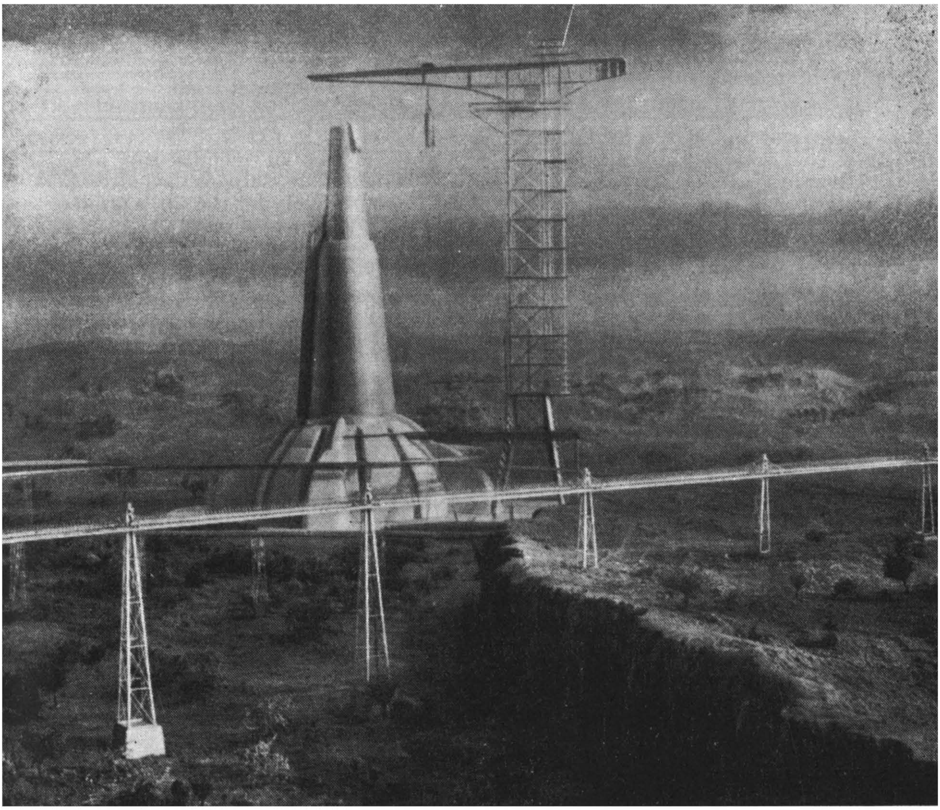
JOURNAL

OF THE

British Interplanetary Society

FEBRUARY, 1937. **6**d. to non-members



By Courtesy of Armchair Science.

PRINCIPAL CONTENTS.

THE BRITISH INTERPLANETARY SOCIETY

DEVOTED TO THE CONQUEST OF SPACE.

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The annual subscriptions for the three classes of membership are: Fellowship, £2-2-0; Membership, 10/6; Associate Membership, 5/-. Quarterly subscriptions are issued at 10/6, 3/- and 1/6 respectively for the three grades of membership, and all subscriptions date from time of election to the Society. Associate Membership is essentially for those under twenty-one years of age, and all classes of membership are open to persons of both sexes.

All members receive free copies of the *Journal* of the Society, as well as copies of *Astronautics* of the American Rocket Society and *Das Neue Fahrzeug* of the E.V. Fortschrittliche Verkehrstechnik (the German Society), as often as they are received.

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THE RESEARCH FUND.

The Research Fund has been established for the purpose of financing rocket and other astronautical research in the British Isles. All contributions and requests for further particulars should be addressed to the Hon. General Secretary-Treasurer or to the Hon. Treasurer of the London Branch of the Society.

The Council invite contributions to the *Journal* of the Society. Matter must be typewritten or in clear script. Preference will be given to first-hand accounts of actual experimentation or theses on theoretical astronautics.

Neither the Society as a body nor the Editor hold themselves responsible for the statements made or the opinions expressed by contributors to the Journal.

ON THE COVER OF THIS ISSUE

is shown the "Space-Gun" from Mr. H. G. Wells' super-film, "Things to Come," the astronautical science of which is criticised in this issue of the *Journal* by Mr. D. W. F. Mayer as being impracticable, and for containing an idea for the conquest of Space that has long been recognised as obsolete.

THE JOURNAL—Published by the British Interplanetary Society, and issued free to all Society members.

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JOURNAL

OF THE

BRITISH INTERPLANETARY SOCIETY

"Founded for the stimulation of public interest in the possibility of interplanetary travel, and to promote research in all problems pertaining to the conquest of space, with the aid of the rocket motor or by any other means."
—*Constitution of the Society.*

EDITOR: L. J. JOHNSON.

No. IX. February, 1937. Vol. 4. No. 1.

All communications for the Society should be addressed to the Hon. General Secretary, 46, Mill Lane, Liverpool, 13, England, or to the Hon. Secretary, The London Branch, 95, Forest Road, Walthamstow, London, E.17.

EDITORIAL

While expressing regret for the delay in appearance of this issue of the *Journal* we feel justified in repeating the explanation already conveyed to our members in a special notice. This number has been held over pending completion of various arrangements that have had to be made in view of a probable transfer of the administration to London.

Throughout the past year the Society has more or less paralleled the world's experiences. 1936 started on a note of considerable optimism based upon the appearance of Mr. Cleator's book, *Rockets Through Space*, and upon the hope of conducting practical experiments before the year had come to an end.

The formation of a new and, we believe, more democratic Council, the publication of *Rockets Through Space*, and the birth of a bigger and better *Journal* promised exceedingly well for the future. But, alas, we had wrongly drawn the shape of things to come.

Upon our overworked Hon. Secretary descended a flood of new members attracted by the Council, the larger *Journal* and Mr. Cleator's book. It is impossible to estimate the relative drawing-power of these three factors but, in justice to our late President, we admit our suspicion that *Rockets Through Space* exerted the strongest pull.

After the sunshine the sunburn. Correspondence piled up to a height that one spare-time worker could not reduce. The Society's greater strength reduced the ratio of the Merseyside membership to a mere one-sixth of the whole, and the tail was wagging the dog with a vengeance.

Our London branch, numerically twice as strong and undoubtedly much better placed to interest influential people, became our logical heirs. Members should have no difficulty in perceiving the import of the following Motion that was adopted at a Special General Meeting held upon December 6th., 1936, at 46, Mill Lane, Liverpool, 13:

"That the Society's Annual General Meeting for the year 1937 shall be held at a time and place to be determined by the London Membership."

Our Metropolitan colleagues have arranged for the Annual General Meeting to be held at "The Mason's Arms," Maddox Street, Regent Street, London, W.1, commencing at 7.0 p.m. on Sunday, February 7th., 1937. Two matters of outstanding importance to the Society will be discussed at this meeting: it is proposed that the Society's Headquarters be transferred from Liverpool to London forthwith, and that the Society shall accept a Constitution drawn up and tabled by a Special Committee of the London Branch.

It seems likely that this will be the last Editorial from a Liverpool pen, and it is not out of place to acknowledge our indebtedness to that tiny group of individuals who brought the Society into being and carried it through its first difficult stages. We on Merseyside, have such confidence in our London Branch that we have not the slightest doubt the transfer, if it is effected, will be a great step towards a much larger and more active Society.

A CRITICISM of "THINGS TO COME"

By D. W. F. MAYER.
(Associate Member, Leeds)

During recent months, almost every popular scientific journal in England and America has contained some reference to the film, "Things to Come," but none have pointed out its outstanding misconception—H. G. Wells actually suggests that the scientific world of 2036 will revert to the fantastic, 19th. Century, Vernian idea of space travel, that by means of a gun-fired projectile.

A little mathematics soon indicates the absurdity of this scheme. I have no data as to the length of the barrel of the

" Space-Gun," but for the sake of simplicity, we will assume it to be half a mile. To obtain a muzzle velocity of 7 miles per second--the minimum velocity required by the projectile—would necessitate an acceleration up the barrel of 49 miles per second. Assuming the weight of either of the space travellers as 120 lbs., and using the equation p=m.f, we see that the force on either person would be about 435 tons!

Although the film characters are made to say such things as " Adjust the shock absorbers," " Contract your muscles," etc., I doubt if the ingenious H. G. Wells—or any other science fiction author, for that matter—could devise a method of making the human body resist a " kick " of 435 tons!

Mr. Wells has incorporated into the " Space-Gun " scenes of the film an idea which no astronaut has seriously considered since the days of Jules Verne. If the " Man in the Street " is to be introduced to the possibility of space travel via the medium of films—especially films with as much publicity as was given to " Things to Come "—it is up to the writers of them to make sure their facts are reasonably accurate, and not to give the public the idea that modern astronautical societies resemble the Baltimore Gun Club.* Play the game, Mr. Wells!

* The Society responsible for the flight in Jules Verne's story, *From the Earth to the Moon.*

An Associate Member, aged 19, wishes to correspond with members of his own age. Please write to:

W. HEELEY, 25, CRAYFORD ROAD, MANCHESTER, 10.

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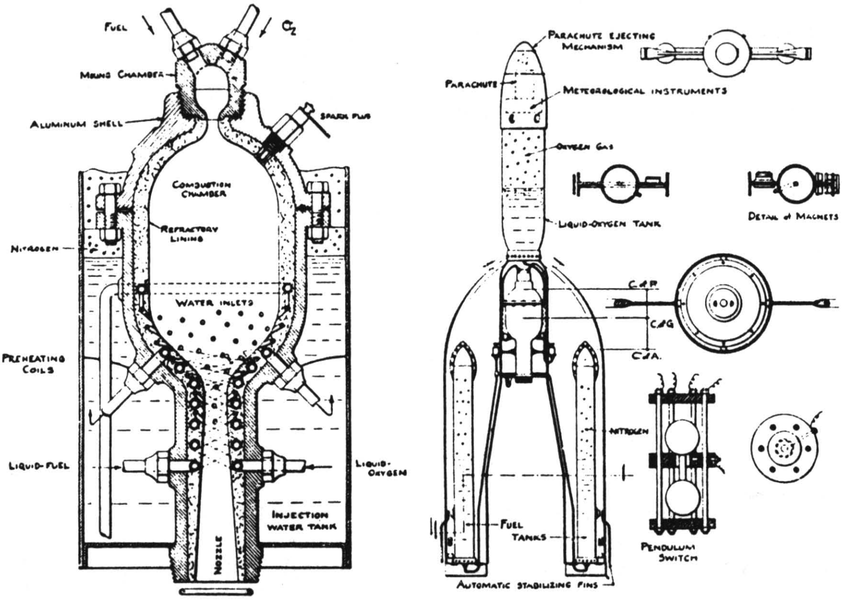
* The Council wish to acknowledge with thanks receipt of the following publications:— *The Aero Field*, Jan.-Feb., 1937, by F. J. Field, Ltd.; *Dictatorship or Democracy?*, *The Left Review*, August, 1936, and *It's Up to Us* by the Publishers; *Cosmoglotta*, March-April, 1936, and literature from the Occidental-Secretariat; *Das Neue Fahrzeug*, May, August and December, 1936, by the E.V. Fortschrittliche Verkehrstechnik; *The Quarterly Bulletin*, June, September and December, 1936, by the Indian Air Mail Society; *Astronautics*, No. 34, by the American Rocket Society; American Edition of *Rockets Through Space*, by P. E. Cleator; *Centerbladet*, June, 1936, by the Publishers; *Monatala Letro*, August, 1936, by the International Language (Ido) Society of Great Britain; six copies of the *Popular Science Educator*, by L. J. Johnson; *Aero-Modeller*, June, 1936, by the Publishers; and the *Time Traveller*, February, 1932, by L. J. Johnson.

*** UNLESS MATTER IS ACKNOWLEDGED IN THE JOURNAL IT HAS NOT BEEN RECEIVED BY THE SOCIETY.**



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PRIZE WINNING PAPER ON ROCKET DESIGN

The following article is reproduced from the pages of the Scientific American by kind permission of the Editor.

Announcement has just been made that the annual prize of 5000 francs awarded in the Rep-Hirsch Astronautical Competition in Paris will be divided between the American Rocket Society and Alfred Africano, the author of a paper entitled "Design of a Stratosphere Rocket." We heartily congratulate both the Society and its president, G. E. Pendray, whose patient efforts we have described, and the author, who is following up this triumph by a trip to Europe to survey the latest foreign developments in rocket design.

Mr. Africano has given us permission to abstract his valuable work, and we are all the more happy to do so because it constitutes not only a record of skilled experimentation but a thoroughly sound introduction to this new and difficult art.

First of all there is given a description—for the first time in truly technical form—of how rocket motor experiments may be carried out. While infinite patience and some courage are required for such investigations, the expenditures are relatively small. Other groups besides the American Rocket Society are sure to make similar attempts in various parts of the country.

The arrangement of the proving ground on the estate of Mr. Pendray, the instrument board, and the barricade which protects the experimenters are shown. In another illustration there is a close-up of a typical rocket motor in position for a test. (Unfortunately it was not found possible for us to reproduce these photographs in the *Journal* —Ed.).

The main elements of the rocket motor may be listed as follows: (a) The nozzle from which the jet issues; (b) The aluminium combustion chamber; (c) Fuel and oxygen inlet; (d) Quick-opening valves; (e) Safety valve; (f) Hydraulic piston (for test purposes only); (g) Copper liquid oxygen tank; (h) Copper liquid fuel tank; (i) Angle iron frame of proving stand (j) Pipe connection to chamber pressure gauge.

The nozzles used at first were of cast aluminium, which burned out after each run. Later, the nozzles were machined from nichrome steel rod, threaded at the lower end so that they could be screwed into the exhaust end of the combustion chamber. The combustion chamber itself was made of aluminium for all but one of the rockets. It consisted of two cylindrical end parts, shaped inside as hemispheres of one-inch radius. In between the hemispheres cylinders of varying lengths could be inserted and bolted rigidly in place. Thus the effect of varying length/diameter ratios could be determined. The fuel (generally gasoline) and the liquid inlet orifices were drilled in a nichrome plug, screwed into the lower or feed end of the combustion chamber. Both the fuel tank and the liquid oxygen tank were made of copper, three inches in outside diameter and 21¼ inches long. The liquid oxygen was poured into the tank by rather primitive methods. As the liquid oxygen (intensely cold to begin with) absorbed heat from the air, it built up pressure in the free space at the top of the oxygen tank. The building up of the pressure was rather slow, about 125 pounds per square inch in a minute's time. Nitrogen gas under a pressure of 450 pounds was forced into the top of the fuel tank. This slow building up of the pressure was a blessing to the investigators since they had plenty of time to run behind the barricade. When a pressure of 450 pounds per square inch in the oxygen tank was also reached, a switch was closed, firing a gunpowder fuse securely fastened to the mouth of the nozzle. The moment this fuse was seen to be burning vigorously, two quick-release valves were opened simultaneously by a tug on a cord.

If the method of ignition succeeded—as it generally did—a jet of brilliant white flame shot up instantly three or four feet from the nozzle and the typical powerful roar of the rocket motor was heard, making the surrounding ground vibrate from the intensity of the sound and forces being released. Reports were that the roar of the jet was heard three miles away, and this will be readily believed by anyone who witnessed the tests.

There was plenty of excitement for the courageous men who practised this fascinating hobby. But they did not seek amusement alone. On the contrary, little by little they developed a real technique of experimentation.

Since the jet reaction was downward, its thrust was made to force down a piston in a cylinder filled with water. The increased water pressure registered on a gauge, and gave a continuous indication of the amount of thrust obtained during a run. A second gauge was connected to the fuel tank measuring the pressure of the nitrogen gas as it forced the fuel into the combustion chamber. A third gauge measured the pressure built up above the liquid oxygen. A fourth recorded pressures in the combustion chamber. The fifth dial showed the time of combustion in seconds.

By photographing these dials simultaneously with a motion picture camera, the exact relationships of these five quantities at all times during combustion was permanently recorded. In addition, detailed records were kept during each run of the kind and amount of fuel and liquid oxygen used, the rocket motor dimensions, and all observed phenomena. Something like a pint of gasoline was used on the average run, and about a quart of liquid oxygen.

With the chamber of dimensions previously given, and with a nozzle throat of about ½ inch diameter, jet reactions of between 57 and 128 pounds were secured. The duration of the reaction was about eight seconds. The velocity of the exit jet was estimated to be about 4000 feet per second. The thermal efficiency was somewhere in the neighbourhood of 6 to 8 per cent., which is low.

A great number of things were learned from these tests, Alcohol proved a more efficient fuel than gasoline. Nichrome nozzles stood up remarkably well under the terrific temperatures of 3000 degrees Fahrenheit (so estimated from the white colour of the jet flame), much better than the cast aluminium nozzles which were first thought to be adequate. A carbon chamber and nozzle proved unsatisfactory. The alcohol burned more smoothly than the gasoline because of its chemical homogeneity. Contrary to a general belief, the liquid fuels proved to be infinitely superior to gunpowder. Gunpowder is violent, dangerous, acts much more quickly than the liquid fuels but develops a smaller value of jet reaction multiplied by time. If these experiments had done nothing more than dispel the notion that gunpowder can be used for rockets, they would have thoroughly justified themselves.

We cannot, unfortunately, go into all the mathematical treatment which Mr. Africano has given this subject. His paper will be a classic from which references will be drawn for many years to come. In particular, he has gone carefully into the actual design of a rocket for high altitude flight. While the present thermal efficiency and the propulsive efficiency of the rocket motor are low, Mr. Africano has made out an excellent theoretical case for a high speed, high altitude rocket, with serious possibilities for meteorological and cosmic ray research, and with possibilities also as an offensive weapon. It is a strange thing that every advance in applied science seems to lead to a new method of destruction.

Without going into the actual calculations, we shall refer briefly to two sketch designs which the author has supplied.

A careful reader, by following these diagrams, will see readily how the experience gathered at the test stand has led to an entirely logical conception of a rocket motor with combustion chamber, water cooling, refractory lining, ignition, nitrogen control of the fuel, and so on. One of the diagrams shows a stratosphere rocket equipped with a parachute-ejecting mechanism to carry the meteorological instruments down safely. A magnetic control is also provided for the parachute ejection.—A.K.

A new design of Society notepaper is now available for inter-member and other correspondence. Specimen sheets may be obtained on request. Price: 2/6 per 100 sheets (post free) in the British Isles (excluding the Irish Free State); 2/- per 100 sheets, plus postage, for all other countries. Members can have their name and address printed on the heading for a special extra charge.

ADVERTISEMENTS

THE JOURNAL.—The terms for Advertisements in the *Journal* of the Society are as follow:

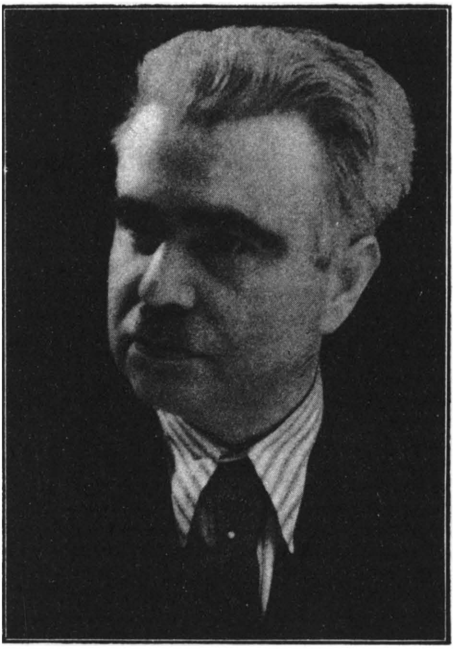
Full-page, 40/-; half-page, 21/-; quarter-page, 11/-, with the exception of the back page for which the rates are: Full-page, 45/-; half-page, 25/-; and quarter-page, 13/-. Terms for smaller announcements than quarter-page are available on application. Society members are allowed a discount of 33⅓%. All Advertisements are accepted subject to the approval of the Council.

The *Journal* reaches all members of the British Interplanetary Society, the American Rocket Society, and the E.V. Fortschrittliche Verkehrstechnik (the German Society), as well as many persons prominent in the scientific world and numerous newspapers and periodicals.

Advertisement pages are offered specially to philatelists, telescope, radio and all scientific instrument manufacturers; and also to publishers and sellers of scientific books and magazines.

THE FIFTIETH BIRTHDAY OF DR. OTTO STEINITZ

By MISS D. M. FARMER.



DR. OTTO STEINITZ,
Chairman of the E. V. Fortschrittliche Verkehrstechnik (the German Society interested in the conquest of Space).

Last year* Dr. Otto Steinitz, well-known engineer, celebrated his fiftieth birthday, and at the same time the 25-year jubilee of his practical work in connection with motor development. This work has become known in England and a number of Continental countries through his brilliant writings, for the most part based on his own research and tests. The following details of his many-sided experience will be of interest.

Otto Steinitz studied engineering at the Technical High School in Berlin-Charlottenburg, and took his diploma in 1911, specialising in the subject of internal combustion engines. In 1915, he took the degree of Doctor of Engineering when his dissertation dealt with the study of flying-machine engines, a subject of which he had considerable experience as it was he who designed and constructed the first test stands for the Deutscher Versuchsanstalt fuer Luftfahrt (German Institute for Aeronautics) in Adlershof. In the establishment of this Institute, which later was very considerably extended, he was the only scientific collaborator of the Director, at that time Dr. Bendemann; and he was also the organiser of the " Emperor's Prize Competition " for airplane engines, held in 1912.

Dr. Steinitz developed a number of new devices while in the employ of various important industrial firms, and soon rose to be a Works Manager. Then it was he created—amongst other

* Dr.Steinitz was born on June 14th., 1886.

things—a new kind of propeller for airships. This was so successful that during the Great War his firm received all orders for propellers for Zeppelins and other German airships. The head of the army and other authorities made use of his expert co-operation. For a number of years in succession he was admitted as sworn expert for internal combustion engines and propellers in the highest Prussian court. He was always working on numerous inventions and patents, chiefly connected with these aspects of his work, and later was admitted as a Patent Solicitor to the German Patent Office.

Since the War, Dr. Steinitz has so far only been working on his own account. Of his various productions, the best known has been the " propeller-driven railway car," which—although proved to be successful in design and construction, and economical to run—has not obtained the support necessary for it to be introduced further. The Doctor has also been active in connection with the science of rocketry, partly in conjunction with the famous champion of space travel, Professor Oberth. He is at present Chairman of the E.V. Fortschrittliche Verkehrstechnik (Society for the Development of Traffic Technique), which is on good terms with the British Interplanetary Society, and is working on the same lines. Dr. Steinitz has worked with success in other spheres of motor engineering, for instance in matters concerning motor cycles, motor cars and Diesel engines. In these departments he is considered as one of the most important research scientists.

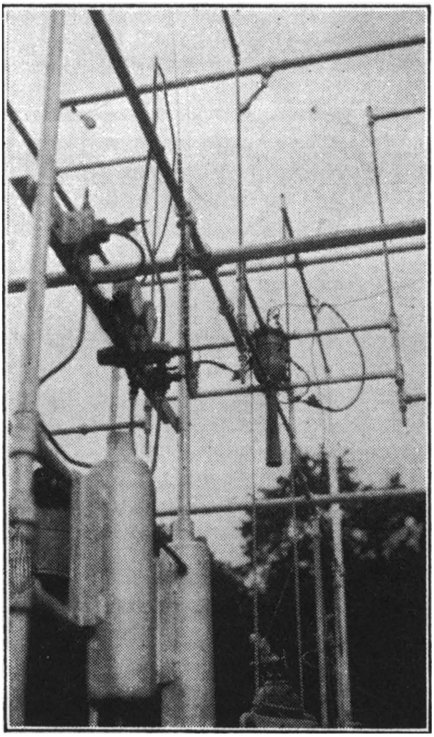
In addition to working as a practical engineer, Dr. Steinitz is also a distinguished writer and publicist. Books of instruction on combustion engines and motor cycles, written by him, have run into many editions. In addition to a few further books on special aspects of traffic technique, Dr. Steinitz has produced 1400 articles, long and short, chiefly in the leading European technical periodicals. These are mostly popular reports on technical progress and international Motor Shows, while some are strictly scientific treatises. Among the latter my be mentioned the method, discovered by Steinitz, of calculating aero-dynamic cross-sections as used when finding the most economical travelling speed of airships—in connection with the vibration of combustion engines; and many other contributions to our knowledge of motors and space travel.

Dr. Steinitz is therefore engaged in branches of work, with the fullest publicity, which are of the greatest importance to world traffic and world trade. It is our sincere wish that he will be able to continue successfully with this work for very many years to come.

DOUBTS ON THE THEORY OF ORIFICE DESIGN

By J. H. EDWARDS.

(B.I.S. Director of Research, London).



Cleveland Rocket Society Photo.

A rocket motor of the Cleveland Rocket Society shown on the proving stand.

Experiments on propulsion jets have, in the past, been directed by certain theoretical calculations, the principal result of which has been to show that when hot gases pass out from the combustion chamber through an orifice, their velocity can never exceed the speed of sound unless the orifice is tapered, the ultimate velocity being a function of the ratio of lip section to throat section.

If, however, an attempt is made to design the ideal form of tapered orifice some peculiar facts come to light. Since the gases at the throat are already travelling at the speed of sound, their path in free space would only slowly spread out. Thus a tapered orifice can be devised such that the pressure on it is negligible, and so that it does no useful work, while at the same time it provides the required expansion to give the gases their extra velocity.

A careful examination of the problem shows where the error has arisen. It has always been assumed that the thrust equals the mass of the gas per second multiplied by the velocity with which it leaves the lip, but in practice this is not the case.

The assumption is only correct for zero pressure at the lip, which is never attained in practice. The velocity of the gas leaving the lip is determined by the pressure gradients between the firing face and the lip, and any residual pressure on the lip calls for increase in the thrust pressure at the firing face.

This is not a contradiction of the law of equal and opposite action and reaction, for the residual pressure causes a pressure gradient outside the tube. The result is that the ultimate velocity of the gases is higher than the velocity with which they leave the tube.

This may account for many of the discrepancies between theory and the results of practical tests. Unfortunately, however, all tests so far made have been at approximately atmospheric pressure, and as no one is very sure how to make the corrections for this, the information gained is only very moderately applicable to actual working conditions in the stratosphere or space.

It would seem, therefore, that allowing for the above points, the gain from tapered orifices is likely to be a lot less than was originally anticipated. In fact, most of the gain that has been found in practice is probably due to the lower velocities in the flame chamber allowing time for more complete combustion.

(Continued from Page 19.)

Committee could not be officially appointed, but in view of the fact that Mr. L. J. Johnson was coming from Liverpool on Sunday, the suggested members of the Committee would commence their work immediately. A meeting was to be called in honour of Mr. Johnson on the Sunday evening, when the Committee could be officially appointed.

* * * * * *

A Visit from Mr. L. J. Johnson.

A meeting was held on Sunday, November 15th., 1936, at 7 p.m. at "The Mason's Arms," Maddox Street, in honour of Mr. L. J. Johnson of Liverpool, who has been Hon. Secretary of the British Interplanetary Society since it was founded in 1933. Mr. E. J. Carnell was elected Chairman of the meeting.

Mr. Carnell introduced Mr. Johnson to the members, and explained how enthusiastically and unselfishly he had worked for the Society.

In reply, Mr. Johnson gave a summary of the history of the Society, reading extracts from the Minute Book from time to time, and giving particular attention to the struggles of the Council to draft and put into force a Constitution which would be satisfactory to all concerned. He said he thought the Liverpool members would be glad to co-operate with the London members in this matter.

Mr. R. A. Smith proposed that a Committee should be set up to draft a Constitution for submission to the membership. Mr. Carnell seconded the proposal, which was carried unanimously. It was decided, also unanimously, that the members of the Committee should be as follows: Messrs. J. H. Edwards, E. J. Carnell, A. C. Clarke, K. W. Chapman, R. A. Smith, W. H. Gillings, and Miss Huggett.

A vote of thanks was then accorded to Mr. Johnson in appreciation of the trouble he had taken in coming to London to address the London members.

FOR THE ASTRONAUTICAL LIBRARY.

Rockets Through Space.
By P. E. Cleator.
(*G. Allen & Unwin, Ltd. Price 7s. 6d. net*).

P. E. CLEATOR,
author of "Rockets Through Space," a Founder Fellow and, until recently, President of the Society.

This is the third book on the subtle art of rocketry to be published in the English language, and if we can be forgiven our vagabond superstition we shall say that Mr. Cleator's opus supports the ancient adage that three times does it.

So long has Science been bed-mate to a stink, we can afford to disregard the odious cdorousness of comparisons and opine that *Rockets Through Space*, because of its thorough up-to-dateness, should make astronautical pedants of those converted but not educated by its predecessors.

The stunt of holding 'em up side by side may smack of the mock auctioneer disposing of a pair of Burslem vases, but imitation sometimes has its justification and its profit. To put it with more old-fashioned dignity—where others have dabbled their toes in their subject, shuddered and complained about the temperature, Mr. Cleator has ripped off his tiger-skin, with rare abandon has climbed the steps, bounded hell-for-leather along the spring-board, and dived into recoil-propulsion with a sky-spraying splash that proves action and reaction can never hope to be equal and opposite.

There are 227 pages of heresy-tinged information in this tome, all of it what reporters are supposed to describe as exclusive dirt. Five pages for tuppence!—we've paid twice the price for books worth half as much. And, mercifully, devoid of profound technicalities and those grandiloquent phrases which, behind the author's back, have come to be known as Cleatorisms.

Not satisfied with this excellent measure, Mr. Cleator has to bulldoze Prof. A. M. Low into becoming a fellow-culprit in the opening pages, tacks a useful cross-reference to the concluding sheets, and spaces the rest with numerous photographs of planets and rocket-shots, with several examples of good draughtsmanship thrown in.

We gather Mr. Cleator has some experience of beating down sales resistance. We'd hate to have him try sell us an insurance. But we feel compelled to salute the author who is so concerned with the impartial assembling of his facts and theories he can give unpleasant truths prominence equal to the pleasing ones. Whether complete sincerity can gain converts remains to be seen; it is plain that those capable of being persuaded by insincerity are not Mr. Cleator's quarry.

Do you know what is a Mirak? Or an artificial space-station? Who is Willy Ley, or K. E. Ziolkowsky, or Friedrich Schmiedl? What is a step-rocket, what is the fuel problem, how can small satellites be exploited for space-travel?

Have you ever heard of the *Na-utschnoje Obosrenije*, or of Dr. Walter Hohmann's economical course for interplanetary navigation? We find the answers to these questions when looking at random through *Rockets Through Space*.

—E. F. Russell.

LIQUID-PROPELLANT ROCKET DEVELOPMENT

By R. H. Goddard.

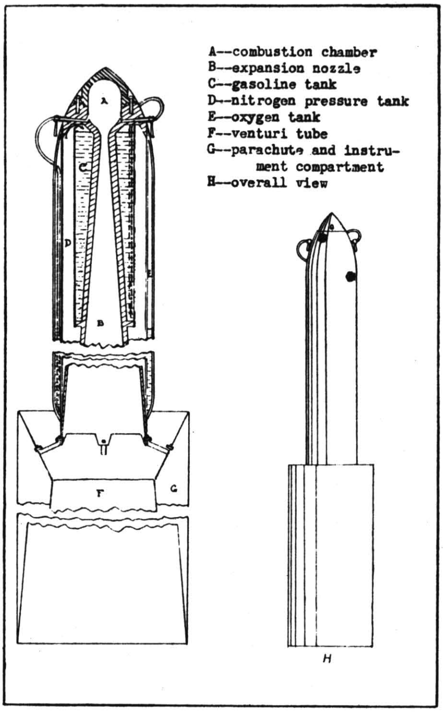
(*The Smithsonian Institution, Washington, D.C., U.S.A.*)

It has been shown in previous papers that to produce a rocket having a high velocity of ejected gases and a low mass as compared to the mass of the fuel carried, it was necessary that the products of combustion should be discharged through a tapered nozzle, arrangements being made to feed successive portions of mixture into the firing chamber and to use a series of rockets of decreasing size, abandoning the shell of each as its fuel is used.

Work has since been carried out on the use of liquid fuels. The advantage of these lies in the fact that they have a higher calorific value (than the powder fuels previously used—Ed.), and that the pressures developed are lower so that the construction can be lighter.

Of the liquid fuels, liquid oxygen* and liquid hydrogen have the highest calorific value, but owing to the difficulty of keeping hydrogen liquid, hydrocarbons such as methane or gasoline may be more suitable.

*Abbreviated to loxygen.



By Courtesy of Armchair Science.

A diagrammatic section of one of Dr. Goddard's rockets.

Experiments were carried on using loxygen in conjunction with gasoline, propane or ether. The results showed that it was possible to use such mixtures in an arrangement as outlined above without danger of explosion or of damage to the tubes

Tests were made of pumps and of compressed nitrogen for feeding the fuel to the jets.

For the first free rocket test, the pressure was started from an external source, and maintained by heating with an alcohol flame. The nozzle was bracketed out in front of the body of the rocket, but subsequently tests were made with the nozzles in the rear.

Towers were constructed in which tubes could be tested while supporting weights which were adjustable up to 2,000 lbs.

Test results, for 5 lb. (2,300 g.) weight tube.

Force 289 lbs. (1.3×10^8 dynes).

Time 20 secs.
Gas Velocity 5000 ft./secs. (1.5 Km/s.).

Power 1030 H.P. (780 Kw.).

Free rocket test result.
Max. Height 2000 ft. (.6 Km.).

Max. Velocity 500 m.p.h. (.22 Km/s.).

Other tests were made, substituting liquid nitrogen for compressed nitrogen for feeding pressure. A remote control system 1000 ft. away was then set up and also a recording telescope at 3000 ft. for use in stabilisation tests.

Stabilisation was to be obtained by forcing deflecting vanes into the gas stream. Two methods were tried of operating the vanes, one by pendulum, and one by gyroscope. In both cases the functioning depended on the directon of the resultant force of jet reaction, air resistance and gravitation, and consequently was less effective at high velocities than at low.

The pendulum proved very ineffective, the rocket rising to 1000 ft. and then deflecting completely.

After a number of adjustments and improvements, however, the gyroscopes were made to operate up to a velocity of 700 m.p.h. with an altitude of 7500 ft. The reaction to the stabilising arrangements was delayed, the oscillations from the vertical rising to a maximum of 30° and occupying 1 to 2 seconds.

Spasmodic bright flames appeared in the tail and sometimes explosions of gasoline vapour in the air below the rocket.

—J. H. Edwards.

STRATOSPHERE and ROCKET FLIGHT (Astronautics)

By C. G. Philp.

(*Sir Isaac Pitman & Sons, Ltd. Price 3s. 6d. net*).

This is the first British book on astronautics to be published, the author being an Associate of the American Rocket Society. A clear outline is given of the history and development of the rocket, and as non-technical language is used throughout, the details will be readily understood by all previously ignorant of the subject.

The action of the rocket motor is fully explained, and special attention is given to the fact that a rocket reaches its maximum efficiency when working in a vacuum. This, it is hoped, will finally silence the large number of otherwise intelligent persons who believe a rocket must have air, or sometimes even a wall, to push against.

The author deals more with the use of rocket ships as passenger and mail carrying vessels on earth than as a means of reaching the planets, but he expresses his firm belief that interplanetary travel is possible. The B.I.S. is not mentioned in the book, and while the author states that there is nobody working for the advancement of rocketry in this country, it would seem from the text of his book that he knew of the existence of this Society.

The book is recommended as an introduction to the study of astronautics, and as a handy volume for reference purposes.—T. McNab.

STOP PRESS.

The Editor regrets that, owing to the exigencies of space, it has been found necessary to exclude from this issue of the *Journal* certain interesting features. These include "Notes and News," "Correspondence," and "New Members."

The latter list includes two new Honorary Fellows, 31 new Members, 14 Associate Members, and 2 graduates from Associate Membership to Membership. Two members have resigned from the Society. It is expected that the full list, with any later additions, will be included in the next issue of the *Journal.*

The LONDON BRANCH of the SOCIETY

Proceedings.

L. J. JOHNSON,
a Founder Fellow and Hon. General Secretary-Treasurer of the Society.

Inaugural Meeting

The first meeting of the London members of the B.I.S. took place on Tuesday, October 27th., 1936, at Professor A. M. Low's offices, 8, Waterloo Place, Piccadilly, and resulted in the formation of the London Branch of the British Interplanetary Society. Success was assured from the outset by the enthusiasm with which all present greeted the formation of the Branch, and the subsequent difficulty in keeping rigidly to the programme was somewhat allayed by the friendly spirit in which Professor Low, who was present, endeavoured to make everyone feel at ease.

Mr. J. H. Edwards, who had suggested the formation of a London Branch in the last issue of the *Journal*, opened the proceedings with a few remarks about the vital significance of the occasion and proposed Mr. E. J. Carnell as Chairman. The Motion was seconded by Professor Low and carried by the meeting. Mr. Carnell gave a brief summary of the Society's activities during the past three years, drawing special attention to the financial position. It was obvious, he said, that new schemes would have to be tried to attract more members. From this, he went on to describe events leading up to the resignation of Mr. P. E. Cleator, the former President. In May, 1936, he explained, a Council had been formed in Liverpool to consider and approve all actions on behalf of the Society. Mr. L. J. Johnson of Liverpool, who had been Hon. Secretary of the Society since its formation, had become dangerously overworked, and as a consequence, in June the idea of a London Branch was first seriously formulated. If successfully founded, this Branch would eventually become the Headquarters of the Society. Mr. P. E. Cleator, the President, disagreed with the proposal that the Headquarters should be moved, and as the movement was strongly supported, he had resigned from the Presidency. However, he promised that the Society would still have his every support. The Society, continued Mr. Carnell, would always be grateful to him for the invaluable assistance he had given in helping it to its present position.

Speaking on the proposed transfer of Headquarters to London, Mr. Carnell said there could be no thought of any transfer until such time as the new London Branch had justified itself as an important unit of the Society. This, it was hoped, would eventually come to pass, as there was a larger number of members in London than anywhere else. One could also look forward with confidence to the time when experiments could be conducted by the London membership, including as it does many technical experts.

The election of Branch Officers resulted as follows: President, Professor A. M. Low, D.Sc.; Joint Hon. Secretaries, K. W. Chapman and Miss E. Huggett; Hon. Treasurer, A. C. Clarke; Director of Research, J. H. Edwards; Director of Publicity, E. J. Carnell.

Professor A. M. Low gave an extremely interesting address drawing a comparison of prejudiced public opinion throughout the ages with the aims of the Society to-day, and emphasised the importance of not being discouraged by this, or, in our turn, becoming prejudiced. He touched lightly upon the possibility of life forms, totally unfamiliar to Man, existing on other planets and even upon spiritualism, which, he thought, we were hardly in a position to accept as yet. He offered interesting suggestions for increasing the present membership (which were held over for consideration at a later meeting), and concluded by asking if the London meeting had the full approval of Liverpool. In answer, the Chairman declared that he had been in constant communication with the Hon. General Secretary in Liverpool to this effect, and that the meeting had the good wishes of the Council of the Society.

Mr. J. H. Edwards gave a short address in which he mentioned the enormous amount of work waiting to be done in the way of research and investigation, and pointed out the wide fields these would have to cover. He outlined his suggestions for tackling outstanding problems, and requested the whole hearted co-operation of the members in an endeavour to reach their solution. All contemporary science fiction authors, he continued, put the ultimate time for space travel at the year 2000, but he was firmly convinced that it would become fact before that date. He foresaw consternation amongst the Governments of the world should any particular country succeed in the conquest of Space, and thought the only way out of any complications would be a united International Astronautical Society composed of all the societies in the world.

A general discussion ensued upon the advisability of changing the name of the Society to one less imaginative, but no decision was made. A number of other important questions were referred for consideration at the next meeting of the Branch.

Professor Low proposed a vote of thanks to the Chairman, and the members passed a vote of thanks to the Professor for his kindness in allowing the meeting to take place at his offices, and for his enthusiastic support of the new Branch. Mr. L. Klemantaski took a number of group photographs of a gathering which, it is hoped, will mark a great step forward in the progress of the Society.

Several favourable reports of the meeting appeared in the Press during the remainder of the week.

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An Informal Meeting.

An informal meeting of the London Branch was called on Tuesday, November 10th., 1936, with the object of promoting general discussion so that the views, interests, capabilities and intentions of the members and other interested persons could be ascertained.

A strong feeling developed that it would be necessary to overhaul the Constitution of the Society before the London Branch could satisfactorily carry out its work. It was suggested that a Constitution Committee should be set up to consider this point and report back to the London membership. As the meeting was informal, the

(Continued on Page 13)