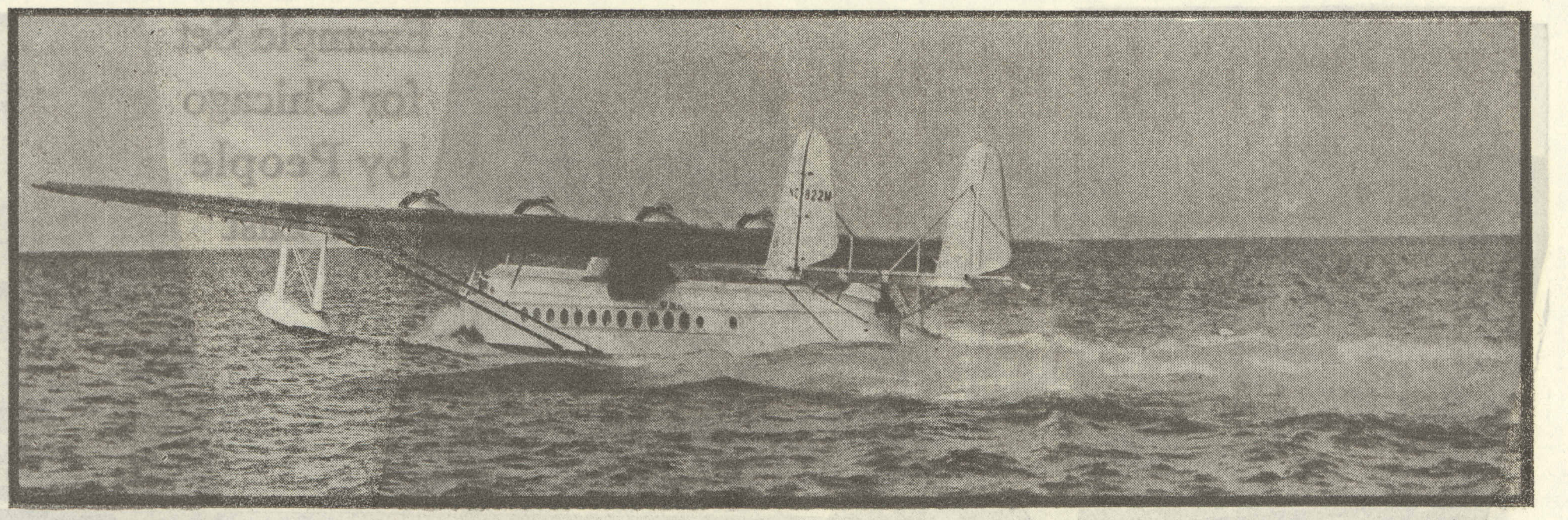
Six Countries Speed Plans for Trans-Atlantic Flying

Scheduled Air Service Across Ocean Is Seen by End of This Year



Sikorsky S-42, holder of ten world's speed and weight-carrying records, leaving Miami harbor. With all four motors humming, the big boat heads out to sea for its takeoff. This ship will be one of the first used on trans-Atlantic airways. It can carry passengers and mail 3,000 miles nonstop. (G. W. Romer photo.)

[Continued from page one.]

maximum allowance. The designer compromised by cutting down the internal structure but adding spars which brace the center section of the wing to the hull. The tapering wing tips are braced only internally.

Contrary to previous Sikorsky designs, the tail unit was placed directly on the boat, and spars and wire rigging, which have been a part of every previous ship built by this designer, were eliminated.

Power plants used in the S-42 are Pratt & Whitney Hornet engines of improved type capable of producing 750 horsepower at 6,500 feet. Each is cowled with anti-drag fairing and each drives a three-bladed, two-position, variable-pitch propeller, the largest ever built by the Hamilton Standard company.

Some idea of the size of this monster aircraft can be gained from the dimensions and weights. The wings have a span of 114 feet 2 inches and the hull is 67 feet 8 inches long from stem to stern. Empty the weight is 19,764 pounds, and the useful load is 18,236 pounds, together producing a gross weight of 38,000 pounds.

Nine watertight doors separate the various compartments of the ship. In the bow is a locker containing marine equipment, and immediately behind this is the cockpit, with places for two pilots and full dual flying and navigating equipment. In the same compartment are places for radio operator and navigator and an engineer.

Behind the cockpit is a small baggage compartment, and then come four passenger cabins with seats in each for eight passengers. At the rear is another baggage compartment, which also houses radio equipment.

Tanks holding 2,580 gallons of gasoline and 1,000 pounds of oil are in the wings and the wing floats.

The Martin 130 is quite similar in construction but even larger than the S-42. It has a total weight of 51,000 pounds, of which the empty weight is 23,100 pounds and the useful load 27,900 pounds.

It is also a high-wing monoplane, with the boat body hung below a wing which has a span of 130 feet. Four Pratt & Whitney twin-row Wasp engines, producing 800 horsepower each at 6,500 feet, are set in the leading edge of the center section. This section alone is braced externally, the wing tips being cantilever.

The whole boat is built of metal, both duraluminum and 24ST alclad — a newer synthetic metal — being used. The Martin has no wing tip floats, as can be seen in the illustration on page one. It depends for stability in the water on stub wings, or sponsons, which give an added lifting surface in the air and serve also as tanks for 3,200 gallons of gasoline.

The tail unit is attached directly to the boat body, with a single giant vertical stabilizer instead of the twin vertical stabilizers used on the S-42.

Quarters for the crew, pilots' cockpit, radio, and navigating and engineer's equipment are fitted in the upper of two decks on the Martin. The lower is fitted with accommodations for 50 passengers, two lavatories, cargo space, and galley. Total length of the hull is 89 feet 6 inches.

Performance of the S-42 has been proved in tests, but in the case of the Martin the figures following largely are estimates.

Cruising speed, S-42—160 miles an hour, Martin—163 miles an hour; top speed, S-42—188 miles an hour, Martin—180 miles an hour; initial climb, 1,000 feet a minute for S-42, 950 feet a minute for Martin; time of takeoff, 25-30 seconds in dead calm for both; landing speeds, S-42 65 miles an hour, Martin 70 miles an hour.

The S-42 lands slower, although having a higher top speed, because it is fitted with a trailing edge wing flap. In its tests this airplane has set ten world's records for speed and load-carrying capacity for seaplanes.

The chief reason for the fine performance of both ships is the departure of both designers from the theory that a low wing loading is necessary. Both planes have an extremely high wing loading, and this accounts for the high speeds, high load-carrying capacity, and steadiness in turbulent air.

Either boat at present could fly any of the ocean routes projected on the page one map. Both carry heavy loads of passengers and mail nonstop for 1,200 miles. The Martin will carry 14 passengers and a ton of cargo nonstop for 3,000 miles and has a range of 4,000 miles as a mail ship without passengers. The Sikorsky's maximum range is 3,000 miles with 5 passengers and 1,000 pounds of cargo.

The longest water hop on any of the ocean airways is approximately 2,500 miles. Thus both boats have an additional range of 500 miles, which provides safety if it is necessary to dodge bad weather in the air or at the end of the flight.

Now that the projected flights can be viewed in the light of equipment available, it is possible to predict with considerable accuracy the first steps that will be taken for the north Atlantic crossing.

Undoubtedly the New York-Plymouth route will be flown first by American ships. Probably the flight will be made in two jumps, with the intermediate stop at Newfoundland.

In summer no weather conditions save heavy fog at the refueling point would interfere. This would be remedied by providing a mother ship at which the flying boats could refill their tanks at some point off the coast if Harbor Grace or any other terminal were weatherbound.

In winter, it is reported by the Newfoundlanders, there is always open water at some point or other on the Gulf of St. Lawrence. The problem of refueling again would be solved by providing a mother ship to remain always in the open water. Its position could be picked up by radio from the air liners each time a stop was made.

The Chicago-Plymouth route probably will be flown soon afterward. Such an air line will make a world port out of the largest city in the world's most prosperous valley. The actual flying presents exactly the same problems as those encountered on the New York-Plymouth route, and the great circle course has virtually the same mileage, as will be seen by reference to the page one map.

Somewhat different technical problems are presented when the northern route from Chicago to Berlin is attempted. Summer flying on this route will be easy, with the big boats carrying heavy pay loads and making frequent fuel stops.

Investigation, however, has shown that winter locks all water within ten days after the seasonal change. Probably any winter flying on the northern route would be done with a different type of airplane, one equipped to land on ice or snow with skis.

From the weather standpoint the Bermuda-Azores route probably is the most uniform the year around. During the winter, however, hurricane winds and high seas move up from the south Atlantic across the flight routes. Difficulties in anticipating these disturbances, which come from a portion of the ocean which is almost never crossed by ships, tend to discourage operations there. Distances between refueling points, on the other hand, would be well within the ranges of existing airplanes.

The reliability of the ocean planes is constantly challenged. Their designers point out two features which they say take most of the hazard out of any regular trans-Atlantic service. These are the multiplicity of the motors and the seaworthiness of the planes even though they should be forced down.

Modern motors are extremely reliable, designers also point out, motor failures on the major air lines of the nation averaging less than one for every million miles of flight. With proper care, such as any ocean-flying operator must provide, the chances of failure of more than one motor at any time during an ocean flight are remote.

Moreover, the American planes are built to fly on any two of their four motors, and both of them have demonstrated the ability to take off the water on any three of the four motors. The engineers point out that even though two motors should break down on a flight, the remaining two would be sufficient to carry the plane to safety.

Concerning the seaworthiness, even the designers are none too optimistic. The big boats, they say, can be landed with complete safety in quite heavy seas. Once down, they are, according to Pan American pilots who have conducted tests with the S-42, as seaworthy as the average boat of equal tonnage.

However, no one will deny that if one of the big birds went down in a real storm it soon would break up. Still it is said the S-42, unless it struck unusually bad weather, could safely be taxied across the Atlantic.

Auditors say four-engine aircraft of Pan American Airways have been operated for $1.25 a mile. The newer, more efficient planes of virtually the some horsepower should not cost more. Thus an average 4,400-mile crossing should be made for $5,500.

Passengers anxious to cut a five-day journey to 30 hours in the air should be willing to pay $400 for passage. With ships now capable of carrying from 5 to 14 passengers, even with small average capacity, a large proportion of costs should be found in this source. The Graf Zeppelin has been carrying passengers across the south Atlantic for $500 a head, with the trafic on the upgrade.

This source of income, however, would be secondary at best. Subsidy, either direct or indirect, is essential. Millions already have been spent, and millions more will be spent before the service is established.

Subsidy probably will come from the postal authorities, already interested. Payments of $2 a mile for a given poundage, with increases in pay when poundage is greater, as is the case with given American air lines carrying mails outside the United States, would be sufficient to insure a profit on every crossing.

The keenest competition is expected to come from the English. England wants to end the trans-Atlantic line at Montreal or Quebec, and she has so informed Pan American representatives who are negotiating for a base at Plymouth.

Obviously England wants to control the north Atlantic air trafic, like her merchant marine has controled the trade on the ocean's surface. She also wants to bind the Canadian dominion as closely to the mother country as the air routes to Australia and South Africa bind those territories of the southern hemisphere.

So the United States must not relax efforts to insure New York City and Chicago as the terminals of an American transoceanic line. The English will act slowly, but they will produce if given time. The French already have begun building flying boats intended for ocean service, but their flights will be confined to the south Atlantic if Americans are first over the northern routes.

It will not be difficult to maintain first place once the ocean flights are begun, say Designers Sikorsky and Martin. Within three years flying boats capable of speeding 4,500 miles nonstop at 200 miles an hour with 24 passengers and luxurious quarters can be built from plans already drawn. Then there will be no stop at Harbor Grace, and London will be only 20 hours out of New York.

Compartment of type in which passengers on north Atlantic air liners will travel in near future. This picture was taken aboard a Pan American Clipper, Caribbean division. Newer ships designed for transoceanic service will be similarly furnished.

The Graphic Laboratory of Popular Science

Researchers Realize Alchemist's Dream

By Thomas M. Beck

CHEMISTS, like bankers, surgeons, and tavern keepers, did not always occupy the same high social plane that they do today. Back in the middle ages the chemist, or, as they called him then, the alchemist, was generally regarded as a rather shady sort of individual. In those days, instead of being interested in pH determinations, diazo couplings, and Raman spectra, he had his choice of working on two problems. One was the preparation of the elixir of life, which was supposed to confer eternal youth upon the drinker. The second was the discovery of the philosopher's stone, whose touch would convert the base metals, such as iron or lead, into gold.

By the year 1800 most of the alchemists, at least of the honest ones, appear to have lost heart and stopped trying to transmute lead into gold. Shortly after this time most of the scientists came to accept the molecular and atomic theories of matter. According to this viewpoint, matter was made up of many different kinds of small particles called molecules, which in turn were built up of atoms. The atoms of a single element were identical, but different from those of all other elements.

The chemist of the nineteenth century usually pictured atoms as sort of submicroscopic billiard balls of different sizes corresponding to the various elements. This theory explained why chemical compounds could be changed into one another, picturing such changes as taking place through the addition or removal of atoms from the molecule, or the substitution of other atoms for some of those already there. It also accounted for the fact that elements could not be changed into one another, since elements, being the ultimate degradation products of compounds, consist of only one kind of atom, and the atoms were considered to be immutable.

Then certain disturbing events took place in Paris. In 1896 the physicist Becquerel accidentally discovered that the presence of a piece of ore containing the element uranium would fog a photographic plate. It was found that uranium had the property of giving off a faint radiation, which made itself manifest not only by exposing photographic plates but also by making the air around it a conductor of electricity.

Becquerel turned part of this problem over to two young friends of his, Pierre Curie and his Polish wife, Marie. The Curies first investigated a uranium ore, pitchblende, that showed this unusual property, later called radioactivity, to a greater extent than usual. They eventually succeeded in isolating compounds of two new elements of much greater activity, polonium (named by Marie after Poland) and radium. The latter was found to be millions of times more radioactive than uranium.

Eventually it was found that the radiation from radium consisted of three distinct kinds, which were cautiously named alpha, beta, and gamma rays.

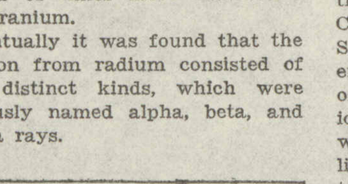


Diagram of a radium nucleus undergoing radioactive change.

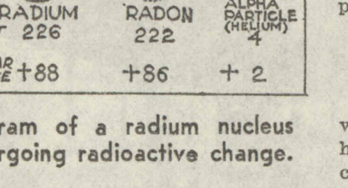


Diagram of an artificial transmutation brought about by exposing beryllium to alpha rays.

Weight units: .0000000000000000000000000059 of an oz.

Electrical units: .00000000000000000016 of a coulomb.

The late Marie Curie, co-discoverer of radium.

The gamma rays were shown to be electro-magnetic waves similar to radio waves, light, and X-rays, particularly the last. The beta rays were found to be streams of electrons shot into space with speeds approaching that of light. As for the alpha rays, a brilliant young Canadian, Ernest Rutherford (later Sir Ernest and still later Lord Rutherford), showed that they consisted of small particles. A British physicist, Soddy, measured their speed, which was about a tenth that of light. He also determined their nature and found, to the amazement of the scientific world, that they consisted of helium atoms bearing a positive electrical charge.

The unusual thing about this fact was that it raised the question of how an element like radium could be converted into helium, another element. Rutherford partly explained and partly involved the question still more when he showed that when a radium atom gives off an alpha particle it is changed into an atom of a new element, radon, the atomic weight of which is less than that of radium by exactly the weight of the helium atom. Furthermore, radon is much more vigorously radioactive than radium and spontaneously breaks down into still other radioactive elements.

To make a long story short, at the present time there are about three dozen known radioactive elements that are calmly disintegrating in complete disrespect of the classic atomic theory. The speeds of their various breakdowns, which are measured by the time it takes for a sample of the element to lose half its weight, cover a rather wide range, from about ten billion years for thorium to one hundred billionth of a second for thorium C prime. These spontaneous transmutations are something of a vindication for the old-time alchemist. There is one thing about them he would not like, however. The final product resulting from these series of changes is always lead, which was the one thing he was trying to get away from.

Why are these radioactive changes said to be different from ordinary chemical reactions? For one thing, the energy they give off is vastly greater than that of any chemical change. And then, while chemical reactions are greatly influenced or even reversed by such factors as temperature, pressure, or concentration, radioactive change is totally unaffected by these.

Prof. Aristid von Grosse, who isolated the radioactive element protactinium for the first time.

At the present time an atom is no longer pictured as a billiard ball, but as a sort of microcosmic solar system. In the center is an almost infinitesimal nucleus possessing nearly all of the atom's weight and bearing a charge of positive electricity. Surrounding the nucleus is a swarm of negatively charged electrons sufficient in number to balance the positive nuclear charge. Now, this charge on the nucleus, and not its weight, is what determines which element it is. For example, a pure sample of a certain element may contain atoms of half a dozen different weights, but their nuclei all have the same net charge. Moreover, some of the atoms of an element may be identical in weight with those of another, but the difference in nuclear charge causes a difference in chemical properties.

The scientists picture the radiations of radioactive elements as coming from the nucleus as a result of some mysterious sort of strain inherent in the atom. Naturally the loss of a negative beta particle is going to increase the positivity of the nucleus and convert it into an element of higher nuclear charge. Similarly the loss of an alpha particle, which is positive, will give an element of lower charge, and, since the alpha particles have appreciable weight, one of lower atomic weight as well.

As the nuclei of atoms are too small to be seen or handled, the only practical method of learning about them is to smash them and see what kinds of fragments result. Alpha and beta particles, because of the great energies resulting from their high speeds, are the most useful tools the scientist has available for this destructive purpose. The alpha ray is the more useful of the two; although considerably slower than the beta, it is some 7,500 times as heavy and so can strike a much harder blow.

By firing alpha rays at nitrogen atoms, Rutherford in 1919 was able to score a few direct hits on the nitrogen nuclei. Whenever such hits were made the helium and nitrogen nuclei emerged from the collision battered into the form of hydrogen and oxygen nuclei. The significance of Rutherford's work lay in the fact that he had converted certain elements into others.

The main objection to the use of alpha particles to smash atoms lay in the fact that both they and their targets were positively charged and the repulsion between these two like charges caused a loss of momentum. To remedy this, investigators have used the proton, or hydrogen nucleus, which has only one-fourth the weight of the alpha particle and only one-half the positive charge. Unfortunately, there are no convenient radioactive substances that eject this particle at high speed, so it is necessary to speed it up artificially by sending it through a powerful electro-static field. The recent discovery of heavy hydrogen has made its nuclei available for such missils; these particles have double the weight of ordinary hydrogen, but no increased positive charge.

But what promises to be the most useful subatomic bullet of all is the neutron, discovered by Chadwick four years ago as one of the products resulting from the collision of an alpha particle with the nucleus of a beryllium atom. It has the weight of a proton and is ejected at a very high speed; and it has no electrical charge at all, so there is nothing to deflect it from its target.

Scientific Queries Answered

Mr. Beck will be glad to answer questions of scientific nature. Address Thomas M. Beck, Graphic Section, Chicago Tribune. For personal reply, inclose stamped, addressed envelope.

Why is it that dry ice does not melt?—W. R. F., Chicago.

If the air pressure on any substance is reduced, the boiling point of that substance also is greatly reduced, while the freezing point remains almost unchanged. If the air is pumped out of a flask containing some water, eventually the boiling point of the water falls to the same temperature as the freezing point. At pressures below this, the theoretical boiling point is less than the melting point, with the result that on heating the ice passes directly into vapor without melting. Dry ice is solid carbon dioxide. It happens that it shows this same property at atmospheric pressure. If dry ice is placed in a container and subjected to pressures much higher than atmospheric, it can be made to melt.

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If poor Kidney and Bladder functions cause you to suffer from any symptoms such as loss of Vitality, Getting Up Nights, Backache, Leg Pains, Nervousness, Lumbago, Stiffness, Neuralgia or Rheumatic Pains, Dizziness, Dark Circles under Eyes, Headaches, Frequent Colds, Burning, Smarting or Itching Acidity, you can't afford to waste a minute. You should start testing the Doctor's Prescription called Cystex (pronounced Siss-tex) at once.

Cystex is probably the most reliable and unfailing successful prescription for poor Kidney and Bladder functions. It is swift, safe and sure in action, but does not contain any dopes, narcotics or habit-forming drugs. It is a gentle aid to the Kidneys in their work of cleaning out Acids and poisonous waste matter, and soothes and tones raw, sore, irritated bladder and urinary membranes.

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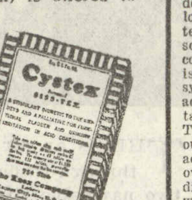
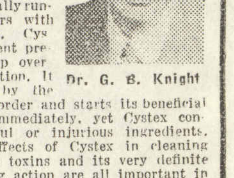


Doctor's Advice Helps Sufferers

Doctors and Druggists everywhere approve of the prescription Cystex because of its splendid ingredients and quick action. For instance Dr. Geo. B. Knight, Physician of Camden, N. J., recently wrote the following letter: "When the kidneys don't function properly and fail to properly throw off the waste matter strained from the blood, aches develop in muscles and joints, the appetite suffers, sleep is disturbed and the patient is generally rundown and suffers with lowered vitality. Cystex is an excellent prescription to help overcome this condition. It is assimilated by the system in short order and starts its beneficial action almost immediately, yet Cystex contains no harmful or injurious ingredients. The soothing effects of Cystex in cleaning out accumulated toxins and its very definite acid-neutralizing action are all important in overcoming symptoms of functional kidney disorders. I consider Cystex a prescription which men and women in all walks of life should find beneficial in the treatment of functional kidney disorders." (Signed) Dr. George B. Knight



Dr. G. B. Knight