CHAPTER VI

Vast Range of Ether Vibrations

IT is of interest to call attention to the fact that what is called the spectrum—that is to say, the known range of vibrations in the ether—is now nearly complete. By different methods it is now possible to detect and obtain rates of vibration ranging from those of quite low frequency, expressed by such small figures as 1, or even a fraction, per second, up to those which are so immensely rapid as to be almost uncountable.

To deal with the slow ones first, the capacity of a farad joined to an inductance of a henry would have an oscillation period of six seconds, which is about the same as the oscillation period of a charge upon the sun. On the earth a charge would complete an oscillation in the seventeenth part of a second. A microfarad connected to a henry of inductance would oscillate a thousand times in six seconds, and so generate a feeble wave 1,800 kilometres long. To get anything like strong radiation we must quicken the rate of vibration, and shorten the wave; but a very practical wave,

1,800 metres long, with a frequency of vibration about 170,000 per second, can be got by coupling a millimicrofarad, or nine metres capacity, to a millihenry, or 10 kilometres inductance. It is still easier to get waves of great intensity only a few metres long. A wave of 300 metres has an oscillation frequency of a million per second; and with care and precaution these so-called wireless waves can be shortened in the laboratory down to something like a centimetre, which would correspond to thirty thousand million vibrations per second.

So already the electrical rates of vibration are getting considerable, but still nothing like those which we have learned to associate with ordinary light.

The range of luminous vibrations, that is, those which can affect the eye, and therefore are popularly called light, is, as is well known, limited to "an octave," ranging from about 400 to 800 millions of millions per second. But below the visible range we have the infra red, sometimes called "heat" waves, extending downwards without anything but an experimental limit, until they almost reach a range of extremely high electrical vibrations, such as those above mentioned, rising up to meet them. Electrical vibrations go on extending downwards, through the great range

of wireless waves with frequencies of anything from a million to, say, ten thousand per second, to the slow oscillation of large capacities joined to great inductances, such as one might have in a transformer station, or with alternating dynamos; it being understood that the radiation from these slower things is insignificant, and that the radiating power increases (other things being equal) with the fourth power of the frequency of the vibration.

At the other end of the scale, above the visible range, we have ultra-violet radiation, extending into the photographic region without obvious limit. There has been a practical limit until lately, but now the range has been extended, by photo-electric devices, until it overtakes and begins to overlap the soft X-rays. And these rise, through ordinary X-rays of excessively high frequency, up to the gamma rays emitted by radium, which at present constitute the highest terrestrially known rate of vibration, some hundreds of thousands of millions of millions per second.

It is possible that in the sun, or especially in the interior of some of the hotter stars, there may be rates of vibration even higher than that, due to the disintegration of atoms and the excessive temperatures which would be there encountered.

All these higher rates of vibration would be very deleterious to us ; but fortunately they are easily stopped by a thin layer of matter, so that from the stars they hardly emerge, while those from the sun are screened from us by the earth's atmosphere. We only encounter a few of them when we ascend to great heights ; and then we do experience their blistering effect.

It used to be taught that the solar rays consisted of three different constituents merged into one—thermal, luminous, and actinic rays—though such an opinion was never seriously held by experts. The truth is that the waves differ in nothing but wave-length or rapidity of vibration, but that the short waves find something in atoms to respond to them, and thereby excite vision and chemical action, while all waves generate heat in proportion to their energy when absorbed, long waves being usually the most energetic.

It is beginning to seem probable now that the earth is kept warm by the absorbing power of a layer of ozone in the upper regions of the atmosphere, which has the power of stopping a good deal of radiation and of becoming warmed by it ; thus constituting a sort of blanket, and preventing us from ever feeling the full intensity of the dread cold of space,

which must be a close approximation to absolute zero. When the sky is clear and the sun is set, we do feel some traces of this cold, and that is what gives us our hard frosts. But for the most part, the earth as a whole is mercifully screened from the more violent ranges of temperature: otherwise life could not have persisted and attained the approach to perfection which in the course of millions of centuries it has attained. Presumably there is some kind of similar provision on most of the other planets; and accordingly it appears probable that life of some kind—though not necessarily human life—would be found on them also.

By the planets here mentioned we mean the planets of the solar system, the only planets of which we have anything like adequate knowledge. What may be happening on the innumerable other planets which may be circulating round the infinitude of stars in space, we have at present no conception. But the universe is so majestic, and its possibilities so immense, that no one with any wisdom would venture to put a limit to the possibilities and variety of existence.

THE EARTH A HEAVENLY BODY

We seem to have travelled far afield from the more or less practical considerations with which we began. But now that we are beginning to deal in an intelligible and practical manner with the ether—that universal medium which unites all the worlds—no one can say what may be the ultimate outcome. The ether has already brought us much information as to the chemical constitution and other details of what are called the "Heavenly Bodies"—though it should always be remembered that the earth is one of them, though a small one, yet just as much a heavenly body as the others, difficult as it may be occasionally to believe it, or to reconcile that fact with some of the doings of humanity The ether, I say, has already brought us so much information about the heavenly bodies, that it will surely in the progress of science bring us more ; and so in due time we may receive quite unexpected information about them.

For science is as yet in its infancy. Our methods of exploration are continually enlarging ; we have already found that we are not isolated and disconnected from the rest of the universe as we formerly believed, and as in olden times, for all practical purposes

and by the methods of science, we were. Though it should always be remembered and admitted that, by methods other than those of science, men have always believed themselves to be in touch—at first in awe-stricken but afterwards reverent and even affectionate touch—with a higher order of existence. Things half known, and but dimly glimpsed by the ancients, may in process of time become known to us, through the accumulation and passing on of laboriously acquired knowledge.

And just as the higher and lower regions of the spectrum have gradually united, so that some approach to continuity is established through the whole range, so it may be hoped, and even confidently expected, that in the long run the regions of knowledge and of faith will approach each other by gradual extension, and merge into a comprehensive unity.