movement, over a ledge formed by the bottom of the feeding box. The weight of the fuel so pushed over is regulated by means of an adjustable cam on the driving shaft, so that the rate of feed can be seen by noting the position of the cam. The simple motion of turning a hand-nut, whilst the machine is running, enables the coal feed to be graduated from nothing to a ton per hour. The fuel thus pushed over falls on to a flat plate called the shovel box, from which it is projected into the fire at intervals by an angular shovel, being effectually scattered over different portions of the grate. The shovel is actuated by the patent pneumatic gear. This consists of a long coiled spring enclosed in a cylinder and pressing on a piston, the spring being used merely to propel the shovel forward, any remaining force being taken up by an air cushion, thus avoiding all shock or jar on the boiler front, and making a practically noiseless machine. The cam which draws back the shovel has four varying lifts, the effects of this motion being to scatter the fuel on the fire in four divisions, each about 18 inches long, so that in a 6-ft. furnace the fuel is thrown on only a quarter of the fire at once; a most material point where smokelessness is important, giving time for each portion of the fire to become incandescent between its charge.

When using low class or waste fuels, which generally contain a large proportion of clinker and ash, the air space in the fire bars of ordinary furnaces soon become, more or less, covered or stopped up, and the fire suffers in consequence. It is manifestly impossible to adjust the supply of air to the fire, to consume the fuel perfectly, unless the clinker and ash are continuously removed. In the Bennis patent self-cleaning compressed air furnace, this is effectually accomplished. This consists of tubular fire troughs of the length the grate is intended to be. The upper surface of each fire trough consists of small interlocking grate bars in about two feet lengths upon which the fire rests. The fire troughs all move into the fire together about two inches, and are then drawn out by means of four-inch cams on a transverse shaft. These cams are made the full width of the troughs, so that there is scarcely any wear upon them, and so powerful is the self-cleaning action, that in travelling from the front of the fire to the back, the coal ascends an incline of more than 3 inches. The clinker and ash are slowly carried forward by this action to the end of the bars, where they drop over into a closed chamber, give up their heat to the boiler, and are drawn out about once or twice every day.

The air spaces between the bars being always free and open, and each tubular fire trough having its own supply of air, fed by a minute steam jet, the draught is evenly distributed over the whole fire grate, and the boiler continues to do its work even while cleaning out the clinker from the chamber, while the fire being always clean is ready to have sudden calls for steam made upon it, and by turning on the blowers full, the rate of combustion can be enormously increased. The bars are constructed with extremely fine air spaces so that breeze or dust fuel may be burned with advantage.

Any wear of the cams upon the compressed-air bars is taken up by adjustable replaceable, highly chilled, cast-iron wedge, wearing pieces, which dove-tail into sockets prepared for them in the compressed-air troughs. This renders the moving furnace bars practically everlasting—the wearing parts can be adjusted or replaced, and the small inter-locking bars, subject to the action of the fire, may also be changed when worn out; the fire never reaches the tubular fire trough.

An interesting refuse-destructor installation has recently been carried out at Zurich by the Horsfall Destructor Co., Ltd. The destructor comprises 12 cells, in which 120 tons of refuse can be burnt daily, just as it is collected by the dust carts, without any addition of fuel. The carts are unloaded by means of an electric crane. An electrically driven fan draws in the hot air over the furnace doors and sends it back through the blast flues to the sides of each furnace.

The air thus heated passes through the grate bars and is forced into the main flue, which is kept in an incandescent condition by the gases coming from the furnaces. The mixed gases then pass to the boiler house, where two boilers are at present installed, each having a heating surface of 170 square metres.

The steam, at a pressure of 8 kilos per sq. cm., is passed through a superheater to a 165-h.p. Brown-Boveri-Parsons turbine, which drives a three-phase 150-kilowatt alternator. Part of the current thus generated is utilised for driving the auxiliary plant, the surplus going, after transformation, to the Municipal distributing system. The clinker, which represents from 30 to 40 per cent. of the refuse, can also be utilised, being well adapted for the manufacture of special bricks.

THE INTERIOR OF THE EARTH.

BY BERESFORD INGRAM, B. A., F.C.S.

IT is generally conceded that the present shape of the globe is due to the fact that at one time the earth was a semi-fluid mass which revolved round its axis with a definite uniform velocity.

Experiments have been conducted with spheres of plastic material rotating with different velocities round their axes. These have proved indubitably that, under the above conditions, a flatness is always produced at the two extremities at which the axis emerges, while a corresponding increase in diameter is observed midway between these two extremes It was also noticed that the greater the velocity of rotation, the more *oblate* the mass became.

Nevertheless, there are, in this, many experimental considerations which would not be applicable to the earth in its earliest history; so that while the plausibility of the demonstration must be fully admitted, it would be unwise to accept the supposition as conclusively established.

On the other hand, there does exist absolute proof that the earth is a cooling body. The high temperatures that have been registered at the bottom of mines and deeper borings prove the point beyond all doubt that, as the centre of the earth is approached, the temperature becomes higher. Heat must, therefore, be travelling from the interior to the surface, and thus daily dissipated, in almost inconceivable quantities, into space.

Taking the average of all the observations, it would appear that the temperature rises 1° Fahr. for every 51 feet of the earth's crust penetrated. It follows that, at a distance of less than two miles, the temperature is the same as that of boiling water; while at a distance of 30 miles below the surface, the temperature is sufficient to melt iron; in fact, at a distance of 50 miles the temperature is higher than any that has yet been artificially produced. There still remains the best part of 4,000 miles to travel before the earth's centre is reached. It would therefore, be meaningless to calculate the temperatures that exist below 50 miles.

The existence of enormous temperatures naturally raises the question, what is the condition that prevails in the interior? Is the rock in a liquid condition, or can it conceivably be in any other state?

On this point geologists seriously disagree.

Undoubtedly as the earth's crust is penetrated a temperature must be reached which is sufficient to melt solid rock under ordinary circumstances, but it is equally certain that at that depth an enormous pressure is affecting the underlying mass. Now it is well known that, if the pressure on a solid is increased, the melting-point of that solid becomes higher, and, moreover, that different substances are differently affected by the increase in pressure.

As it is not known what is the composition of the rocks that exist at these great depths it becomes impossible to do anything but conjecture what effect the pressure has on the melting-point. When the pressure is relieved in any way (as is supposed to have taken place in volcanic outpourings of lava) it would appear that the condition necessary to keep the rock in a solid state is destroyed, with the observed result. These considerations have led some scientists to consider the earth as a solid mass with its interior at a very high temperature.

But it may happen that the increase in pressure at certain depths is not sufficient to prevent the liquefaction of the rock in which case the earth would have a solid crust with a liquid interior. It may be, however, that, after a certain depth, the pressure becomes great enough to prevent further liquefaction in which case a section through the earth would show three concentric rings, the innermost having a diameter of over 7,000 miles and marking the extremities of the solid nucleus, then a ring, about 7,800 miles in diameter, defining the limits of the liquid substratum, and finally there would be the earth's crust, which, varying according to the position of mountain, land, and water, would probably in no place exceed a depth of over 70 miles

A very potent argument has been urged against this second assumption to the effect that, if the crust were so thin as the theory states, it would yield to the deforming influence of the sun and the moon; in which case the water would be drawn up with the earth, and thus no sensible tidal effects could be produced. In order to counteract this attraction it would be necessary to admit that the thickness of the earth's crust is at least 2,000 miles. An unsatisfactory compromise has thus been suggested, by which it is supposed that the earth is at the present time solid throughout (having passed through the stage of alternate solidity and fluidity), but that large fluid cavities exist throughout the mass.

If the reader should find himself incapable of coming to any definite conclusion on this question, how much more impossible is it for the student of geology (or mathematics) to settle the difficulty satisfactorily? Each theory initially commends itself with much plausibility to its reader, but as the more important but less apparent tests are applied, certain defects come into prominence.

FISHER'S THEORY.

Fisher succeeded in forming a theory that would comprehend and explain all the difficulties that each previous assumption had encountered. He accepted the idea of the existence of a liquid substratum, with this difference, that it consisted of a mixture of *fused* rock and a *dissolved gas* (in all probability hydrogen).

The origin of earthquakes and volcanoes can be satisfactorily explained on this assumption, which has the additional qualification of accounting for the appearance of vast quantities of that gas (*i.e.*, hydrogen) in all volcanic outbursts. Furthermore, the fused mass, which Fisher supposes to exist, would not give rise to any tides within the earth's crust, and thus one of the most serious objections to the "liquid substratum hypothesis" (which is itself based on the fundamental notions of the effect of heat on solids) is satisfactorily removed. At the same time the theory admits the possibility that the fused mass *may* communicate its movements to the earth's surface (although not in the form of "tides"), which deduction, taken with all the other scientific explanations, should strongly recommend the theory to all whom it may interest.

Britain's Unemployed Problem.

A "RIGHT TO WORK" MANIFESTO.

The "Right to Work" National Council have issued an "appeal to the people," in which they affirm that, "as all workers must work in order to live, all workers have a right to demand work." The manifesto continues:—

"We are seeing in Russia what united action can accomplish. Shall the enfranchised workers, with their wives and little ones, in this the richest nation in the world continue to suffer in silence? The Right to Work National Council urges the men and women of the nation to unite in a determined effort," and formulates these demands: (a) The amending of the Unemployed Workmen Act to give power to national and local authorities to take such action as will enable them to place useful work within the reach of all applicants; (b) The voting of money from the National Exchequer necessary to finance the farm colonies and other works for dealing with unemployment; (c) The putting in hand of works of utility in order to give employment such as afforestation, reclamation, of improvement and cultivation of land, the building of harbours of refuge, and other similar undertakings of a national character; (d) The issuing of reasonable regulations by the Local Government Board."

Wonderful New Photographic Process.

The interesting catalytic process called the "Catatype Process" was devised by Professor Ostwald and Dr. Gros. It is concerned with the making of photographic prints without sunlight. Since, thanks to Dr. Gros, the writer was made practically acquainted with this process at the works of the Neue Photographische Gesellschaft, at Steglitz, the reader may try it for himself. We already know how easily peroxide of hydrogen decomposes in the mere presence of metals. This is here the primary fact. A piece of cotton is dipped into a mixture of peroxide and ether, and is then quickly rubbed over the face of the negative. It is then left for a brief instant. During this brief instant the ether evaporates, and wherever there is no silver the peroxide is catalysed by its presence into water, and wherever there is no silver the peroxide is left unaltered. There is thus on the face of the negative an invisible positive of peroxide. Place now the negative in contact with a piece of gelatinised paper in a "printing frame," and this invisible positive is at once transferred to the paper, and on placing this paper immediately into an alkaline solution of manganous sulphate, for example, you will obtain a beautiful picture in brown tones. With an alkaline silver solution the print will be black. The process is peculiarly applicable for the easy production of beautiful "carbon" prints. The pigmented and unsensitised paper is brought into contact, as described above, and is then treated in the ordinary way.