The two contrasting attitudes of thirty years ago, the research worker's "I am it" and the reporter's attitude of complete indifference have now been largely merged into a common attitude on the part of both, "let's get together."

However, tradition still is strong, and the cooperation is not yet so complete as perhaps it might be. So we are gathered here to-day to survey the problem of bringing science to the people, to make a frank confession of the difficulties of both sides, and thus to arrive at a better understanding.

The chairman next called upon Mr. David Dietz, science editor of the Scripps-Howard newspapers.

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(*To be continued*)

RESEARCH NOTES FROM THE HARVARD OBSERVATORY

THE investigations described in the following paragraphs appear to have a wider interest than many of the routine astronomical researches at the observatory, and they are here abstracted with a minimum of technical detail.

New Variable Stars: One of the foremost problems of the Harvard observatory has always been the discovery and study of variable stars. In addition to the general search for variables on the regular plates, the past two years have seen the beginning of a special intensive study of the faint variables in the Milky Way from plates taken in series for the purpose.

Between four and five thousand variable stars have been discovered at Harvard since 1890, and the rate of discovery is not decreasing, for in the interval from September 30, 1927, to May 1, 1928, the discovery of five hundred new variable stars has been announced, and two hundred more await publication. Miss Swope has found about half of these seven hundred stars in one special Milky Way region; Miss Woods, in another Milky Way region, has discovered over a hundred and fifty; sixty have been noted by Dr. Luyten in the blink microscope while looking for proper motions, and Professor Gerasimovič has found thirty in a special search of the Harvard map plates. In addition, two novae have been discovered by Miss Woods.

The mere discovery of variables is not of great significance; but when certain regions have been thoroughly examined, and the types and periods of the variables determined, we have important information about the district of space in which they are situated. Dr. Luyten, Professor Gerasimovič and Miss Swope have been able to determine the periods of many of the stars on their lists, and for many others the type of variation can confidently be assigned. If the other regions of the Milky Way are as rich in variables as the one hundred square degrees in which Miss Swope has discovered over three hundred fainter than the tenth magnitude, the number of undiscovered variables must be enormous. It seems likely that this particular region is a very rich one, and the results of close examination of neighboring parts of the sky are awaited with great interest.

The Fall of Meteors into Stars: Interstellar space evidently is numerously populated, for it has been reliably estimated that the earth's daily catch of meteoric bodies is about thirty million. Perhaps as much as thirty tons of matter, largely iron, is caught by the atmosphere every twenty-four hours. The smaller bodies are destroyed by the heat generated as they penetrate the atmosphere; the larger ones are the fireballs from whose high velocities we infer that some, at least, are of interstellar origin. Because the sun is larger and more massive than the earth, the number of meteors that it catches must be far greater; in fact, the sun must accumulate in this way much matter that is a potential source of radiated energy. Two thousand tons per second is a fair estimate of the intake; four million tons per second is the computed outgo in the form of radiation.

There are undoubtedly more densely populated regions of space than the one through which the solar system is now passing; the Pleiades, for instance, are enmeshed in nebulosity, which shines mainly by reflected light, and therefore consists of solid particles. The amount of matter captured by Alcyone, the brightest of the Pleiades, must greatly exceed that caught by the sun, because the neighborhood is richer in supplies, and because the star is many times larger, and probably ten times as massive as the sun. The collecting power of large and massive stars in heavily nebulous regions may well bring them millions of tons of matter a day.

Every meteor is a typical comet and may be expected to yield a cometary spectrum under appropriate conditions. Such conditions arise when the comet or meteor is near a star; for the solar comets we observe an emission spectrum to which cyanogen, nitrogen and hydrocarbons contribute the more typical features, and in which iron has also been recorded. The same molecules are also competent to produce an absorption spectrum, and we should expect to find the corresponding absorption lines in the spectra of meteor-infested stars—especially of massive stars, and of stars in nebulous regions. And in fact we do find absorption lines when we have realized how their appearance would be modified by the nature and situation of their source.

Four years ago a diffuse absorption band was recognized in the region of the third cyanogen band (4215 A), and more recently I have called attention to its widespread occurrence in the early type spectral classes, and its frequent association with a diffuse absorption in the region of the fourth cyanogen band at 3883 A. The diffuseness and absence of a definite band head are believed to be the result of the Doppler shift, caused by the rapid orbital motions of comets and meteors near the stars and by the high velocities as they plunge into the hot stellar atmospheres. Their velocities are at a maximum when their absorbing power is probably greatest—in the few minutes during which they are quite close to the surface of the star—but they are doubtless effective absorbers for a long time before, perhaps for the week during which they are approaching the star.

Besides occurring in the spectra of many early type stars, the cyanogen bands also appear in those of later stars, where, however, they are obscured by normal stellar cyanogen. The cyanogen absorption, moreover, is accompanied in many stars by a wide absorption band that corresponds in wave length to the ultimate lines of iron, and the strongest lines of magnesium within the photographic range. The two commonest metallic constituents of meteors are iron and magnesium, and they are evidently represented by their most easily excited lines in the spectra of the stars that are in the act of absorbing meteoric material.

The solar system at present does not receive a representative share of meteoric visitors, and its cometary system has probably been depleted by age and planetary perturbations. An indication of the significant rôle that meteoric matter may play in the universe only begins to appear when we correlate terrestrial fireball phenomena, spectrophotometry by the newer methods, and the study of nebulae.

Bright Lines in Stellar Spectra: Theory has recognized two ways in which bright lines may arise in the spectrum of a star; they may be the effect of a nebulous envelope, or they may originate from a special accumulation of atoms above the photosphere. The bright lines produced by a nebulous envelope are essentially fluorescent, and the spectra of nebulae, nebulous stars and Wolf-Rayet stars may be interpreted in this way. An example of the other class of bright lines is furnished by the reversal of the H and K lines in the solar spectrum, an effect typical of many late dwarfs, and produced by the floccular regions at the surface. These two mechanisms for the production of emission lines are effective for stars of constant brightness in a steady state; the problem of the emission spectra of variable stars is as yet theoretically untouched.

Professor Gerasimovič has recently considered the enigmatic problem of the emission spectra given by supergiants of classes B0 to F5; they show the bright lines of hydrogen and ionized iron—lines that require considerably less energy of excitation than the absorption lines of helium and doubly ionized silicon that accompany them. The immediate inference is that the bright lines originate at higher pressures than the absorption lines, and therefore deeper in the atmosphere, and this supposition is borne out by the observed structure of many such emission lines, which show a fine central reversal.

The appearance of emission lines, as Professor Gerasimovič has shown, also requires that the electron temperature be higher than that of the stimulating radiation from the photosphere, and this condition is not fulfilled in the atmosphere of the normal star. He finds a possible cause of relatively high electron temperature in local sources of hard radiation of very short wave-length, situated not far below the surfaces of stars that have emission spectra. At the centers of stars the radiation is all of exceedingly short wave-length, but for most stars it is transformed by Compton scattering, and emerges from the surface with a normal Planckian distribution corresponding to a temperature of a few thousand degrees. For a hard enough source, situated near enough to the surface of a star, Compton's mechanism can not complete the transformation to black body radiation; it is possible that free electrons with high velocities may even increase the frequency of the radiation which traverses the strata they occupy. The hard radiation that emerges from the surface raises the electron temperature and fulfils the condition for the production of bright lines.

The atmospheres of the early supergiants thus seem to be superexcited, and we may expect this condition to be accompanied by abnormal luminosities and temperatures. Professor Gerasimovič himself has lately shown statistically that the luminosities are in fact abnormal; the temperatures, as inferred from colors, are less suited to statistical treatment, but he confirms the low temperatures derived by other workers for early supergiants by finding for P Cygni (Class B1p) the striking temperature of seven thousand five hundred degrees, less than half the temperature usually assigned to Class B1.

The Meteoric Procession of February 9, 1913: On the night of February 9, 1913, a most remarkable procession of large and brilliant fireballs crossed the sky. They traveled about forty-three hundred miles in eight minutes, for they were seen from Saskatchewan to Long Island, and observed from ships at sea south of the equator. The motion of a satellite-like meteor, passing through the upper atmosphere, presents a serious dynamical problem, and the observations of the procession were so difficult to reconcile with the kind of path that the fireballs were supposed to have taken that several investigators actually questioned the reliability of the data. The fireballs were seen by many people in Ontario, and the height at which they passed was definitely found to be 26.4 miles. It was questioned at the time whether a swarm of meteors passing Canada at so low an altitude could persist in its motion near the curved surface of the earth for three thousand miles; moreover, some of the observations made from ships fell by several miles on the wrong side of the projected great circle path that best represented all the northern observations.

Dr. Fisher has recently examined the data again, and he concludes that the observations can now be satisfactorily interpreted. The swarm of fireballs, he considers, was an extensive one, so that the lower members seen in Saskatchewan and Ontario fell into the Atlantic near the coast, and their companions, which passed unobserved over Canada at greater altitudes, were the bright fireballs observed from ships in the southern Atlantic. Dr. Fisher has succeeded in interpreting the observations by considering two factors previously neglected; the earth's equatorial bulge and its daily rotation. It is the existence of the equatorial bulge that draws a satellite meteor towards the earth's surface as it rushes through the atmosphere. The effect of the earth's rotation is perhaps more striking; a meteor entering the atmosphere moves relative to the earth as a whole, not to the rotating surface, and therefore the projection of its path is not a great circle—it turns out in this case to be a curve, concave (in the northern hemisphere) to the southwest, and having a turning point at the equator. All the reliable observations of the swarm of February 9 are satisfactorily represented by such a curve, and their satisfactory interpretation marks an advance in the study of the dynamical problem of the motions of meteors.

In his researches on meteors, Dr. Fisher is effectively studying the fundamental cosmic problem of the composition and motions of the population of interstellar space, and a knowledge of the dynamics of meteors is one of his more important tools. If other fireballs, or swarms of fireballs (the so-called minor comets) could be observed as widely as the swarm of 1913, and with greater accuracy, the study of interstellar space could become an individual science. But like all other sciences, it requires a basis of accurate and systematic observation, and at present the student of interstellar visitors is dependent for his facts upon an unprepared and uninstructed public. To educate them is perhaps his foremost task.

HARLOW SHAPLEY

FAMILY NAMES

THE International Code of Zoological Nomenclature dismisses the subject of family and subfamily names with two very brief pronouncements:

> Art. 4. The name of a family is formed by adding the ending *idae*, the name of a subfamily by adding *inae*, to the root of the name of its type genus, and
>
> Art. 5. The name of a family or subfamily is to be changed when the name of its type genus is changed.

A very serious difficulty arises from two points of view, each extensively employed by taxonomists, as to what shall constitute the type genus of a family.

The one point of view is that the oldest contained genus, *ipso facto*, regardless of other considerations is the type genus of the family. The other school considers that the first author to employ a contained generic name with a plural ending, with the significance of a group higher than genus (whether he called it family, subfamily, tribe, cohort, legion, phalanx or what-not) by that fact established the genus in question as type of the higher group and that his action is not subject to change.

The principle of establishing a type, whether of a specimen for a species, a species for a genus or a genus for a higher group, is the same. It is founded upon recognition of the fact that authorities disagree and have an inalienable right to disagree as to the limits of groups—whether species, genus or family. Therefore, when an author proposes a new species or a new genus or a new family, he is not at liberty to bind the future as to the limits which the group shall assume—no code recognizes his right to do that, for that is a matter of taxonomic fact and of personal judgment, not subject to fiat. All he can do (so far as the codes of nomenclature are concerned) is to establish a nucleus for his group—the type specimen or type species or type genus, as the case may be, and all that a code of nomenclature can do is to establish, in case the original author did not make it clear, *what* that nucleus is, and having once established that, then they proclaim that in the future said nucleus or type together with all other individuals that are considered cospecific with it or species congeneric with it or genera belonging to the same family, as the case may be, shall always and forever be called by the group name which the original author proposed, provided he met certain requirements as to form of name and was not anticipated in his action by others.