PHYSICS

Gun Firing Into Gun Devised For Super-Pressure and Heat

New Apparatus to Produce Momentary Pressures And Temperatures Greater Than Any Yet Made by Man

IN THE laboratory high pressures or high temperatures can be obtained separately but not together. All materials soften when highly heated and consequently will not withstand high pressure unless the temperature is moderate.

The record for high pressure is held by Dr. P. W. Bridgman of Harvard University, and stands around 600,000 pounds per square inch. This is equivalent to the pressure at the bottom of a pile of bricks 100 miles high. Temperatures around 5,000 degrees Fahrenheit have been obtained in the laboratory, but only at moderate pressures.

Higher in Nature

Nature, however, produces vastly higher pressures and temperatures and produces them both together. Inside the stars, pressures are measured in millions of tons per square inch, and temperatures in millions of degrees. Even inside our own earth they are measured in thousands. How matter behaves under these conditions is at present entirely in the realm of hypothesis based on enormous extrapolation from experimental data. We would like to have more direct evidence.

Now comes Dr. C. Ramsauer with an ingenious though simple contrivance, which he describes in the current number of the *Physikalische Zeitschrift* of Leipzig, by which high pressures and high temperatures can be produced simultaneously—but only for a fraction of a second. However, science is accustomed to phenomena of short duration. Speeding electrons and cosmic rays flash by in a millionth of a second, yet what vast fields of new knowledge they have opened up. And materials can withstand momentarily pressures and temperatures that would be fatal if prolonged. Much may therefore be learned from Dr. Ramsauer's apparatus in which matter for the first time approaches a little way toward the conditions to be found in the stars.

The apparatus consists merely of a gun which shoots a cylindrical projectile straight into the barrel of another similar gun. The projectile is brought to rest by compressing the air or other gas contained in the second gun. Not only is the pressure thus enormously raised but also the temperature, for, as anyone knows who has pumped up an automobile tire, rapid compression of a gas heats it up. This is also shown by the diesel engine, in which the explosive charge is heated by mere compression to the ignition point.

Calculation shows that if the gas is perfect and its specific heat or thermal capacity is constant, a projectile having a velocity of 300 feet per second, brought to rest in a distance of three feet—the length of the second tube—will compress the air therein to 375 pounds per square inch, and raise its temperature to 2,240 degrees Fahrenheit. These are very moderate figures. But if the speed of the projectile is raised to 3,000 feet per second, which may easily be done, the pressure jumps to 14 billion pounds per square inch, and the temperature to 216,000 degrees.

No Gas is Perfect

Of course it is not expected that anything like these figures will actually be reached. No gas is perfect, the specific heats are not constant, and other things may happen in this as yet unexplored region, which equations based on observations at much lower pressures and temperatures cannot predict. Nevertheless the calculation indicates that by this simple means very high pressures and temperatures can be produced, and produced simultaneously.

The apparatus as actually constructed consisted of a single long tube, the firing being done at one end and the compressing at the other end. A number of slits near the middle allowed the products of combustion to escape. For speeds up to 600 feet per second, compressed air was used to fire the gun. Under these circumstances it was found that the projectile bounced back and forth between the compression and the gun chambers as many as 24 times. Smokeless powder was used for higher speeds, but at 1,500 feet per second the apparatus was damaged. These are of course only preliminary trials. The real research is yet to be carried out.

It may be asked—what information can be gathered from such a research? Dr. Ramsauer points out three problems that can be attacked at once:

1. The maximum possible density that a gas can attain without shattering its molecules or stripping its atoms of their planetary electrons.
2. The sort of radiation that a gas so compressed and heated emits.
3. The electrical conductivity of a gas under high pressure and temperature.

These are all problems of importance for theoretical physics.

Science News Letter, February 17, 1934

RADIO

Better Microphones And Loud Speakers Sought

VERY LITTLE real progress in the technical improvement of radio broadcasting has been made in the past four years. This is the opinion of Stuart Ballantine, president of the Boonton Research Corporation, who recently discussed the problem at a meeting of the Franklin Institute in Philadelphia.

The loud speaker is the weakest link in the receiving end of the chain of sound and electrical impulses from studio to listener. According to Mr. Ballantine, it produces more distortion than any other parts of the system, with the exception of the microphone. The conventional loud speaker not only fails to reproduce a high enough range of frequencies but its sound output fluctuates too much over the range it does cover. New high-fidelity receivers and loud-speakers have been developed which are capable of accurately reproducing sounds from 60 to 8000 cycles and whose performance is noticeably superior to present types.

In the transmitters which are important in controlling radio quality because they serve so many receivers, Mr. Ballantine believes that high quality transmission is realizable without wholesale scrapping of present equipment and at only reasonable additional cost.

The ear responds to sound frequencies from 16 to 16,000 cycles per second. The separation between radio broadcasting stations is only 10,000

cycles, and Mr. Ballantine finds that the transmission of a 7,000 or 8,000 cycle band is about all that is technically feasible. Although 7,000 to 8,000 cycles does not give the ear all that it is capable of hearing, reproduction of this frequency range is quite acceptable and the ear does not materially notice the range of sound frequencies that have been omitted. Actually, however, many transmitters are now only feeding a band of 5,500 to 6,000 cycles width into their broadcasting, and this does not give convincing re-creation of sound.

The utilization of wire lines, now made available by the telephone companies, which are capable of 8,000 cycle transmission was urged by Mr. Ballantine. Ordinary wire lines usually impose a limit of about 6,000 cycles.

Serious frequency distortion is caused by many of the microphones now in use in studios and Mr. Ballantine recommended the replacement of all carbon and condenser microphones with the newer crystal and ribbon types. Broadcasting studios should also install for monitoring and audition purposes high fidelity loud speakers. These would allow them to place the microphones within the studios to better effect.

Science News Letter, February 17, 1934

PHYSICS

Experiments With Big Guns Give New Sound Speed Value

Dr. Miller's Computation of Data Gathered by Microphones At Sandy Hook Decreases Text Book Figure .87 of Foot

SOUND travels 1087.13 feet per second. This new and highly precise value for the velocity of sound has been computed by Dr. Dayton C. Miller of the Case School of Applied Science, using data obtained as a result of big gun firing at Sandy Hook just after the close of the World War.

Because he has been engaged upon his important ether drift experiments, Dr. Miller did not find time to compute his experiments until recently.

The new value, which is for standard conditions, in free air, at the freezing point (0 degrees Centigrade), is near the mean of values of other experiments, the recognized velocity in textbooks now being 1,088 feet per second. This means that sound travels a little over a fifth of a mile in a second. The old trick of finding the distance of a lightning flash by counting seconds until thunder is heard, then dividing by five to obtain the distance in miles, is still useful.

An accurately surveyed base of about four miles in length was available to Dr. Miller. The source of sound was the discharge of a large gun at the Sandy Hook Proving Ground. Six listening stations were placed along the course, the first one being about 100 feet from the gun, and the last one four miles away. At each station was a microphone, similar to those used in radio studios. Each microphone was connected by an electric circuit to a recording galvanometer which made a photographic record of the time of the arrival of the sound at the corresponding station. The galvanometer was of the type known as a string galvanometer, which is used in laboratories for various purposes, one such being the recording of the sounds from the heart beats in medical researches.

Meteorological observations for temperature, humidity, barometric pressure, and the velocity and direction of the wind were made at both ends of the course and at two intermediate stations. Seventy-one sets of records were obtained.

Science News Letter, February 17, 1934

MEDICINE

Measles Cycle Now at Peak; Many Cases Are Reported

THIS is a measles year. Large numbers of cases are being reported in all parts of the country. For the week ending February 3, the latest for which figures are complete, 21,119 cases were reported to the U. S. Public Health Service by state health officers.

Measles outbreaks seem to run in cycles of about two and one-half or three years, health authorities point out, and this is apparently the peak of the cycle. The cycles are even more noticeable in given areas than nationally.

Parents are cautioned to keep children under three years away from schools, playgrounds and crowds generally, where they may be exposed to the disease, since small children are less able to withstand an attack of measles. Dr. Huntington Williams, Commissioner of Health of Baltimore, has warned families there that the disease is fatal about forty times as often to children between 6 and 18 months as to children of school age.

When a child has measles it is particularly important to keep him in bed so that he will be protected from cold and chilling.

Control of measles epidemics is made difficult, however, by the extremely contagious nature of the disease and by the fact that symptoms are not obvious until some days after the contagious stages have set in.

The wisest procedure at the present time during a measles epidemic is to have a daily medical inspection of all school children, because in the majority of cases a skilled physician can detect the disease in the pre-eruptive stages. A child so affected should be sent home to bed.

Science News Letter, February 17, 1934

SEISMOLOGY—ENGINEERING

Earthquake Problems Automatically Solved

EARTHQUAKES will have less terror for cities in active seismic regions, as the result of engineering data obtainable with a new device demonstrated at the Massachusetts Institute of Technology. It is known as a stress recorder, and is the invention of A. C. Ruge, research associate in seismology in the department of civil engineering.

The stress recorder consists basically in a train of lenses and reflecting prisms, which pick up a slender beam of light and pass it on to a sheet of photographic