PURIFICATION OF AIR BY MEANS OF OZONE.

A DESCRIPTION OF NEW APPARATUS.

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The fact that ozone is an efficient destroyer of odors of every kind is now generally recognized, and ozone is already employed extensively for purifying the air of rooms. The question whether ozone, as it is used

mespheric germs even when it is used in so diluted a form as is customary in ventilating apparatus, provided that the air is somewhat moist and is exposed for a long time to the influence of the ozone. Within

kilowatts in the large model (Figs. 2 and 3). As only a very small proportion of ozone is required for the purification of air—from 0.05 to 0.5 milligramme (0.008 to 0.08 grain) of ozone to a cubic meter (35.3

FIG. 2.—OZONE APPARATUS FOR CENTRAL VENTILATION.

FIG. 6.—OZONE APPARATUS IN BRANCH VENTILATING PIPE.

for this purpose, exerts a germicidal, as well as a deodorizing and oxidizing action, cannot be answered until special bacteriological researches have been made.

FIG. 4.

It seems fair to assume, however, that ozone, which possesses so remarkable sterilizing properties when concentrated, is not wholly powerless to destroy at-

the past year the firm of Siemens & Halske of Berlin has put on the market a number of devices for purifying air by means of ozone, some of which were shown in operation at the fourteenth international hygienic congress at Berlin. Some of the devices are described below.

The apparatus illustrated in Figs. 1, 2, and 3 is designed for use in connection with large central ventilating systems. Both types of apparatus have air compressors and the ozone is generated by electrical discharges in cylinders of glass and aluminium. The apparatus shown in Fig. 1 has ten glass cylinders, while that shown in Figs. 2 and 3 has eight cylinders of aluminium surrounded by larger cylinders of glass. Both forms are operated by an alternating current, obtained from a direct current with the aid of a rotary converter, as illustrated, or taken from an alternating current circuit. One pole of the ozone generator is grounded and the wire which connects the other pole with the transformer is insulated and made inaccessible, so that the apparatus may be handled without danger at all times. These ozone generators have high efficiency, as is shown by the curves of Fig. 4. As in other electric generators of ozone, the quantity of ozone formed is a function of the current density and the quantity of air which is forced through the apparatus. The consumption of energy is small, being only 0.75 kilowatt in the small model (Fig. 1) and 2

cubic feet), according to recent experiments—this apparatus is capable of ozonizing 200,000 cubic meters (about 7,060,000 cubic feet) of air per hour.

In cases where it is desired to ozonize only a portion of the air current, used for the ventilation of cer-

FIG. 5.—OZONE ELEMENT AND TRANSFORMER IN BRANCH VENTILATING PIPE.

tain rooms, it is advisable and quite practicable to insert the ozone generators in the branch air pipes. A simple apparatus for this purpose is illustrated in Figs. 5 and 6. It consists of a number of air-cooled ozone generating cells with plate electrodes, and a "step up" transformer. The entire apparatus is

FIG. 1.—SIEMENS OZONIZING APPARATUS WITH TEN GLASS GENERATING CELLS AND ROTARY CONVERTER. FOR CENTRAL VENTILATING SYSTEM.

FIG. 3.—WALL APPARATUS INCLUDING TWO OZONIZERS, SWITCHES, GALVANOMETERS, AND TRANSFORMER.

mounted on a frame in the air pipe, with the concavities of the inner electrodes facing the current.

Fig. 7 illustrates other types of ozone elements designed for use in ventilating shafts. All have metallic electrodes, one of which is surrounded by glass or some other solid dielectric, and are so constructed that the air circulates freely through them, as stagnation of air would cause overheating and diminish the production of ozone. The electrodes are of various forms. Type *a* has a plate perforated with smooth

FIG. 7.—VARIOUS TYPES OF ELECTRODES OF OZONE ELEMENTS.

holes, in *b* the edges of the perforations are raised, in *c* the bare and covered electrodes form two interlocking gratings of round bars, in *d* flat bare electrodes alternate with round covered electrodes, and in *e* both electrodes have the form of nets or gratings. Fig. 8 shows the appearance of the completed apparatus, type *d*.

The number of ozone elements required is determined by the volume of air and its degree of impurity. The normal types of Siemens ozonizers are made for currents of from 2,000 to 8,000 cubic meters (71,000 to 282,000 cubic feet) of air per minute and require a power of from 100 to 400 watts. The cost of operation is therefore very small.

For rooms ventilated not by a direct blast of air but by windows, with or without fans, opening upon simple air shafts or the outside of the building, the apparatus shown in Fig. 9 is designed. This apparatus, which is called an "ozone ventilator," contains a number of ozone elements so arranged that they are traversed by part of the entering air current and are sufficiently cooled by the remainder of the current, which passes over their tops. These ozone ventilators may be built into the wall or stand detached. For use in hospitals there is a portable ozonizer, which is inclosed in a frame mounted on rollers, so that it can be moved from room to room (Fig. 10).

An ozonizing apparatus differing from any of the above and still in the experimental stage is illustrated in Fig. 11. This apparatus, which may be attached to the ceiling or wall, contains a number of flat ozone elements of the ordinary type, in which ozone is generated by bluish discharges from a high potential circuit and above or behind these elements a number of metal gratings charged to the same high potential, but placed so far apart that there is no perceptible discharge or production of ozone, but only the precipitation of dust and smoke which is characteristic of statically charged metallic surfaces. This property is strikingly demonstrated by the simple experiment illustrated by Fig. 12. A glass jar about 20 inches high and 4 inches in diameter, into which are inserted two broad strips of moderately fine wire netting, is filled with a dense cloud of tobacco smoke, and the strips of netting are connected with the poles of a transformer, induction coil or influence machine. A violent disturbance, of cyclonic character, is set up

FIG. 8.—OZONE APPARATUS WITH ROD AND PLATE ELECTRODES IN THE SHAFT.

in the smoke-laden air, and the smoke vanishes in a few seconds. Dust diffused through the air in the jar is precipitated in the same manner.

The various types of apparatus described in this article are capable of the widest application in purifying the air of theaters, restaurants, factories, markets, and slaughter houses, tunnels, subways, barracks, prisons, churches, lodging houses, and the cabins and holds of vessels. They possess the special advantage that the supply of ozone can be regulated to suit the demand with the greatest ease, either by varying the potential of the electric current or by employing a larger or smaller number of generating cells.

MAN'S PLACE IN NATURE.*

By Prof. HENRY EDWARD CRAMPTON.

WE must now state distinctly and fairly the present views of science regarding man's place in nature. Surely human evolution is a subject that falls within the scope of zoological investigation, unless indeed it can be shown that the human species is exempt from the control of those laws of nature that hold sway over the animate world elsewhere, unless something can be found which excludes man from the animal kingdom. Notwithstanding the most prolonged search not only by zoologists but as well by those who have been unfriendly to the doctrine of descent, the study of man and of men has revealed nothing essentially unique. What is known of the anatomy, development and fossil relations of man is summarized in the state-

FIG. 11.—CEILING OZONIZER WITH DUST-CATCHING ELECTRODES.

FIG. 12.—ELECTRICAL PRECIPITATION OF SMOKE.

ment that he belongs to the genus and species *Homo sapiens*, placed with the apes and some other forms in the order primates because of agreement in certain peculiar details. The primates agree with the carnivora, rodents, and many other orders in the characteristics of the class mammalia, which in turn is only a branch of the limb vertebrata or chordata, which also bears the avian, reptilian, amphibian and fish branches. And all the vertebrates including man agree with the varied groups of invertebrates in their cellular constitution and in the similar protoplasmic basis of life. As in these structural respects, so in physiological activities and in environmental relations the human species proves more surely with increased knowledge to be only one of the terms in the extensive series of animals. Indeed, the scientific monism of Haeckel and Clifford ventures to assert that man and all other living creatures are one with the mind-stuff of the inorganic world—and this, I believe, is only the logical extension of the genetic and mechanistic hypotheses. However this may be, science holds that human structure is animal structure, and that human lives are biological phenomena.

Man is structurally inferior in many respects to some of his zoological relatives—he is a degenerate, indeed, in many parts of the alimentary, muscular and skeletal systems—yet he finds in the higher development of his nervous system an advantage that offsets the weaknesses of his constitution elsewhere. He holds his supreme place by virtue only of superior and more effective control of his organization.

Behind their seeming structural differences, only one real distinction can be found to separate man from the apes—the higher development of the brain. The erect posture, the correlated modifications of skeletal

and muscular structures, and apparently the powers of speech and reason, seem to be dependent upon the enlargement of this organ, which, so to speak, has pushed the face around under the brain-case. Therefore he who would be ο ἀνθρώπος—he who looks ahead—must needs stand erect in order to prevent his

FIG. 10.—PORTABLE OZONIZER FOR HOSPITALS, ETC.

eyes from looking straight into the ground. But the most careful analysis has so far failed to detect any essential differences in either structural or functional respects between the human brain and the corresponding organs of the higher apes. In brief, then, differences in degree and not in kind or category seem to distinguish man from the apes—as far as science goes.

Moreover, the human body is a veritable museum of rare and interesting relics of antiquity—the useless vestiges and rudiments of structures that are more developed in other animals. The complete coat of hair of the embryo, the disappearing thirteenth rib, the ape-like and transitory clasping muscle of the newborn infant's hand, the curvature of the lower limb and the hand-like foot of the embryo, these and scores of other characters are mutely eloquent witnesses to the past history of change that has brought man to his present place in nature. Embryology gives a vast amount of additional independent testimony. For like all embryo mammals and birds and reptiles, the human embryo possesses gill-slits, and fish-like heart and brain. Above all it begins life as a single cell. Zoology asks: What can these things mean, if they do not mean evolution and a common ancestry with other forms? The objection that no one has ever seen a one-celled organism evolve into a many-celled one, or into a fish or an ape, or into a man, the zoologist answers by placing upon the table the evidence that a single cell, the human egg, actually does compass the whole history in becoming the almost inconceivably complex adult organism. The process can take place for it does take place. Paleontology also presents evidence relating to the history of our species, as the third support of the tripod upon which rests the doctrine of human evolution. While opinions differ with respect to the remains of man taken from the many caves and mounds of Europe and America, there is but one generally accepted view regarding the ape-man *Pithecanthropus* of the Javan rocks. The remains of this animal prove among other things that its brain was intermediate between the average ape brain and the average human brain, that the animal was indeed an ape-man and nothing else.

Science holds furthermore that natural factors alone have brought about human evolution. While it is true that the explanation is no more complete for this spe-

FIG. 9.—OZONE VENTILATOR FOR WINDOWS.

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