



CRITICAL POINT APPARATUS

*With these capillary tubes Andrews found the point where gases are liquids and liquids are gases.*

liquid state, the question does not, I believe, admit of a positive reply. Carbonic acid at  $35^{\circ}.5$ , and under 108 atmospheres of pressure, stands nearly midway between the gas and the liquid; and we have no valid grounds for assigning it to the one form of matter any more than to the other. The same observation would apply with even greater force to the state in which carbonic acid exists at higher temperatures and under greater pressures than those just mentioned. In the original experiment of Cagniard de la Tour, that distinguished physicist inferred that the liquid had disappeared, and had changed into a gas. A slight modification of the conditions of his experiment would have led him to the opposite conclusion, that what had been before a gas was changed into a liquid. These conditions are, in short, the intermediate states which matter assumes in passing, without sudden change of volume, or abrupt evolution of heat, from the ordinary liquid to the ordinary gaseous state.

In the foregoing observations I have avoided all reference to the molecular forces brought into play in these experiments. The resistance of liquids and gases to external pressure tending to produce a diminution of volume, proves the existence of an internal force of an expansive or resisting character. On the other hand, the sudden diminution of volume, without the application of additional pressure externally, which occurs when a gas is compressed, at any

temperature below the critical point, to the volume at which liquefaction begins, can scarcely be explained without assuming that a molecular force of great attractive power comes here into operation, and overcomes the resistance to diminution of volume, which commonly requires the application of external force. When the passage from the gaseous to the liquid state is effected by the continuous process described in the foregoing pages, these molecular forces are so modified as to be unable at any stage of the process to overcome alone the resistance of the fluid to change of volume.

#### Properties are General

The properties described in this communication, as exhibited by carbonic acid, are not peculiar to it, but are generally true of all bodies which can be obtained as gases and liquids. Nitrous oxide, hydrochloric acid, ammonia, sulphuric ether, and sulphuret of carbon, all exhibited, at fixed pressures and temperatures, critical points, and rapid changes of volume with flickering movements when the temperature or pressure was changed in the neighborhood of those points. The critical points of some of these bodies were above  $100^{\circ}$ ; and in order to make the observations, it was necessary to bend the capillary tube before the commencement of the experiment, and to heat it in a bath of paraffin or oil of vitriol.

The distinction between a gas and vapour has hitherto been founded on principles which are altogether arbitrary. Ether in the state of gas is called a vapour, while sulphurous acid in the same state is called a gas; yet they are both vapours, the one derived from a liquid boiling at  $35^{\circ}$ , the other from a liquid boiling at  $-10^{\circ}$ . The distinction is thus determined by the trivial condition of the boiling point of the liquid, under the ordinary pressure of the atmosphere, being higher or lower than the ordinary temperature of the atmosphere. Such a distinction may have some advantages for practical reference, but it has no scientific value. The critical point of temperature affords a criterion for distinguishing a vapour from a gas, if it be considered important to maintain the distinction at all. Many of the properties of vapours depend on the gas and liquid being present in contact with one another; and this, we have seen, can only occur at temperatures below the critical point. We may accordingly define a vapour to be a gas at any temperature under its critical point. According to this definition, a vapour may,

by pressure alone, be changed into a liquid, and may therefore exist in presence of its own liquid; while a gas cannot be liquefied by pressure—that is, so changed by pressure as to become a visible liquid distinguished by a surface of demarcation from the gas. If this definition be accepted, carbonic acid will be a vapour below  $31^{\circ}$ , a gas above that temperature; ether a vapour below  $200^{\circ}$ , a gas above that temperature.

We have seen that the gaseous and liquid states are only distant stages of the same condition of matter, and are capable of passing into one another by a process of continuous change. A problem of far greater difficulty yet remains to be solved, the possible continuity of the liquid and solid states of matter. The fine discovery made some years ago by James Thomson, of the influence of pressure on the temperature at which liquefaction occurs, and verified experimentally by Sir W. Thomson, points, as it appears to me, to the direction this inquiry must take; and in the case at least of those bodies which expand in liquefying, and whose melting-points are raised by pressure, the transition may possibly be effected. But this must be a subject for future investigation; and for the present I will not venture to go beyond the conclusion I have already drawn from direct experiment, that the gaseous and liquid forms of matter may be transformed into one another by a series of continuous and unbroken changes.

*Science News Letter, May 28, 1932*

#### ARCHAEOLOGY

### Explorer of Calakmul Finds Second Ruined Maya City

**A** SECOND ruined Maya city, much smaller than Calakmul, has been reported by C. L. Lundell, Dallas, Texas, botanist, upon his return from Yucatan bringing details of his finds.

The second ruined city reported by Mr. Lundell is called Nohoxna and it is located fifteen miles from the Guatemalan border in the Mexican state of Petan about half way between Calakmul, the other city he reported, and Uaxactun, a ruin where Carnegie Institution archaeologists have been working. It contains nine monuments.

Mr. Lundell stopped off in New Orleans on his way home, and conferred with Dr. Frans Blom of Tulane University. The finding of Calakmul was declared by Dr. Blom to be of the greatest importance. He predicted that the

reading of hieroglyphs found on the monuments may fill gaps in present knowledge.

The finding of Calakmul was announced on April 30 by the Carnegie Institution of Washington which sent a party to confirm Mr. Lundell's report. Dr. Sylvanus G. Morley, who visited the ruins, pronounced them the largest of Maya cities and important in understanding the early history of the Maya Indians.

Reports from Mexico City credit the discovery of Calakmul to a Mexican chicle gatherer, Francisco Morales.

*Science News Letter, May 28, 1932*

#### ICHTHYOLOGY

### New Game Fish Given Home In Glacier National Park

**T**WO NEW species of game fish have been added to the piscatorial family of Glacier National Park. They are the landlocked salmon and the Pyramid Lake (Nevada) cutthroat, both noted for their hard fighting qualities and the fact that they appear tireless in their violent struggles to escape the hook.

Thirteen thousand of the salmon and 36,000 of the new cutthroat species were introduced, all in St. Mary's Lake, which is visited by most tourists in the park. If these new varieties thrive, larger numbers will be planted in the park in the future.

*Science News Letter, May 28, 1932*

Twenty-five breeding colonies of the white pelican have been located in the United States and Canada.

#### ANTHROPOLOGY

## "Gorilla" Picture of Gangster Based on Facts of Science

**P**OPULAR conception of the "natural born" killer, that has recently given him the nickname "gorilla," has a solid basis of scientifically determined fact.

This is indicated by researches of Prof. Earnest A. Hooton, Harvard University anthropologist, who made a preliminary report before the meeting of the American Philosophical Society. His address was also broadcast over the network of the Columbia Broadcasting System, under the auspices of Science Service.

Prof. Hooton and his associates have measured and examined thousands of criminals in a number of penitentiaries in this country, in an endeavor to learn whether there are any consistent departures from given racial norms in criminals convicted of a given type of offense.

#### Specifications for Murderers

The composite picture yielded by the examination of the group of native American first-degree murderers is strikingly suggestive of the typical "hard guy" of fiction and the movies. Following are Prof. Hooton's specifications:

"First degree murderers diverge significantly from total criminal population in that they are older, heavier, taller, bigger-chested, with greater head

circumferences, narrower foreheads, longer and relatively narrower noses, broader jaws, broader ears, relatively narrower shoulders, relatively shorter trunks, relatively longer heads, less head hair, more body hair, straighter hair, more pronounced forehead slope, more convex noses, fewer and poorer teeth, both flatter and more projecting ears, less facial asymmetry, etc. Some of these differences, but by no means all of them, are due to the higher average age of this class of prisoner."

#### Heredity Largely Responsible

Most other criminal groups, however, were found to be physically inferior to their fellows of the same race without the walls; and this held for Negroes and Negro-White crosses as well as for the purely white-skinned folk.

Prof. Hooton paid his wittily caustic disrespects to criminologists who adhere to the doctrine that environment and training make the criminal, and that the evildoer's heredity has no connection with his evil deeds. While he regards Caesar Lombroso's early attempt to define a "criminal type" as unscientific and unsuccessful, he does believe that Lombroso made a bad start in the right direction, and that significant physical departures from the normal can be found in various types of criminal, no less than his psychological departures from the normal.

*Science News Letter, May 28, 1932*

#### MEDICINE

### Fascist Salute Seen As TB Preventive In Italy

**T**HE ANTI-TUBERCULOSIS crusaders in Italy have approved the Fascist salute, with the arm lifted up over the head, as a hygienic substitute for the handshake or the kiss, either of which may be the means of spreading tuberculous infection.

The Italian government has set aside one day of every year, generally an Easter day, for a sort of tag day when the anti-tuberculosis campaigners may gather money for their cause in the streets of all Italian cities.

*Science News Letter, May 28, 1932*

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