimenter before mentioned was surprised to find that two grasshoppers, one of which was three times the bulk of the other, leaped an equal height. This was what might be expected of two animals similarly constructed. The spring was proportioned to the bulk. In experiments on the insects with powerful wings, such as bees, flies, dragon-flies, etc., it was found that the weight they could bear without being forced to descend was in most cases equal to their own. In some cases it was more, but the inequality of rate of flight, had it been taken into the reckoning, would have accounted for this.

Take two creatures of different bulk but built upon exactly the same plan and proportions, say a Brobdingnagian and a Lilliputian, and let both show their powers in the arena. Suppose the first to weigh a million times more than the second. If the giant could raise to his shoulder, some thirty-five feet from the ground, a weight twenty thousand pounds, the dwarf can raise to his shoulder, not, as might be thought, a fiftieth of a pound, but two full pounds. The distance raised would be a hundred times less. In a race the Lilliputian, with a hundred skips a second, will travel an equal distance with the giant, who would take but a skip in a second. The leg of the latter weighs a million times the most, but has only ten thousand times as many muscle fibers, each a hundred times longer than those of the dwarf, who thus takes one hundred skips while the giant takes one. The same physical laws apply to all muscles, so that, when all the factors are considered, muscles of the same quality have equal power.—*Am. Field.*

OIL IN CALIFORNIA.

J. W. MCKINLEY, writing to the *Pittsburg Dispatch*, gives the following account of the California oil field at Newhall:

On the edge of the town is located the refinery of the company, connected by pipe lines with the wells, a few miles distant. Leaving Newhall, we drove to Pico Cañon, the principal producing territory of the region. As we approached, we saw, away up on the peaks, the tall derricks in places which looked inaccessible; but no spot is out of reach of American enterprise and perseverance. In one of the wildest spots of the cañon, about thirty men were making the mountains echo to the strokes of their hammers upon the iron plates of a new 20,000 barrel tank. Along the cañon are scattered the houses of the employees of the company, most of whom have recently come from Pennsylvania. Near one of the houses was a graded and leveled croquet ground, with a little oil tank on a post, for lighting it at night. Farther up we came to a cluster of producing wells, with others at a little distance on the sides of the mountains, or even at the top, hundreds of feet above our heads.

The first well was put down about eight years ago, but more has been accomplished in the last two years than in all the time previous. One well which we visited has produced 130,000 barrels in the last three years, and is still yielding. There have been no very large wells, the best be-

ing 250 per day, and the average being about 90 barrels, but they keep up their production with scarcely any diminution from year to year. Drilling has been found difficult, as a great portion of the rock is broken shale lying obliquely. The tools slip to one side very easily, and a number of "crooked holes" have resulted. One driller lost his tools altogether in a well, and finished it with new ones. The cost of putting down a well is from \$5,000 to \$7,000, depending upon depth, etc. Most of the wells are from 1,200 to 1,500 feet, but some have yielded at a much less depth. One well of 270 feet depth produced 40 barrels per day for about three years, has been deepened, and is now yielding even more. Another one of 800 feet is said to have produced 200,000 barrels in the last five or six years. Drilling has been very successful in striking oil in paying quantities wherever there were indications of its presence.

The Pacific Oil Company now has 27 wells producing or drilling, and during the last two years has been rapidly widening the scope of its operations. It has now from 30 to 40 miles of pipe lines, and is preparing to lay 20 miles more, to connect its land with ocean shipping at Ventura. The producers of California have a great advantage in their proximity to the ocean, which gives them free commerce with the outside world. Crude oil is now sold at \$3 per barrel in Los Angeles, and the oil companies are making immense profits. There is a very large amount of oil territory as yet undeveloped, and a rich reward awaits enterprise in these regions. In the Camulos District, which lies west of the San Fernando, are even stronger surface indications of oil than there were in the Pico Cañon. We first went up the Brea Cañon, in which are numerous outbursts and springs of oil. Ascending the mountain west of this cañon, we could plainly see the break in the mountains crossing from the San Fernando through this district to those beyond which have been developed. A couple of miles farther west, the Hooper Cañon stretches back over two miles into the mountain, and is full of oil. Great pools of oil fill its water courses, that are dry at present. Hundreds of barrels of oil must be wasted away and evaporated during a year. A well put down only 90 feet by horse power, struck light oil in considerable quantity, and, had it not been for the death of one of the owners and the consequent suspension of operations, would doubtless have yielded in large quantities at the depth of a few hundred feet.

The mountainous territory between these two cañons will probably in a few years be the scene of great activity. In the Little Sespe District, a few miles west of Camulos, a 125 barrel well was struck at 1,500 feet recently. The Santa Paula region, a little farther west, is also yielding large profits to the parties developing it.

NUTRITIVE VALUE OF CONDIMENTS.

By HELEN D. ABBOTT, Assistant in the Chemical Laboratory of the Philadelphia Polyclinic, and College for Graduates in Medicine.

THE prevailing opinion respecting the substances known as condiments is, that they possess essentially stimulating qualities, rendering them peculiarly fitted for inducing, by reflex action, the secretion of the alimentary juices. Lethargy gives, as the functions of condiments, such as pepper, mustard, spices, pot-herbs, etc., that besides their stimulating properties they give flavor to food; and by them indifferent food is made palatable, and its digestion accelerated. He enumerates as aids to digestion—proper selection of food, according to the taste of the individual, proper treatment of it as regards cooking, and proper variation of it, both as to its nature and treatment.

While it is difficult to give an entirely satisfactory definition as to what constitutes food, the following extracts from standard works will serve as guides. Hermann* says: "The compound must be fit for absorption into the blood or chyle, either directly, or after preparation by the processes of digestion, i. e., it must be digestible. It must replace directly some inorganic or organic constituent of the body; or it must undergo conversion into such a constituent while in the body; or it must serve as an ingredient in the construction of such a constituent." He further says that water, chlorides, and phosphates are the most indispensable articles of diet. Watts† states that "whatever is commonly absorbed in a state of health is perhaps the best, or rather the truest, definition of food."

Chemical analysis shows that the most important and widely applicable foods contain carbon, hydrogen, oxygen, nitrogen, and mineral matter, the latter containing phosphates and chlorides. Other things being equal, it may be considered that the comparative nutritive value of two articles is in proportion to the amounts of carbon, nitrogen, and phosphoric acid they contain.

"The food of man also contains certain substances known under the name of condiments. Since these bodies perform their functions outside the real body, though within the alimentary canal, they have no better reason to be considered as food than has hunger, *optimum condimentum*."‡ Such is the positively expressed opinion of Foster, the author of the article on nutrition in Watts' Dictionary of Chemistry. With a view of determining how far the common condiments deserve this summary dismissal, a number of analyses have been made in the laboratory of the Philadelphia Polyclinic. My examinations were especially directed to the mineral matter, phosphoric acid, and nitrogen. The following table shows the result of the analyses:

	Percent. of ash.	Per cent. of P ₂ O ₅ .
Fennel	9.00	.103
Marjoram	8.84	.050
Peppermint	8.80	.016
Thyme	8.34	.122
Poppy	7.74	.024
Sage	7.58	.033
Caraway	7.08	.118
Spearmint	7.06	.017
Coriander	6.10	.097
Cloves	5.84	.563
Allspice	5.54	.017
Mustard	3.90	.134
Black pepper	3.60	.011
Jamaica ginger	3.16	.052
Cinnamon	3.02	.009
Mace	2.44	.230
Nutmeg	2.24	.092
Celery	1.29	.082
White pepper	1.16	.017
Aniseed	1.05	.113

* Elements of Human Physiology, by L. Hermann. Translated by Gamgee.

† Dictionary of Chemistry, vol. iv., pages 147-8.

‡ Ibid., page 149.

The articles were examined in the condition in which they were obtained in the market, without any preliminary drying, selecting, or preparation. The ash was obtained by burning in a platinum crucible, at as low a temperature as possible, dissolving in hydrochloric acid the phosphoric acid separated as ammonium molybdo-phosphate, and determined in the usual manner.

Qualitative tests made for nitrogen indicated its presence in each one of the condiments examined.

It is of importance to observe that the majority of these condiments are fruits, ripe or nearly so. The seed appropriate to itself the nitrogen and the greatest nutritive properties for the development of the future plant. All nutritive substances fall into two classes: the one serves for the repair of the unoxidizable constituents of the body, the other is destined to replace the oxidizable. Condiments fulfill both of these requirements, as is shown by a study of their composition; the phosphoric acid and nitrogen are taken up by the tissues, as from other substances used in diet. Some articles affect the character of the excretions; this is often due to essential oils; the presence of these in the excretions cannot be said to diminish the value of the substances in supplying the tissues the necessary elements. The same holds true for condiments; the essential oils conspicuous in them are accorded only stimulating properties; however, it may be observed that the essential oils in tea and coffee are accredited with a portion of the dietetic value of these beverages. It appears that when condiments are used in food, especially for the sick, they may serve the double purpose of rendering the food more appetizing and of adding to its nutritive value. The value of food as a purely therapeutic agent is attracting some attention at present, and in its study we must not neglect those substances which combine stimulant and nutritive qualities.—*Polyclinic.*

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